**2016-2017 Sciences Assessment Report**

**Program Name: Biochemistry**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and 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:** *Biochemistry*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were acceptable this year. The department has opted to not make any changes to the curriculum 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 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. |

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| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 (–0.22$\sigma$). Two individuals failed to meet the –1.5$\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of –1.5σ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of –1.5σ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |

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| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |
| 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) 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 Chemistry exam. | 1) Mean ETS composite score is 151.5. (+0.24σ). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course/program and is not particularly worried about this individual low score given the context. |

**Program Name: Biology Clinical Laboratory Science**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).

- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and chemical phenomena within a Christian worldview (Stems from Malone Educ. Goals D2, E1, and E5).
- Students should develop an enriched understanding of the nature of human identity, development, and behavior through a study of human anatomy and physiology. (Stems from Malone Educ. Goal A3)

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

**Department:** *Natural Sciences*
**Program:** *Biology Clinical Laboratory Science*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |
| 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. |

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| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5σ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |

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| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 ($-0.22\sigma$). Two individuals failed to meet the $-1.5\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of $-1.5\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of $-1.5\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |

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| 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. 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | The current in-house biology pre-test / post-test exam has been altered to accommodate 12 questions covering human A&P content. The performances of our biology pre-professional students and our Exercise Science students will be evaluated on these 12 questions. We have set tentative post-test performance standards as well as tentative improvement standards. The first administration of this altered exam was occurred in Fall 2016, but only aggregate pre-test data have been collected. Until the exam is offered as a post-test in Spring 2017, we will not have post-test data to examine. We are already aware that 2 questions need to re-written to raise the rigor (over 80% of pre-test takers responded correctly). We are also aware that some individuals who had already taken A&P took this test as a "Pre-test" this in Fall 2016. These scores would have artificially inflated the pre-test cohort average making the 70% improvement very difficult. The instrument has been altered to prevent this from occurring again. The current A&P instructor is also researching an additional assessment that might allow for true comparisons with national averages. |
| 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | See comments in table cell for Departmental PILO 'L'. |
| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |

**Program Name: Biology (General Track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

**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 biology, the underlying assumptions of biological knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists at a level sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological 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:** *Biology (General Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5σ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |

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| Demonstrate an understanding of the various factors that impact biological populations (Departmental Outcome H). | 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 biology exam Population Biology/Evolution/Ecology sub-score. | 1) Average Population Biology/Evolution/Ecology sub-score is 51.9 (–0.02$\sigma$). All individuals met the -1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the population biology/evolution/ecology sub-section, the department has opted to not make any programmatic changes at this time. The institutional cohort averages on this section are some of the highest and represent strengths of the department's biology programs. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 (–0.22$\sigma$). Two individuals failed to meet the –1.5$\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of –1.5$\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of –1.5$\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |

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| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |
| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |

MALONE UNIVERSITY
CHRIST'S KINGDOM FIRST

**Program Name: Biology (Pre-Medicine track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and 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:** *Biology (Pre-Medicine Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were acceptable this year. The department has opted to not make any changes to the curriculum 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 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5$\sigma$ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |

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| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| Demonstrate an understanding of the various factors that impact biological populations (Departmental Outcome H). | 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 biology exam Population Biology/Evolution/Ecology sub-score. | 1) Average Population Biology/Evolution/Ecology sub-score is 51.9 (–0.02$\sigma$). All individuals met the -1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the population biology/evolution/ecology sub-section, the department has opted to not make any programmatic changes at this time. The institutional cohort averages on this section are some of the highest and represent strengths of the department's biology programs. |

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| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 ($-0.22\sigma$). Two individuals failed to meet the $-1.5\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of $-1.5\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of $-1.5\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |

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| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |

MALONE UNIVERSITY
CHRIST'S KINGDOM FIRST

**Program Name: Biology (Pre-Optometry track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level

sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).

- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and chemical phenomena within a Christian worldview (Stems from Malone Educ. Goals D2, E1, and E5).
- Students should develop an enriched understanding of the nature of human identity, development, and behavior through a study of human anatomy and physiology. (Stems from Malone Educ. Goal A3)

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

**Department:** *Natural Sciences*
**Program:** *Biology (Pre-Optometry Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were acceptable this year. The department has opted to not make any changes to the curriculum 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 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5$\sigma$ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |

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| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 ($-0.17\sigma$). One individual failed to meet the $-1.50\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of $-1.5\sigma$ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 ($-0.22\sigma$). Two individuals failed to meet the $-1.5\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of $-1.5\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of $-1.5\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |

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| 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. 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | The current in-house biology pre-test / post-test exam has been altered to accommodate 12 questions covering human A&P content. The performances of our biology pre-professional students and our Exercise Science students will be evaluated on these 12 questions. We have set tentative post-test performance standards as well as tentative improvement standards. The first administration of this altered exam was occurred in Fall 2016, but only aggregate pre-test data have been collected. Until the exam is offered as a post-test in Spring 2017, we will not have post-test data to examine. We are already aware that 2 questions need to re-written to raise the rigor (over 80% of pre-test takers responded correctly). We are also aware that some individuals who had already taken A&P took this test as a "Pre-test" this in Fall 2016. These scores would have artificially inflated the pre-test cohort average making the 70% improvement very difficult. The instrument has been altered to prevent this from occurring again. The current A&P instructor is also researching an additional assessment that might allow for true comparisons with national averages. |
| 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | See comments in table cell for Departmental PILO 'L'. |
| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |

**Program Name: Biology (Pre-Physician's Assistant Track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

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

- Students should develop an enriched understanding of the nature of human identity, development, and behavior through a study of human anatomy and physiology. (Stems from Malone Educ. Goal A3)

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

**Department:** *Natural Sciences*
**Program:** *Biology (Pre-Physician's Assistant Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were acceptable this year. The department has opted to not make any changes to the curriculum 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 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5$\sigma$ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |

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| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 ($-0.17\sigma$). One individual failed to meet the $-1.50\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of $-1.5\sigma$ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 ($-0.22\sigma$). Two individuals failed to meet the $-1.5\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of $-1.5\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of $-1.5\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |

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| 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. 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | The current in-house biology pre-test / post-test exam has been altered to accommodate 12 questions covering human A&P content. The performances of our biology pre-professional students and our Exercise Science students will be evaluated on these 12 questions. We have set tentative post-test performance standards as well as tentative improvement standards. The first administration of this altered exam was occurred in Fall 2016, but only aggregate pre-test data have been collected. Until the exam is offered as a post-test in Spring 2017, we will not have post-test data to examine. We are already aware that 2 questions need to re-written to raise the rigor (over 80% of pre-test takers responded correctly). We are also aware that some individuals who had already taken A&P took this test as a "Pre-test" this in Fall 2016. These scores would have artificially inflated the pre-test cohort average making the 70% improvement very difficult. The instrument has been altered to prevent this from occurring again. The current A&P instructor is also researching an additional assessment that might allow for true comparisons with national averages. |
| 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | See comments in table cell for Departmental PILO 'L'. |
| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06σ). Lowest individual score is 135 (-1.38σ).<br>2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient.<br>Both criteria were met and no changes are deemed necessary at this time. |

**Program Name: Biology (Pre-Veterinary Medicine track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

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

- Students should develop an enriched understanding of the nature of human identity, development, and behavior through a study of human anatomy and physiology. (Stems from Malone Educ. Goal A3)

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

**Department:** *Natural Sciences*
**Program:** *Biology (Pre-Veterinary Medicine Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were acceptable this year. The department has opted to not make any changes to the curriculum 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 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5σ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 |

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| | ETS biology exam Molecular Biology and Genetics sub-scores. | failed to meet the $-1.50\sigma$ criterion. | of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |

**Program Name: Chemistry (Forensic Science Track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018**
**Reporting cycle of January 2016 – December 2016**

## 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 (Forensic Science Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 14.41; minimum composite score = 8; # of individual component scores of 1 was 3. | Data here represent the sixth data set ever collected with this instrument. Average composite score and individual composite scores all met the departmental criteria for success. However, 3 individual component scores were not acceptable. Two of the low individual component scores were from a single individual's essays who, we believe, avoided the question due to the sensitivity of the material. As a result, the department reworded the instrument to be less offensive to students whose worldviews differ significantly from Malone's in order to elicit more on-task participation. |
| 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. 2) ACS Gen Chem II Exam score used as a Pre-Test for obtaining baseline data only (not used to assess success, but merely preparation for freshman chemistry sequence). | 1) Mean score on the ACS Gen Chem Exam is 29.14 (-0.80$\sigma$). Ten individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.81 giving strong evidence of student improvement, but the scores of the freshman cohort as it exits is well below the national average (24$^{th}$ percentile) | The 10 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department. The extremely low CCDT results for Fall 2008 - Fall 2010 are evidence that our students enter well below the national average, so cohorts exiting below the national average do not necessarily imply a poor program. 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 our students enter below the national average and then exit below the national average in spite of the significant improvement in content knowledge. The department responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017. |

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| 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 ACS Inorganic Chem Exam. 3) 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 and Inorganic Sub-scores. | 1) Mean score on the ACS Organic Chem Exam was 36.45 (–0.23$\sigma$). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Most recent mean score on the ACS Inorganic Chem Exam was 25.67 (–0.33$\sigma$). Only 1 individual failed to meet the –1.5$\sigma$ criterion. 3) Average sub-scores on the Organic and Inorganic sections of the ETS chemistry exam are 61.0 and 56.7 respectively (+0.89$\sigma$ and +0.56$\sigma$ respectively). No individuals failed to meet the –1.5$\sigma$ criterion on either sub-section). | 1) This data set represents the fifth year in a row that ACS composite scores have met the departmental criteria for success. This may be the result of two changes that have been implemented in the Organic Chemistry sequence within the last 5 years. It is still too early to draw any conclusions regarding the implementation of these changes, though. 2) Composite scores on the ACS Inorganic exam have met the minimum standard set by the department since 2009. The occasional individual still misses the –1.5$\sigma$ criterion, however. The success of our students on the ETS inorganic sub-section, however, is comforting and leads us to believe that no programmatic changes are warranted at this time. 3) ETS scores were acceptable again 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 20 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. | Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be sufficient to accomplish the desired change. To step the efforts up a notch, the instructor has also incorporated feedback from the class in a proposal to the department that would add an additional credit hour to the class to assure that the assessments have adequate time for completion. |

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| 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. | Since 2012, a passing grade on each assignment has been officially required in order to pass the class. In Spring 2014, the instructor implemented a policy of assigning a grade of "Incomplete" until all students had met the minimum criteria. As a result, the number of deficient criteria has dropped dramatically. 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 are hoping to implement these new assignments within the next one or two reporting cycles. |
| 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) 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 Chemistry exam. | 1) Mean ETS composite score is 155.7. (+0.51$\sigma$). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 36.45 (–0.23$\sigma$). No individuals failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the fifth year in a row that ACS scores have met the departmental criteria for success in organic. This may be the result of two changes that have been implemented in the Organic Chemistry sequence within the last 5 years. It is still too early to draw any conclusions regarding the implementation of these changes, though. No changes appear to be warranted at this time. |

MALONE UNIVERSITY
CHRIST'S KINGDOM FIRST

**Program Name: Chemistry (Graduate School Track)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018**
**Reporting cycle of January 2016 – December 2016**

## 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 (Graduate School Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |

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| 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. |
| 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) 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 Chemistry exam. | 1) Mean ETS composite score is 151.5. (+0.24$\sigma$). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course/program and is not particularly worried about this individual low score given the context. |

MALONE UNIVERSITY
CHRIST'S KINGDOM FIRST

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

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

**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 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |

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| 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. |
| 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. 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | The current in-house biology pre-test / post-test exam has been altered to accommodate 12 questions covering human A&P content. The performances of our biology pre-professional students and our Exercise Science students will be evaluated on these 12 questions. We have set tentative post-test performance standards as well as tentative improvement standards. The first administration of this altered exam was occurred in Fall 2016, but only aggregate pre-test data have been collected. Until the exam is offered as a post-test in Spring 2017, we will not have post-test data to examine. We are already aware that 2 questions need to re-written to raise the rigor (over 80% of pre-test takers responded correctly). We are also aware that some individuals who had already taken A&P took this test as a "Pre-test" this in Fall 2016. These scores would have artificially inflated the pre-test cohort average making the 70% improvement very difficult. The instrument has been altered to prevent this from occurring again. The current A&P instructor is also researching an additional assessment that might allow for true comparisons with national averages. |

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| 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | 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 0.5$\sigma$ below national mean and no individual score lower than 1.5$\sigma$ below the national mean on the ETS chemistry exam composite score. 2) 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 Chemistry exam. | 1) Mean ETS composite score is 151.5. (+0.24σ). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course/program and is not particularly worried about this individual low score given the context. |


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

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

**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-Medicine Track)*
**Assessed by:** *Jeffrey M. Goff - Chair, Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |

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| 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. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| 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) 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 Chemistry exam. | 1) Mean ETS composite score is 151.5. (+0.24σ). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course/program and is not particularly worried about this individual low score given the context. |

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

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

**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-Pharmacy Track)*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |

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| 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. |
| 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. 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | The current in-house biology pre-test / post-test exam has been altered to accommodate 12 questions covering human A&P content. The performances of our biology pre-professional students and our Exercise Science students will be evaluated on these 12 questions. We have set tentative post-test performance standards as well as tentative improvement standards. The first administration of this altered exam was occurred in Fall 2016, but only aggregate pre-test data have been collected. Until the exam is offered as a post-test in Spring 2017, we will not have post-test data to examine. We are already aware that 2 questions need to re-written to raise the rigor (over 80% of pre-test takers responded correctly). We are also aware that some individuals who had already taken A&P took this test as a "Pre-test" this in Fall 2016. These scores would have artificially inflated the pre-test cohort average making the 70% improvement very difficult. The instrument has been altered to prevent this from occurring again. The current A&P instructor is also researching an additional assessment that might allow for true comparisons with national averages. |

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| 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) NO post-test data for this reporting period. Only pre-test scores are available at this time. Average pre-test score was 5.97 and median was 5.0. | 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 0.5$\sigma$ below national mean and no individual score lower than 1.5$\sigma$ below the national mean on the ETS chemistry exam composite score. 2) 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 Chemistry exam. | 1) Mean ETS composite score is 151.5. (+0.24σ). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Mean score on the ACS Organic Chem Exam was 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. | 1) ETS Composite data have been acceptable for the last several years. 2) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course/program and is not particularly worried about this individual low score given the context. |

**Program Name: Life Science – Chemistry Education**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level sufficient for competent teaching at the high school level (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and 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:** *Life Science – Chemistry Education*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 33.10 (–0.50$\sigma$). One individual failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 58.5 (+0.71$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) This data set represents the first time in 6 years that an ACS score missed the departmental criteria for success. The individual student who missed this criterion had a large number of absences during the semester and failed to turn in several assignments. With a grade of F going into the final exam, the instructor was surprised to see the student show up to take the final exam. The department does not believe that the poor grade of this particular student is a reflection of the quality of the course and is not particularly worried about this individual low score given the context.<br>2) ETS scores were 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |

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| 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 ($+0.08\sigma$). No individuals failed to meet the $-1.5\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of $-1.5\sigma$ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 ($-0.17\sigma$). One individual failed to meet the $-1.50\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of $-1.5\sigma$ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |

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| Demonstrate an understanding of the various factors that impact biological populations (Departmental Outcome H). | 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 biology exam Population Biology/Evolution/Ecology sub-score. | 1) Average Population Biology/Evolution/Ecology sub-score is 51.9 (–0.02$\sigma$). All individuals met the -1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the population biology/evolution/ecology sub-section, the department has opted to not make any programmatic changes at this time. The institutional cohort averages on this section are some of the highest and represent strengths of the department's biology programs. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 (–0.22$\sigma$). Two individuals failed to meet the –1.5$\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of –1.5$\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of –1.5$\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |

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| Demonstrate the capability of working with animals in safe and ethical ways that conform to state and national guidelines (Departmental Outcome J). | 1) Minimum score of 35/60 on an Animal Care Portfolio with no single sub-score lower than 2. | 1) All Animal Care Portfolio composite scores met the departmental criteria for success, while six individual element scores did not. | This instrument is still fairly new (this is the fourth year of good data collected with this instrument). Last year, the department began checking for completion of the Animal Care Portfolio during advising week of a student's junior spring; still, some students procrastinated on their portfolios and did not turn them in until their senior year. The department should be able to enforce this more effectively by opening up lines of communication with the registrar's office. If the department refuses to approve potential graduates or the registrar refuses to release diplomas until the portfolio meets the minimum standards, the desired portfolio quality seems obtainable. However, some students have been petitioning to drop the portfolio requirement altogether. This has prompted the faculty to begin discussions about the future of this instrument. If it is to be retained, enforcement in the junior year must be ramped up. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |
| Demonstrate the level of content mastery required for potential successful performance in secondary science education (Departmental Outcome O). | 1) 100% passing scores on appropriate OAE test. | No New Data since we have no new graduates from this program | Malone has a long history of 100% pass rates on the Praxis II tests. The fact that one student failed the newer OAE test in 2015, though disappointing, does not warrant any programmatic changes at this time. However, the possibility that the OAE test might be more rigorous than the older Praxis II test is something the department must consider and be proactive about. If another student fails this test within the next 3-5 years, the department believes that a much more serious response is in order. Incidentally, the student who failed this test retook the test and passed it at a later date. |

**Program Name: Life Science Education**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

## 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 biology and chemistry, the underlying assumptions of biological knowledge and chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists and chemists at a level sufficient for competent teaching at the high school level (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological and chemical problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists/chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological and 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:** *Life Science Education*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| Program Intended Learning Outcomes (PILO) | Means of Program Assessment & Criteria for Success | Summary of Data Collected | Use of Results |
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| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| 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 20 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. | This course is offered every other fall, so no new data is present in this report. Data below is from last year's report: Of 9 students, only 1 student failed to reach the minimum score of 20 on Safety Project #1 (1 individual element score missed criterion). On Safety Project #2, all students met the minimum composite score criterion of 21 and all individual element scores were satisfactory as well. On Safety Project #3, all students met the minimum composite score criterion of 20, though 1 individual element score missed the minimum standard. | 1) Although two individual element scores were low and 1 student failed to meet a minimum composite score, 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. 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 in last year's report, so the good intentions of the instructor may not be 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. |
| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 ($+0.08\sigma$). No individuals failed to meet the $-1.5\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of $-1.5\sigma$ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |

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| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |
| Demonstrate an understanding of the various factors that impact biological populations (Departmental Outcome H). | 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 biology exam Population Biology/Evolution/Ecology sub-score. | 1) Average Population Biology/Evolution/Ecology sub-score is 51.9 (–0.02$\sigma$). All individuals met the -1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the population biology/evolution/ecology sub-section, the department has opted to not make any programmatic changes at this time. The institutional cohort averages on this section are some of the highest and represent strengths of the department's biology programs. |

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| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 ($-0.22\sigma$). Two individuals failed to meet the $-1.5\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of $-1.5\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of $-1.5\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |
| Demonstrate the capability of working with animals in safe and ethical ways that conform to state and national guidelines (Departmental Outcome J). | 1) Minimum score of 35/60 on an Animal Care Portfolio with no single sub-score lower than 2. | 1) All Animal Care Portfolio composite scores met the departmental criteria for success, while six individual element scores did not. | This instrument is still fairly new (this is the fourth year of good data collected with this instrument). Last year, the department began checking for completion of the Animal Care Portfolio during advising week of a student's junior spring; still, some students procrastinated on their portfolios and did not turn them in until their senior year. The department should be able to enforce this more effectively by opening up lines of communication with the registrar's office. If the department refuses to approve potential graduates or the registrar refuses to release diplomas until the portfolio meets the minimum standards, the desired portfolio quality seems obtainable. However, some students have been petitioning to drop the portfolio requirement altogether. This has prompted the faculty to begin discussions about the future of this instrument. If it is to be retained, enforcement in the junior year must be ramped up. |

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| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |
| Demonstrate the level of content mastery required for potential successful performance in secondary science education (Departmental Outcome O). | 1) 100% passing scores on appropriate OAE test. | No New Data since we have no new graduates from this program | Malone has a long history of 100% pass rates on the Praxis II tests. The fact that one student failed the newer OAE test in 2015, though disappointing, does not warrant any programmatic changes at this time. However, the possibility that the OAE test might be more rigorous than the older Praxis II test is something the department must consider and be proactive about. If another student fails this test within the next 3-5 years, the department believes that a much more serious response is in order. Incidentally, the student who failed this test retook the test and passed it at a later date. |

MALONE UNIVERSITY
CHRIST'S KINGDOM FIRST

**Program: Mathematics**

**Assessed by: Dr. Kyle Calderhead, Dr. David Hahn**

**Date: 2016-2017**

## Mission Statement:

The mission of the mathematics program is to provide students with a mathematical education which prepares them to understand, communicate, and apply mathematics. As a result, our graduates will be able to continue their mathematical education in graduate school, become effective secondary school mathematics teachers, or apply their mathematical knowledge and thinking ability in service or industry.

**Program Goals**:

**Goal 1**: Students will understand a spectrum of mathematical concepts.
**Goal 2**: Students will effectively communicate mathematics.
**Goal 3**: Students will demonstrate an ability to apply mathematical thinking to solve problems.

| **Program Intended Learning Outcomes (PILO)** | **Means of Program Assessment & Criteria for Success** | **Summary of Data Collected** | **Use of Results** |
|---|---|---|---|
| 1a: Students will demonstrate a knowledge base of mathematics consistent with the Mathematical Association of America (MAA) standards. | **ETS Major Field Test in Mathematics**:<br>All senior mathematics majors take this standardized test in the fall semester of their senior year. 80% of scores at or above 138.7 (one standard deviation from the mean) will demonstrate a knowledge base.<br><br>**Ohio Assessment for Educators Test in Mathematics**:<br>All majors seeking education licensure take this test for teaching licensure qualification. The test is 150 multiple-choice questions designed to test the ability to understand and work with five main categories: 1.Mathematical Processes and Number Sense, 2. Patterns, Algebra, and Functions, 3. Measurement and Geometry, 4. Trigonometry and Calculus, and 5. Statistics, Probability, and Discrete Mathematics. The State of Ohio requires a minimum score of 220 to receive licensure. This is assessment was only in its second year, having recently replaced the Praxis II. Our initial goal is 100% of students achieving the passing rate as our benchmark to demonstrate a knowledge base. | **ETS Major Field Test in Mathematics**:<br>Three students took the ETS MFT; the scores were 145, 151, and 164.<br><br>Subject score reports require at least five students, so the following means are for the past two years (national means in parentheses):<br>Calculus: 28 (30.7)<br>Algebra: 30 (33.1)<br>Routine: 27 (31.1)<br>Non-routine: 27 (26.2)<br>Applied: 38 (34.7)<br><br>**OAE Test in Mathematics**:<br>There were two students taking the OAE, with scores of 196 and 242. The state mean was 233.6, with a pass rate of 68.2%. The student with the lower score retook the exam to later get a 232; the comparable state means and pass rates were 237.4 and 82.4%, respectively. | **ETS Major Field Test in Mathematics**:<br>All three students (100%) scored in the target range, including one student (33%) who scored above the national mean.<br><br>Additionally, all subject scores are at or above one standard deviation from the national mean.<br><br>This affirms the effectiveness of our curriculum in giving students a sufficient knowledge base in the field.<br><br>**OAE Test in Mathematics**:<br>While one student required a second try, all students passed before the end of May, which is a key deadline for employment. Given the low initial pass rate this year, this affirms the effectiveness of our curriculum. |

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| 1b: Students will be proficient in mathematics needed to be effective secondary school teachers. | **OAE Test in Mathematics:**<br>100% of students achieving a passing score of 220 for the state of Ohio will indicate proficiency.<br><br>**ETS Major Field Test in Mathematics:**<br>The mean of our students falling within one standard deviation of the mean of 30.7 on the Calculus subsection will indicate proficiency. Thus, a mean of 23.2 will indicate proficiency. | **OAE Test in Mathematics:**<br>There were two students taking the OAE, with scores of 196 (later raised to 232) and 242.<br><br>**ETS Major Field Test in Mathematics:**<br>The calculus subscore mean was 28. | **OAE Test in Mathematics:**<br>One student passed on the first try, and both had passed by the second try. Given that nearly one-third of all test-takers did not pass on their first attempt this year, we feel that this still affirms the value of our curriculum in giving students sufficient knowledge to be effective secondary school teachers.<br><br>**ETS Major Field Test in Mathematics:**<br>Our mean is above 23.2, and near the national average of 30.7, continuing to affirm changes made to re-emphasize calculus later in the curriculum. |
| 2a: Students will demonstrate ability to independently study and verbally communicate mathematics. | **Presentation rubric**: A rubric to assess mathematical presentations. Presentations in MATH 343 and 460 are assessed by all professors in the program.<br><br>Each category on the rubric is scored out of 5 points, and then weighted. Success will be demonstrated if 70% of students get 4 or 5 points (5 point scale) in 7 out of the 10 categories. | **MATH 343**: No data – this is an alternate year course.<br><br>**MATH 460**: Two of the three students met the benchmark (the number of categories with scores of 4 or 5 were 5, 7 & 11). | **MATH 343**: No data<br><br>**MATH 460**: Due to the small number of students, we are not concerned with the 67% success rate as compared to the 70% goal. We will continue to develop students presentation skills, but are cautious about putting too much emphasis on results with such small sample sizes. |

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| 2b: Students will demonstrate ability to independently study and communicate mathematics in writing. | **Paper writing rubric**: A rubric to assess mathematical papers. Student papers from MATH 343, 352, and Math 460 are assessed by all professors in the program.<br><br>As in the Presentation Rubric, success will be determined if 70% of students score a 4 or 5 in 8 out of 12 categories for papers written in MATH 460 (Senior level). For papers written for MATH 343 and 352, success will be demonstrated by 70% of students scoring a 4 or 5 in 6 out of 12 categories. Additionally, the department will track individual scores across the courses and expect improvement. | **MATH 343**: No data – this is an alternate year course.<br><br>**MATH 352**: No data – this is an alternate year course.<br><br>**MATH 460**: One of the three students met the benchmark (the number of categories with scores of 4 or 5 were 3, 5 & 8). | **MATH 343**: No data.<br><br>**MATH 352**: No data.<br><br>**MATH 460**: While a 33% success rate is low, the small sample size demands caution when reacting to this result. Paper writing will continue to receive more focused attention. |
| 3a: Students will write proofs effectively. | **Proof writing rubric**: A rubric to assess mathematical proofs. Selected proofs from MATH 341, 352 and 432 are assessed by all professors in the program. Success will be demonstrated if 80% of students score 18 or higher out of 25 points on the rubric. Additionally, the department will track individual scores across the courses and expect improvement. | **MATH 341**: Two out of fives students met the benchmark (scores were 15, 16, 17, 18, 19).<br><br>**MATH 352**: No data – this is an alternate year course.<br><br>**MATH 432**: No data – this is an alternate year course. | **MATH 341**: A 20% success rate indicates a need to focus more on proving skills, although it should be noted that students are typically sophomores and juniors when taking this course, and are still growing in their proof-writing abilities.<br><br>**MATH 352**: No data.<br><br>**MATH 432**: No data. |

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| 3b: Students will solve a variety of problems. | **ETS Major Field Test in Mathematics**: The mean of our students on the "routine" section will be above 23.9 and on the "non-routine" section will be above 20.5 (above one standard deviation from each mean).<br><br>**OAE Test in Mathematics**: The State of Ohio requires a minimum score of 220 to receive licensure. 100% of students scoring at or above the minimum score of 220 will demonstrate ability to solve a variety of problems. | **ETS Major Field Test in Mathematics**: The "routine" subscore mean was 27, and the "non-routine" subscore mean was 27.<br><br>**OAE Test in Mathematics**: There were two students taking the OAE, with scores of 196 (later raised to 232) and 242. | **ETS Major Field Test in Mathematics**: Both scores fall in the acceptable range, with noticeable improvement in the "non-routine" score from last year.<br><br>**OAE Test in Mathematics**: All students were in the passing range (although one took a second attempt), demonstrating problem-solving ability at the appropriate level. |

**Program Name: Zoo and Wildlife Biology (both tracks assessed)**

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

**Date/Cycle of Assessment: Submitted on 1/18/2018;**
**Reporting cycle of January 2016 – December 2016**

**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 biology, the underlying assumptions of biological knowledge, and be able to employ the methods of inquiry commonly utilized by practicing biologists at a level sufficient for entrance into graduate school, professional schools, and other biological vocations (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving biological problems using both quantitative and qualitative approaches and in analyzing / interpreting data generated by experimental protocols commonly employed by practicing biologists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to biological practice and interpret biological 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:** *Zoo and Wildlife Biology*
**Assessed by:** *Jeffrey M. Goff - Dept. of Natural Sciences*
**Time Period Covered:** *January 2016-December 2016*
**Submission Date:** *1/18/2018*

| 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 = 15.25; minimum composite score = 10; all individual component scores were 2 or higher. | Data here represent the seventh data set ever collected with this instrument. Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary above and beyond what was put in place last year. |
| 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 32.42 (-0.50$\sigma$). Five individuals failed to meet the -1.5$\sigma$ criterion. 2) Class average on ACS Gen Chem pre-test is 18.71 giving strong evidence of student improvement (73.3% improvement in score from pre-test to post-test). | The 5 low ACS Gen Chem Exam scores and the low average score for the cohort are in keeping with other recent cohorts and are disappointing to the department, though not as disappointing as they would have been several years ago. Several reasons were listed in the appendix in support of the fact that this criterion for success needs to be used "with a grain of salt". 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. Nevertheless, the department has responded by developing a new, alternative Gen Chem II course for Zoo and Wildlife Biology Majors. Course is scheduled to run for the first time in Spring 2017 and data for this curricular change are to be expected in next year's report. |

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| Demonstrate an understanding of the biological characteristics of each of the major kingdoms (Departmental Outcome F) | 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 biology exam Organismal Sub-score. | 1) Average Organismal sub-score is 54.3 (+0.08$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the organismal sub-section of the ETS, the department has opted to not make any programmatic changes at this time. Individuals missing the criterion of –1.5σ on other sub-sections or even as composite scores are a concern for us, but legitimate reasons for individual students missing the cutoff (e.g., illness, test anxiety) do exist. The department is more concerned when students who have struggled throughout the curriculum at Malone, eventually graduate, but perform poorly on the ETS exam. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion. |
| Demonstrate an understanding of the fundamental concepts of molecular biology and genetics (Departmental Outcome G). | 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 biology exam Molecular Biology and Genetics sub-scores. | 1) Average Molecular Biology/Genetics sub-score is 50.5 (–0.17$\sigma$). One individual failed to meet the –1.50$\sigma$ criterion. | The composite average score was below the national average this year, but not unacceptably low. Furthermore, although one individual missed the criterion of –1.5σ this year on this sub-score, this student was a transfer student who transferred in 5 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program. No changes appear warranted at this time. |

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| Demonstrate an understanding of the various factors that impact biological populations (Departmental Outcome H). | 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 biology exam Population Biology/Evolution/Ecology sub-score. | 1) Average Population Biology/Evolution/Ecology sub-score is 51.9 (–0.02$\sigma$). All individuals met the -1.5$\sigma$ criterion. | In light of the successful scores of several recent cohorts on the population biology/evolution/ecology sub-section, the department has opted to not make any programmatic changes at this time. The institutional cohort averages on this section are some of the highest and represent strengths of the department's biology programs. |
| Demonstrate an ability to properly relate biological structure and function (Departmental Outcome I). | 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 biology exam Cell Biology sub-score. | 1) Average Cell Biology sub-score is 50.2 (–0.22$\sigma$). Two individuals failed to meet the –1.5$\sigma$ criterion. | This sub-section of the ETS has historically been our lowest. For this reason, a curricular change was proposed and passed by the full faculty that added one credit hour to the introductory Cell Biology course effective Fall 2012. This year represents the first year that this curricular change would be expected to have any bearing on assessment scores of graduating seniors. Several years will be required, though, before the results could approach statistical significance. Furthermore, although two individuals missed the criterion of –1.5$\sigma$ this year on this sub-score, one of the two students was a transfer student who transferred in 6 of their biology courses. This individual therefore does not represent the normal Malone student in the biology program and is not a good reflection of the quality of the program. As for the other student, any individual who completes an entire Malone biology curriculum and misses the criterion of –1.5$\sigma$ on an ETS sub-section remains a concern for us. This has occasionally happened, but not routinely. The department continues to discuss ways to address this issue without having reached a conclusion that we can yet act upon. |

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| Demonstrate the capability of working with animals in safe and ethical ways that conform to state and national guidelines (Departmental Outcome J). | 1) Minimum score of 35/60 on an Animal Care Portfolio with no single sub-score lower than 2. | 1) All Animal Care Portfolio composite scores met the departmental criteria for success, while six individual element scores did not. | This instrument is still fairly new (this is the fourth year of good data collected with this instrument). Last year, the department began checking for completion of the Animal Care Portfolio during advising week of a student's junior spring; still, some students procrastinated on their portfolios and did not turn them in until their senior year. The department should be able to enforce this more effectively by opening up lines of communication with the registrar's office. If the department refuses to approve potential graduates or the registrar refuses to release diplomas until the portfolio meets the minimum standards, the desired portfolio quality seems obtainable. However, some students have been petitioning to drop the portfolio requirement altogether. This has prompted the faculty to begin discussions about the future of this instrument. If it is to be retained, enforcement in the junior year must be ramped up. |
| Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (Departmental Outcome K). | Instrument has been dropped in favor of a newer one that has yet to be developed. | NO DATA | Previous reports have indicated that our department has been having a long and rather continuous conversation about the need to implement a research methods course. This course was finally developed and approved by the department and full faculty. This course ran for the first time in Fall 2016. The exact nature of the assessment instrument is still in flux, but the department has completed the most difficult step in addressing this shortfall. It will be possible to build an appropriate assessment instrument into the course as it runs in Fall 2016 or shortly thereafter. |
| Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools (Departmental Outcome N). | 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 biology exam composite score. 2) Mean score no lower than 31/50 and no individual score lower than 24/50 on the departmental biology Post-Test (A&P questions excluded). | 1) Average ETS composite score is 152.2 (–0.06$\sigma$). Lowest individual score is 135 (-1.38$\sigma$). 2) Mean score on in-house Biology post-test is 33.67. All individuals exceeded the minimum score of 24 (lowest score was 26). | 1) As has been the case for several years, the average ETS composite score has been meeting the departmental standard. Occasionally, an individual student fails to meet the minimum score, but this year all students achieved our minimum standard.<br>2) The lowest score of 26 this year on the In-House Biology post-test is sufficient. Both criteria were met and no changes are deemed necessary at this time. |

# *Appendix*

## MALONE UNIVERSITY ASSESSMENT DATA AND ANALYSIS FOR SELECT PROGRAMS WITHIN THE SCIENCE AND MATHEMATICS DEPARTMENT

Assessment cycle: January 2016 – December 2016. Date submitted: 1/18/2018

This record includes the assessment data and analysis for the following programs/majors:

- **Biology – General Track**
- **Biology – Pre-PA Track**
- **Biology – Pre-Medicine Track**
- **Biology – Pre-Veterinary Medicine Track**
- **Biology – Pre-Optometry Track**
- **Biology – Clinical Laboratory Science**
- **Biochemistry**
- **Chemistry – Forensic Chemistry Track**
- **Chemistry – Pre-Medicine Track**
- **Chemistry – Pre-Dentistry Track**
- **Chemistry – Pre-Pharmacy Track**
- **Chemistry – Graduate School Track**
- **Life Science Education**
- **Life Science/Chemistry Education**
- **Zoo and Wildlife Biology (both tracks)**

Submitted by: Jeffrey M. Goff
(on behalf of the Science and Mathematics Department)

# *Science and Mathematics Department Assessment Data and Analysis for Select Programs (January 2016– December 2016)*

***Introduction***

This report covers data collected during the Spring 2016 semester and the Fall 2016 semester (i.e., a calendar year rather than an academic year).

Over the last calendar year, the Science and Mathematics department has focused its assessment energies for chemistry and biology in several areas. Firstly, the recent inclusion of Anatomy and Physiology questions in our biology pre-test/post-test is an attempt to more effectively and routinely address certain Program-Intended Learning Outcomes. This is the first report to include any data subsequent to the A&P inclusion. Secondly, an alternative second semester chemistry course for Zoo and Wildlife Biology majors has been approved by the full faculty and will be implemented for the first time in Spring 2017. Changes in assessment data that reflect this programmatic change may become evident in next year's assessment report. Thirdly, the expansion of Program-Intended Learning Outcome E to include four additional instrumental techniques has necessitated the development of additional assessment instruments — these are still in the development stage. Completion of these instruments is anticipated by Fall 2018. Fourthly, the chemistry faculty members have begun construction of a chemistry pre-test/post-test that is comparable in purpose to the biology pre-test/post-test. Roughly 32 questions for this test have been compiled with another 16 or so to go. The first iteration of this test is scheduled tentatively for Spring 2018. Lastly, the full faculty has recently approved a departmental proposal to split the Zoo and Wildlife Biology major into two tracks. This split therefore became official in Fall 2016. It was determined that the assessment strategy for the old Zoo & Wildlife Biology Major remains appropriate for both of the resulting tracks.

***Program Intended Learning Outcomes***

The department recognizes 20 *Program Intended Learning Outcomes* (PILOs) distributed over the various biology, chemistry, and secondary science education programs in unique combinations. The PILOs are listed below and the unique combinations of PILOs assigned to each program are delineated in Table 1.

A. *Demonstrate the capability of integrating data and assessing phenomena within a Christian paradigm.*
B. *Demonstrate a comprehension of the central concepts of chemistry including the major theories and laws which govern chemical phenomena.*
C. *Demonstrate an understanding of the relationships between structure and behavior of the chemical elements in their various forms and combinations.*
D. *Demonstrate safe laboratory practices and an environmental ethic as it pertains to chemical use and disposal.*

E. *Demonstrate the capability of analyzing and reporting various kinds of experimental data used in the chemical disciplines including the output of GC techniques, MS techniques, IR, $^{1}$H-NMR, $^{13}$C-NMR, UV-VIS, AA, and Gel Electrophoresis.*
F. *Demonstrate an understanding of the biological characteristics of each of the major kingdoms.*
G. *Demonstrate an understanding of the fundamental concepts of molecular biology and genetics.*
H. *Demonstrate an understanding of the various factors that impact biological populations.*
I. *Demonstrate an ability to properly relate biological structure and function.*
J. *Demonstrate the capability of working with animals in safe and ethical ways that conform to state and national guidelines.*
K. *Demonstrate the capability of analyzing and reporting empirical data from the biological sciences.*
L. *Demonstrate a balanced concept of molecular, micro, and macro levels of biological phenomena in the context of human systems.*
M. *Demonstrate the ability to properly relate biological structure and function in the context of human systems.*
N. *Demonstrate the level of content mastery required for potential successful performance in graduate school biology programs or professional schools.*
O. *Demonstrate the level of content mastery required for potential successful performance in secondary science education.*
P. *Demonstrate the level of content mastery required for potential successful performance in chemical industry, graduate school chemistry programs, or professional schools.*
Q. *Demonstrate an understanding of anatomical, kinesiological, and physiological concepts of exercise science.*
R. *Demonstrate a knowledge of the prevention, care, treatment, and rehabilitation of injuries.*
S. *Demonstrate an ability to assess fitness needs of individuals and groups.*
T. *Demonstrate an ability to plan effective exercise prescriptions for various populations.*

**Table 1**

| **Major, Program, or Concentration** | **Appropriate Program Intended Learning Outcomes (PILOs)** |
|---|---|
| Biology (General Track) | A, B, F, G, H, I, K, N |
| Biology (Pre-Medicine Track) | A, B, C, E, F, G, H, I, K, N |
| Biology (Pre-Optometry Track) | A, B, C, E, F, G, I, K, L, M, N |
| Biology (Pre-Physician Assistant Track) | A, B, C, E, F, G, I, K, L, M, N |
| Biology (Pre-Veterinary Medicine Track) | A, B, C, E, F, G, I, J, K, L, M, N |
| Biology–Clinical Laboratory Science | A, B, C, D, F, G, I, K, L, M, N |
| Biochemistry | A, B, C, E, G, I, K, N, P |
| Chemistry (Graduate School Track) | A, B, C, D, E, P |
| Chemistry (Forensic Chemistry Track) | A, B, C, D, E, P |
| Chemistry (Pre-Medicine Track) | A, B, C, D, E, F, P |
| Chemistry (Pre-Pharmacy Track) | A, B, C, D, E, L M, P |
| Chemistry (Pre-Dentistry Track) | A, B, C, D, E, L, M, P |
| Life Science/Chemistry Education | A, B, C, D, F, G, H, I, J, K, O |
| Life Science Education | A, B, D, F, G, H, I, J, K, O |
| Zoo and Wildlife Biology | A, B, F, G, H, I, J, K, N |

## *January 2016-December 2016 Data*

*Statement Regarding the Use of Standardized Test Data*

Our department has explicitly stated as one of its objectives that our students should emerge adequately prepared for pre-professional schools, graduate schools, and teaching high school science (PILOs N-P). Since several of these career track options are extremely competitive, this departmental objective necessitates the use of standardized testing so we can compare our finished "product" with graduating seniors at peer institutions. Furthermore, the rigorous expectations that professional schools will have of

our graduates has made course rigor a premium for us as well. Therefore, the attention that this report gives to course grades and correlations between course grades and standardized testing has been intentional in order to give our faculty an objective "feel" for the rigor of their courses. We understand that course grades are extremely variable and not inherently useful for assessing student learning. Therefore, some of the data included below will not be deemed useful by many reviewers, but it has been found useful by our department for different reasons and will be included routinely in our assessment reports due to its internal utility. More acceptable measures of student learning, we trust, are also included in this report.

The Science and Mathematics Department is aware that meaningful assessment of our programs' strengths and weaknesses can only be made with reliable baseline data in hand. The baseline data collected and reported herein are as follows: ACT composite score data, ACT science sub-score data, ACT math sub-score data, ACT STEM readiness scores, ACS General Chemistry Final Exam data (used as a pre-test), and data obtained from a departmental biology pre-test that was developed in-house. As mentioned previously, the department has determined to begin collecting additional baseline data in the near future via a departmental chemistry pre-test.

*ACT Composite and Sub-Score Data*

Our primary interest in ACT data is to determine how ready our incoming students are for their freshman chemistry and biology experiences and how they compare to freshmen at other institutions. For several years, now, we have been investigating possible correlations that might exist between these scores and eventual course grades in Chem 131 and Biol 144 as a means of predicting a student's chance of success in these courses. With this data in hand, it is possible to objectively set minimum ACT scores as prerequisites for these courses if this need arises. It would also give us some means of monitoring variations in course rigor over the years. Additional uses for this data may present themselves in the future as well. Summary data are presented below in Table 2.

**Table 2: Average ACT Composite Scores and Science and Math Sub-Scores for Fall 2016 Chem 131 Students and Biol 144 Students**

| | ACT Composite | ACT Science Sub-Score | ACT Math Sub-Score |
|---|---|---|---|
| Chem 131 Cohort Average: | 24.00 | 23.88 | 23.15 |
| Biol 144 Cohort Average: | 24.05 | 23.97 | 22.65 |
| Malone Average⋆: | 21.85 | -- | -- |
| State Average*: | 22.0 | 22.0 | 21.6 |
| National Average**: | 20.8 | 20.8 | 20.6 |

⋆Data drawn from the Fall 2016 Malone Fact Book

*The ACT was taken by 93,659 Ohio students in Spring 2016 (i.e., this cohort's high school senior year; data obtained from https://www.act.org/content/dam/act/unsecured/documents/P_36_369999_S_S_N00_ACT-GCPR_Ohio.pdf

**The ACT was taken by 2,090,342 students nationally in Spring 2016 (i.e., this cohort's high school senior year; data obtained from https://www.act.org/content/dam/act/unsecured/documents/P_99_999999_N_S_N00_ACT-GCPR_National.pdf

The ACT composite scores and science and math sub-scores that our science students obtained are higher than the national averages, the state averages, and the University averages. However, many of the students who took the ACT and thus whose scores were included in national and state averages, did not apply to college or were not accepted based on low ACT scores. Therefore, it does not logically follow that our incoming freshman chemistry and biology students are above average compared to other first-year chemistry and biology college students at other institutions. Average composite ACT scores and select sub-score data for some Ohio four-year colleges are provided below in Table 3 as perhaps a more useful benchmark.[1]

**Table 3: Freshman ACT Score Cutoffs for the 25th and 75th Percentile for Some Ohio Schools**

| School | ACT Composite | | ACT English Sub-Score | | ACT Math Sub-Score | |
|---|---|---|---|---|---|---|
| | 25th %ile | 75th %ile | 25th %ile | 75th %ile | 25th %ile | 75th %ile |
| Cleveland State | 18 | 23 | 16 | 23 | 17 | 23 |
| University of Akron | 18 | 24 | 16 | 24 | 17 | 25 |
| Bowling Green | 19 | 24 | 18 | 24 | 18 | 24 |
| Kent State Univ. (Main) | 19 | 24 | 19 | 24 | 18 | 25 |
| Kent State Univ. (Stark) | 17 | 22 | 16 | 21 | 16 | 21 |
| Walsh University | 19 | 24 | 18 | 24 | 18 | 24 |
| Mount Union | 19 | 25 | 18 | 24 | 18 | 24 |
| Malone University | 19 | 26 | 19 | 25 | 18 | 25 |
| Ashland University | 20 | 25 | 19 | 25 | 20 | 25 |
| Baldwin Wallace | 21 | 26 | 21 | 28 | 20 | 26 |
| Ohio University | 21 | 26 | 20 | 26 | 20 | 26 |
| Miami University | 24 | 29 | 23 | 29 | 24 | 29 |
| Ohio State | 25 | 30 | 25 | 30 | 25 | 30 |

Data taken from http://colleges.collegetoolkit.com/colleges/state/ohio/39.aspx on 5/24/17.

ACT also publishes College Readiness Benchmark Scores (CRBS). A CRBS is defined as the minimum score needed on an ACT subject-area test to indicate "approximately a 50 percent chance of earning a B or better and approximately a 75 percent chance of earning a C or better in the corresponding college course or courses"[2] The 2016 benchmark score for Science Reasoning was 23 (i.e., a student with a 23 or higher on their ACT science reasoning had a 50% chance of scoring a B or better in freshman biology classes). At the national level, only 36% of ACT test-takers were deemed to be "ready" for college biology, while 45% of Ohio ACT test-takers were. Some years, the College Readiness Benchmark scores determined from data collected nationally have closely paralleled the results in our first-year biology course, while in other years our students have achieved grades that appear to be inflated with a higher than expected number of students achieving grades of B or better or C or better. Previous reports have drawn the conclusion that the increase in cohort performance is likely "attributable to either the pedagogy of the particular instructor covering this course or a diminished course rigor." The scores included in this report are in near perfect agreement with the

[1] http://colleges.collegetoolkit.com/colleges/state/ohio/39.aspx
[2] http://www.act.org/research/policymakers/pdf/benchmarks.pdf

nationally collected data in that 51.4% of students who achieved a 23 or higher on the science reasoning component of the ACT achieved a grade of B or better in Biol 144 while 78.4% achieved a grade of C or better. The relationship between ACT science sub-score and course grade in Biol 144 for Fall 2016 is shown below in Table 4. Moving averages at Malone for the last 4 years are close to the national data in that grades of B or better were achieved by 53.0% of students with a Science Reasoning ACT sub-score of 23 or higher and 79.1% of students with this ACT performance achieved grades of C or better.

**Table 4: Comparison of Fall 2016 Biol 144 grades and ACT Science Sub-Scores to Expectations of the ACT College Readiness Benchmark Score for Science (23).**

| Student | ACT Science Sub-Score | Biol 144 Course Grade | ACT ≥ 23 and Grade ≥ B | ACT ≥ 23 and Grade ≥ C |
|---|---|---|---|---|
| 1 | 28 | A | yes | yes |
| 2 | 24 | A | yes | yes |
| 3 | 19 | A | | |
| 4 | 28 | A | yes | yes |
| 5 | 25 | A | yes | yes |
| 6 | 28 | A | yes | yes |
| 7 | 29 | A | yes | yes |
| 8 | 24 | A | yes | yes |
| 9 | 26 | A | yes | yes |
| 10 | 25 | A | yes | yes |
| 11 | 32 | A | yes | yes |
| 12 | 20 | A- | | |
| 13 | 17 | A- | | |
| 14 | 21 | A- | | |
| 15 | 25 | A- | yes | yes |
| 16 | 35 | A- | yes | yes |
| 17 | 22 | A- | | |
| 18 | 30 | B | yes | yes |
| 19 | 21 | B | | |
| 20 | 22 | B | | |
| 21 | 24 | B | yes | yes |
| 22 | 28 | B- | no | yes |
| 23 | 28 | B- | no | yes |
| 24 | 33 | B- | no | yes |
| 25 | 20 | B- | | |
| 26 | 26 | B- | no | yes |
| 27 | 21 | B+ | | |
| 28 | 23 | B+ | yes | yes |
| 29 | 28 | B+ | yes | yes |
| 30 | 24 | B+ | yes | yes |
| 31 | 28 | B+ | yes | yes |
| 32 | 24 | B+ | yes | yes |
| 33 | 27 | C | no | yes |
| 34 | 24 | C | no | yes |
| 35 | 26 | C | no | yes |
| 36 | 28 | C | no | yes |
| 37 | 18 | C- | | |
| 38 | 26 | C- | no | no |
| 39 | 20 | C- | | |
| 40 | 22 | C- | | |
| 41 | 25 | C- | no | no |
| 42 | 20 | C+ | | |
| 43 | 20 | C+ | | |
| 44 | 24 | C+ | no | yes |
| 45 | 23 | C+ | no | yes |
| 46 | 20 | C+ | | |

| | | | | |
|---|---|---|---|---|
| 47 | 25 | D | no | no |
| 48 | 24 | D | no | no |
| 49 | 21 | D | | |
| 50 | 26 | D | no | no |
| 51 | 20 | D | | |
| 52 | 22 | D | | |
| 53 | 22 | D | | |
| 54 | 21 | D | | |
| 55 | 21 | D | | |
| 56 | 18 | D | | |
| 57 | 24 | D- | no | no |
| 58 | 20 | D- | | |
| 59 | 20 | D+ | | |
| 60 | 17 | F | | |
| 61 | 35 | F | no | no |
| 62 | 24 | F | no | no |
| 63 | 19 | F | | |

Note: 19 of 37 students (51.4%) with ACT science reasoning scores ≥ 23 achieved a B or better in Biol 144. Institutional moving average over last 4 years is 71 of 134 (53.0 %).
Note: 29 of 37 students (78.4%) with ACT science reasoning scores ≥ 23 achieved a C or better in Biol 144. Institutional moving average over last 4 years is 106 of 134 (79.1%).

We are continuing to monitor this baseline data for insight into course rigor at the freshman level.

Historically, we have sought to gauge and monitor changes in course rigor in our Chem 131 class as we have in Biol 144, but the ACT does not use its Science Reasoning sub-score to make predictions for success in freshman chemistry courses. In the absence of a comparable CRBS for predicting success in chemistry, we accumulated data for 5 years (Fall 2009 – Fall 2013) in our Chem 131 class and came to the conclusion that an ACT Math sub-score of 25 served as more reliable "Malone Readiness Benchmark Score" for Chem 131 in that students with an ACT math sub-score of 25 or higher obtained a B or better 51% of the time and achieved a C or better 76% of the time. This "benchmark" score was significantly higher than that for predicting success in biology and comports with the anecdotal perception of many of our science majors that freshman chemistry is more difficult than freshman biology. But, did this mean that our freshman chemistry class was too rigorous?

Starting in 2015, the ACT began publishing a College Readiness Benchmark Score for STEM courses. The STEM "sub-score" is simply an average of both the Math and Science Reasoning sub-scores of the ACT. As with other CRBSs, the STEM benchmark attempts to predict the likelihood of success in freshman courses at the college level. The STEM benchmark, specifically, predicts the likelihood of success in freshman STEM classes such as introductory calculus, chemistry, physics, and engineering (Chem 131 would be included in this suite of courses). The published STEM benchmark score is a 26 – quite a bit higher than the other ACT college readiness benchmarks and indicative of much greater course rigor. The ACT is also acknowledging that only 20% of students nationally meet the CRBS for STEM courses. With this new ACT benchmark now developed, we can, for the first time, begin to assess Chem 131 rigor as we have been assessing Biol 144 rigor.

The raw data for the Fall 2016 Chem 131 course grades and respective CRBS for STEM courses are presented below (See Table 5). This year, 70.0% of students with a STEM ACT sub-score of 26 or higher obtained a B or better while 90.0% of students with STEM ACT sub-score of 26 or higher obtained a C or better. These results are higher than the national average and might imply low course rigor, better pedagogy, or, in light of the small sample size of only 10 students, nothing at all. However, the STEM readiness scores published by the ACT will allow us to gain a more objective feel for Chem 131 rigor in the years to come. One observation that is worth documenting for future reference is that only 10 out of 41 of our Fall 2016 chemistry students would be considered "ready" for this course by the ACT. The fact that 31 of 41 students in this class are not considered "ready" for the class is something that must be discussed at length and appropriate curricular changes implemented.

**Table 5: Comparison of Fall 2016 Chem 131 grades and ACT STEM Sub-scores.†**

| Student | ACT STEM Sub-Score | Chem 131 Course Grade | STEM ≥ 26 and Grade ≥ B | STEM ≥ 26 and Grade ≥ C |
|---|---|---|---|---|
| 1 | 18 | A | | |
| 2 | 26.5 | A | yes | yes |
| 3 | 29.5 | A | yes | yes |
| 4 | 24 | A- | | |
| 5 | 27.5 | A- | yes | yes |
| 6 | 23.5 | B | | |
| 7 | 27 | B | yes | yes |
| 8 | 25.5 | B | | |
| 9 | 24.5 | B- | | |
| 10 | 27.5 | B+ | yes | yes |
| 11 | 26.5 | B+ | yes | yes |
| 12 | 29 | B+ | yes | yes |
| 13 | 18.5 | C | | |
| 14 | 23.5 | C | | |
| 15 | 25.5 | C | | |
| 16 | 24 | C | | |
| 17 | 26 | C | no | yes |
| 18 | 24 | C | | |
| 19 | 23.5 | C | | |
| 20 | 25 | C- | | |
| 21 | 19.5 | C- | | |
| 22 | 27.5 | C+ | no | yes |
| 23 | 24.5 | C+ | | |
| 24 | 24.5 | D | | |
| 25 | 20 | D | | |
| 26 | 20 | D | | |
| 27 | 19 | D | | |
| 28 | 27.5 | D | no | no |
| 29 | 19 | D- | | |
| 30 | 19.5 | D+ | | |
| 31 | 25 | D+ | | |
| 32 | 22.5 | D+ | | |
| 33 | 22.5 | D+ | | |
| 34 | 24.5 | D+ | | |
| 35 | 25 | F | | |
| 36 | 19.5 | F | | |
| 37 | 19.5 | F | | |
| 38 | 20 | F | | |
| 39 | 24.5 | F | | |
| 40 | 19.5 | F | | |
| 41 | 21.5 | F | | |

†STEM sub-scores are calculated by average Math and Science Reasoning Sub-scores.
Note: 7 of 10 students (70.0%) with ACT STEM sub-scores ≥ 26 achieved a B or better in Chem 131
Cumulative Institutional Values: 7 of 10 (70.0%).
Note: 9 of 10 students (90.0%) with ACT STEM sub-scores ≥ 26 achieved a C or better in Chem 131.
Cumulative Institutional Values: 9 of 10 (90.0%).

*Pre-Testing / Post-Testing the General Chemistry Sequence*

In Spring 2007, we first began utilizing a standardized exam from the American Chemical Society (ACS Gen Chem II) as our final exam in Chem 132 in order to measure the success of our instruction in the freshman General Chemistry Sequence. We soon realized that we could not link these scores to student learning in our chemistry sequence without reliable front-end data. We therefore began implementing the California Chemistry Diagnostic Test (CCDT) as a measurement of front-end knowledge and preparedness in Fall 2008 and continued to use this "pre-test" through Fall 2010.

As of Fall 2011, we stopped using the CCDT because there were several significant problems associated with this pre-test.

Since Fall 2011, the department of Natural Sciences has employed the ACS Gen Chem II Exam as a pre-test and a post-test for the General Chemistry sequence. The benefit with this approach is that we have national norm comparisons for the exit exam that can be directly linked to student improvement in our course sequence as well.

One question that the department has been wrestling with for quite some time is whether a need exists for a remedial chemistry course for those ill-prepared for the Chem 131/132 sequence. We have also shown in recent reports that it is the Zoo & Wildlife Biology majors, a significant fraction of the class, which appear to be struggling the most in our freshman chemistry sequence. For example, in Fall 2012, the average and median Zoo & Wildlife Biology major final exam scores were 67.6% and 65.2% respectively (overall class average and median scores were 71.0% and 73.6% respectively). Similar results were observed in Fall 2013 when the average and median Zoo & Wildlife Biology major final scores were 62.4% and 71.1% respectively (overall class average and median scores were 72.9% and 74.4% respectively). Thus, we may be attracting students with a particular vocational goal whose passion and academic preparation for that vocation are extremely disparate. The identification of a particular subset that is struggling in the course prompted the department to offer an alternative to Gen Chem II for Zoo & Wildlife Biology majors. The new course, "Chemistry for Animal Managers" (Chem 135), will be offered every other Spring semester beginning in Spring 2017.

We have also investigated the possibility that we have been permitting students to enroll in Chem 132 who have not achieved competency on the Chem 131 material. If this is the case, then it stands to reason that the rigor of our Chem 132 would be lower than desirable to accommodate these below-average students, and students completing Chem 132 would therefore be expected to score below average on the ACS Gen Chem II exam. In response to these concerns, the department considered voting to institute a minimum grade of C- in Chem 131 as a prerequisite for admission into Chem 132. The C- prerequisite is still being discussed periodically, but this particular approach to raising ACS exam scores is only part of the larger picture. Action on the C- prerequisite has

been deferred pending implementation of the Chemistry for Animal Managers course described in the previous paragraph.

Since the ACS Gen Chem II exam is now being utilized in the fall semesters as a pre-test, the scores are expected to be much lower than the published national norms since the national norms reflect the usage of this test as a post-test. This expectation has been born out every year. Data collected from the *pre-test* administration of the ACS Gen Chem II exam are shown below (Table 6 and Charts 1 and 2).

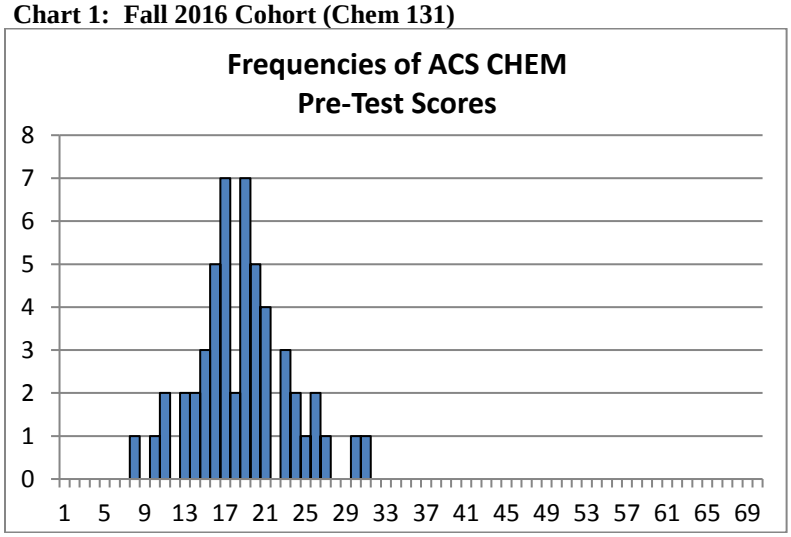
**Table 6: ACS General Chemistry II Exam Raw Scores / Test administered to Chem 131 students in Fall 2016 as a Pre-Test.**

| Student | Score |
|---|---|
| 1 | 20 |
| 2 | 19 |
| 3 | 18 |
| 4 | 16 |
| 5 | 26 |
| 6 | 17 |
| 7 | 16 |
| 8 | 14 |
| 9 | 19 |
| 10 | 17 |
| 11 | 20 |
| 12 | 17 |
| 13 | 15 |
| 14 | 17 |
| 15 | 31 |
| 16 | 10 |
| 17 | 13 |
| 18 | 20 |
| 19 | 19 |
| 20 | 16 |
| 21 | 30 |
| 22 | 18 |
| 23 | 17 |
| 24 | 27 |
| 25 | 25 |
| 26 | 19 |
| 27 | 24 |
| 28 | 17 |
| 29 | 13 |
| 30 | 16 |
| 31 | 21 |
| 32 | 23 |
| 33 | 23 |
| 34 | 15 |
| 35 | 15 |
| 36 | 21 |
| 37 | 8 |
| 38 | 19 |
| 39 | 16 |
| 40 | 17 |
| 41 | 21 |
| 42 | 20 |
| 43 | 23 |
| 44 | 14 |
| 45 | 20 |
| 46 | 24 |
| 47 | 19 |
| 48 | 11 |
| 49 | 21 |
| 50 | 19 |

| | |
|---|---|
| 51 | 11 |
| 52 | 26 |

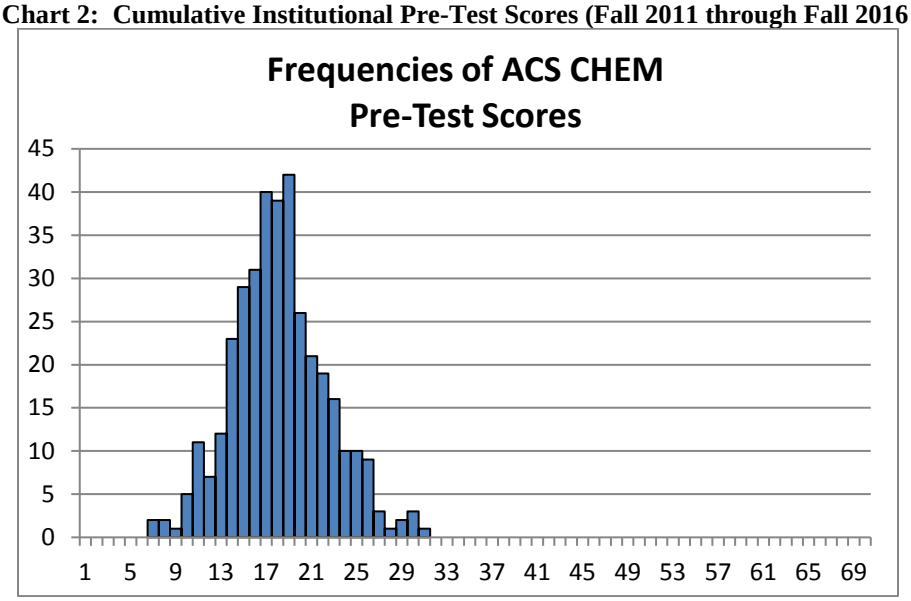
**Class Average:** **18.71**
**Class Median:** **19.00**

**Chart 1: Fall 2016 Cohort (Chem 131)**




**Class Average: 18.71**
**Class Median: 19.00**
*n = 52*

**Chart 2: Cumulative Institutional Pre-Test Scores (Fall 2011 through Fall 2016 Cohorts)**



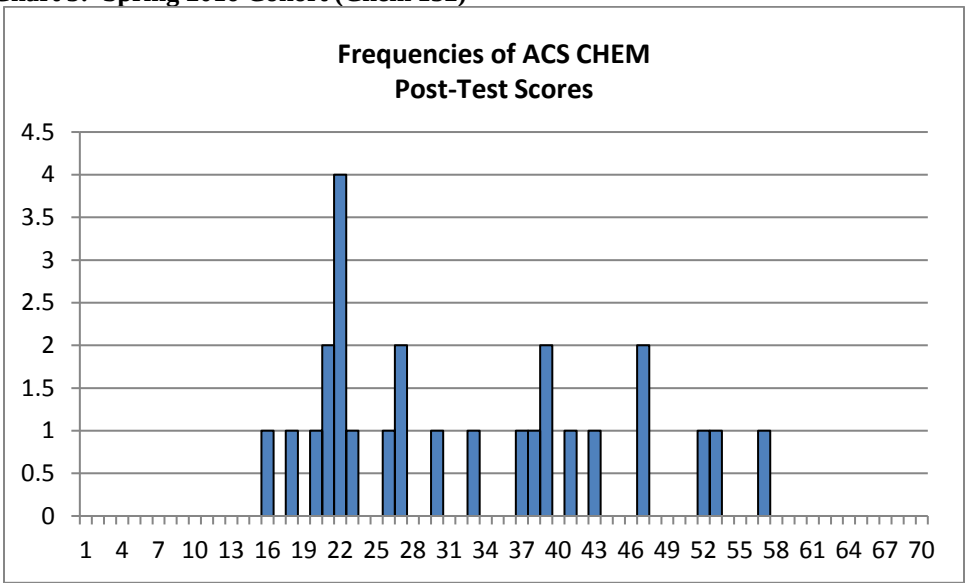

**Institutional Average: 18.28**
**Institutional Median: 18.00**
*n = 365*

When the ACS Gen Chem II exam scores in Table 6 and Charts 1 and 2 above are examined, it is immediately apparent that these scores are much lower than scores we obtain from a post-test scenario. Table 7 and Chart 3 contain data from the post-test utilization of the ACS Gen Chem II Exam at Malone for Spring 2016 and Chart 4 shows a cumulative frequency plot of scores obtained since Spring 2007.

| Table 7: ACS General Chemistry II Exam Raw Scores / Test administered to Chem 132 students in Spring 2016 as a Post-Test. | |
|---|---|
| **Student** | **Score** |
| 1 | 39 |
| 2 | 37 |
| 3 | 52 |
| 4 | 26 |
| 5 | 41 |
| 6 | 21 |
| 7 | 21 |
| 8 | 22 |
| 9 | 27 |
| 10 | 47 |
| 11 | 43 |
| 12 | 22 |
| 13 | 16 |
| 14 | 39 |
| 15 | 22 |
| 16 | 47 |
| 17 | 33 |
| 18 | 18 |
| 19 | 22 |
| 20 | 30 |
| 21 | 23 |
| 22 | 57 |
| 23 | 20 |
| 24 | 53 |
| 25 | 38 |
| 26 | 27 |

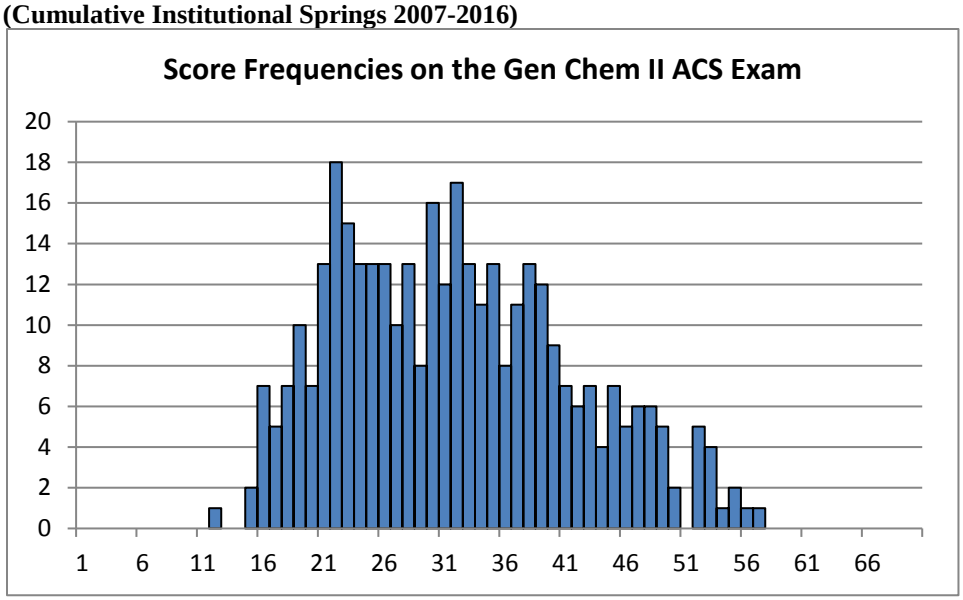
| | |
|---|---|
| **Class Average:** | **32.42** |
| **Class Median:** | **28.5** |
| | |
| **National Average:** | **37.91** |
| **National St. Dev.:** | **10.93** |

**Chart 3: Spring 2016 Cohort (Chem 132)**




**Class Average: 32.42**
**Class Median: 28.5**
*n = 26*

**Chart 4: Frequency Plot of ACS Gen Chem II Exam Scores administered as a Post-Test (Cumulative Institutional Springs 2007-2016)**

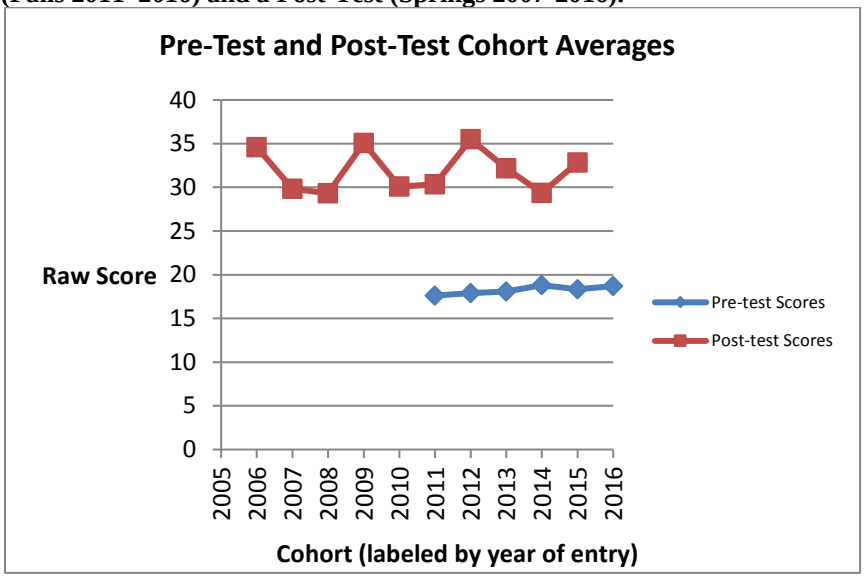



**Institutional Average: 31.88**
**Institutional Median: 31.00**
*n = 359*

We have noticed for several years that Chart 4 above appears to give indication of a bimodal distribution. The apparent bimodality is another argument in favor of our new alternative chemistry course for Zoo & Wildlife Biology majors.

A direct comparison between the six most recent pre-test administrations of the ACS Gen Chem II exam and the last several post-test administrations is readily apparent in Chart 5 below.

**Chart 5: Gen Chem II Exam Scores / Test Administered as a Pre-Test (Falls 2011–2016) and a Post-Test (Springs 2007-2016).**



This report now contains five years of clear evidence of improvement from pre-test to post-test. It is certainly clear at this point that our students are improving in their content knowledge as a result of the General Chemistry sequence. What is not clear is whether the amount of improvement is a respectable amount or even if it meets the "minimum improvement" standard of our department since such a standard has not yet been determined. The five years of student improvement data that have been collected (see Table 8) show an average improvement of 74.4% in scores from pre- to post-test (18.28 to 31.88). It seems that as an initial improvement goal, we would like to make sure that the average improvement doesn't ever dip below 70% and to shoot for 80%. We are also able to see that the maximum pre-test score ever achieved (31) is at or below the average and median post-test scores (31.88 and 31 respectively). These pieces of information seem to affirm the strength of the freshman chemistry sequence. Even with the 74.4% increase in average score, the institutional average for post-test scores at Malone remains below the national average. The cumulative institutional average at Malone would place an average student completing our general chemistry sequence in the 32$^{nd}$ percentile nationally. Also of note is the larger standard deviation for post-test scores than pre-test scores (9.68 vs. 4.15). The larger standard deviation suggests that there is still quite a bit of room for improving each cohort average by decreasing the number of low test scores through one or more of the curricular strategies mentioned earlier.

With five years of student improvement data collected, the department has established a baseline that will serve as a reference for comparison once the anticipated curricular changes are implemented (i.e., Chem 131 prerequisite, Chem 132 prerequisite, and the alternative "Chemistry for Animal Managers" course). The department has reached a point where it is "comfortable" setting a few realistic goals for the freshman chemistry sequence. We would like for the five-year running average on this exam (currently at 31.88) to be raised 2 points or so to about 34. This seems like a challenging yet realistic target. If the ACS exam were to change in the future such that these absolute scores are no longer relevant, we are hoping to see the five-year running percentile rank climb by at least 5 points from its current location (32$^{nd}$ percentile).

By Fall 2018, the department anticipates replacing the ACS exam pre-test with our own in-house Chemistry Exam. Although we will lose the student improvement data over the duration of the freshman chemistry sequence, we will be replacing this piece of information with student improvement data over the entire 4-year chemistry curriculum – something we have not studied to date.

**Table 8: Historical Improvement in the ACS Gen Chem II Exam Scores When Administered as a Pre-Test (Falls 2011–2016) and Again As a Post-Test (Springs 2007-2016).**

| | Pre-Test | Post-Test |
|---|---|---|
| **Sample Size:** | 365 | 353 |
| **Averages:** | 18.28 | 31.88 |
| **Medians:** | 18.00 | 31.00 |
| **St. Deviations:** | 4.15 | 9.68 |
| **Minimum:** | 7.00 | 12.00 |
| **Maximum:** | 31.00 | 57.00 |

*In-house Biology Pre-Test*

Since the Fall of 2008, the biology faculty have been administering a 50-question multiple choice assessment instrument both as a pre-test during the first week of our introductory cell biology course (Biol 144) and again as a post-test to the outgoing seniors. The test was constructed to cover the 4 major sub-disciplines of biology (i.e., cell biology, organismal biology, ecology, and genetics). Beginning in the Fall of 2016, this test was updated with 12 additional questions that cover Anatomy & Physiology content. Since the current version of this assessment now has 62 questions rather than 50, the scores from this version are not directly comparable to previous scores. Data for Fall 2016 are displayed in Table 9 and Chart 6 below.

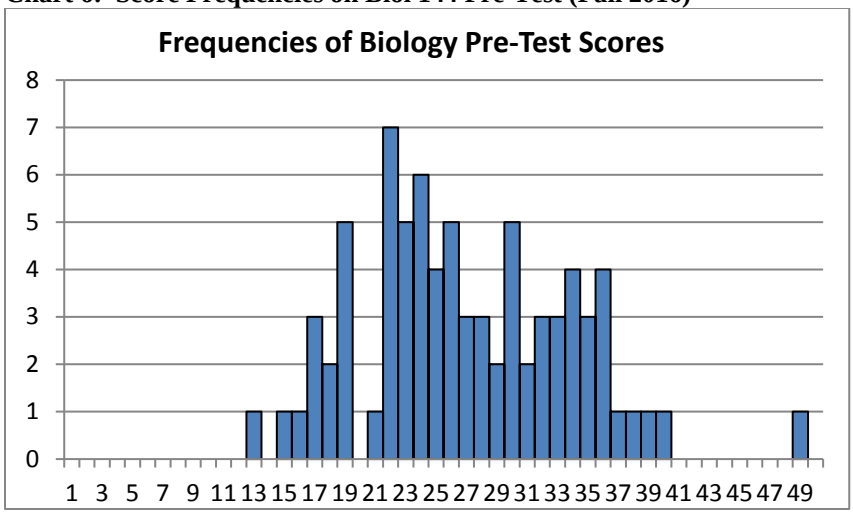
**Table 9: Biology Pre-Test scores for Biol 144 Students (Fall 2016)**

| Student | Biology Pre-Test Raw Score |
|---|---|
| 1 | 25 |
| 2 | 24 |
| 3 | 17 |
| 4 | 22 |
| 5 | 27 |
| 6 | 34 |
| 7 | 18 |
| 8 | 34 |
| 9 | 34 |
| 10 | 25 |
| 11 | 17 |
| 12 | 32 |
| 13 | 40 |
| 14 | 49 |
| 15 | 32 |
| 16 | 23 |
| 17 | 24 |
| 18 | 32 |
| 19 | 25 |
| 20 | 29 |
| 21 | 22 |
| 22 | 22 |
| 23 | 35 |
| 24 | 29 |
| 25 | 19 |
| 26 | 28 |
| 27 | 17 |
| 28 | 36 |
| 29 | 22 |
| 30 | 28 |
| 31 | 23 |
| 32 | 31 |
| 33 | 27 |
| 34 | 35 |
| 35 | 24 |
| 36 | 26 |
| 37 | 22 |
| 38 | 30 |
| 39 | 36 |
| 40 | 37 |
| 41 | 31 |
| 42 | 23 |
| 43 | 28 |
| 44 | 22 |

| | |
|---|---|
| 45 | 19 |
| 46 | 25 |
| 47 | 30 |
| 48 | 19 |
| 49 | 26 |
| 50 | 36 |
| 51 | 33 |
| 52 | 26 |
| 53 | 38 |
| 54 | 22 |
| 55 | 21 |
| 56 | 36 |
| 57 | 33 |
| 58 | 27 |
| 59 | 33 |
| 60 | 24 |
| 61 | 26 |
| 62 | 34 |
| 63 | 16 |
| 64 | 19 |
| 65 | 26 |
| 66 | 30 |
| 67 | 19 |
| 68 | 35 |
| 69 | 30 |
| 70 | 24 |
| 71 | 30 |
| 72 | 13 |
| 73 | 15 |
| 74 | 23 |
| 75 | 39 |
| 76 | 23 |
| 77 | 24 |
| 78 | 18 |

Average: 27.02
Median: 26

**Chart 6: Score Frequencies on Biol 144 Pre-Test (Fall 2016)**



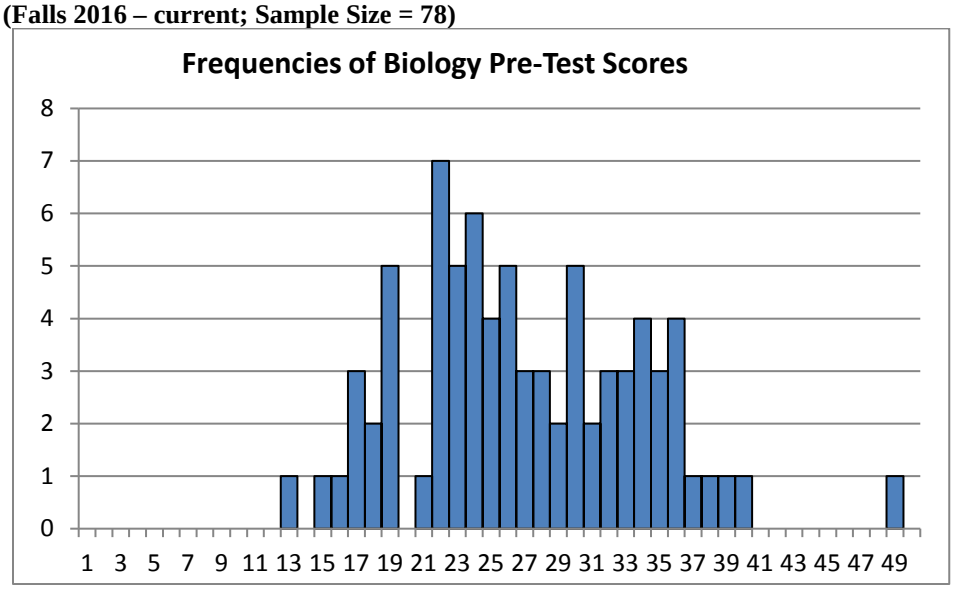

*n = 78*

Since this is the first iteration of the lengthened test, Tables 10 and 11 below contain no additional information than that provided by the previous chart and table; however, the following tables and charts will expand over the next several years with cumulative and running average-type data. They are merely being used as place-holders in this edition of our assessment report.

| **Table 10: In-house Biology Pre-Test Data for Fall 2016 through current cohorts*.** | | | | |
|---|---|---|---|---|
| | *Average* | *Median* | *Range* | *St. Dev.* |
| Fall 2016 | 27.03 | 26 | 13 – 49 | 6.85 |
| Cumulative Institutional | 27.03 | 26 | 13 – 49 | 6.85 |

*Sample size is 78

**Chart 7: Cumulative, Institutional Score Frequencies on Biol 144 Pre-Test (Falls 2016 – current; Sample Size = 78)**



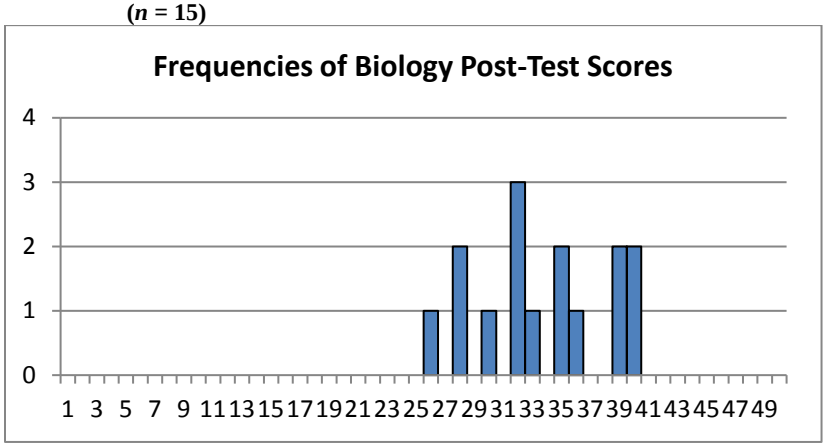

The lengthened test will be administered for the first time as a post-test in Spring 2017. No post-test data for the A&P containing version of this test has been accumulated to-date. However, the 50-question test was administered in Spring 2016, and this data is displayed below.

| **Table 11: Biology Post-Test scores for Spring 2016*** | |
|---|---|
| Student | Biology Post-Test Raw Score |
| 1 | 39 |
| 2 | 32 |
| 3 | 28 |
| 4 | 39 |
| 5 | 28 |
| 6 | 35 |
| 7 | 36 |
| 8 | 26 |
| 9 | 32 |
| 10 | 35 |
| 11 | 40 |

| | |
|---|---|
| 12 | 40 |
| 13 | 33 |
| 14 | 30 |
| 15 | 32 |

**Average:** **33.67**
**Median:** **33**
***Shaded cells, if any, indicate missed criterion.**

**Chart 8: Score Frequencies on Biology Post-Test (Spring 2016) (*n* = 15)**



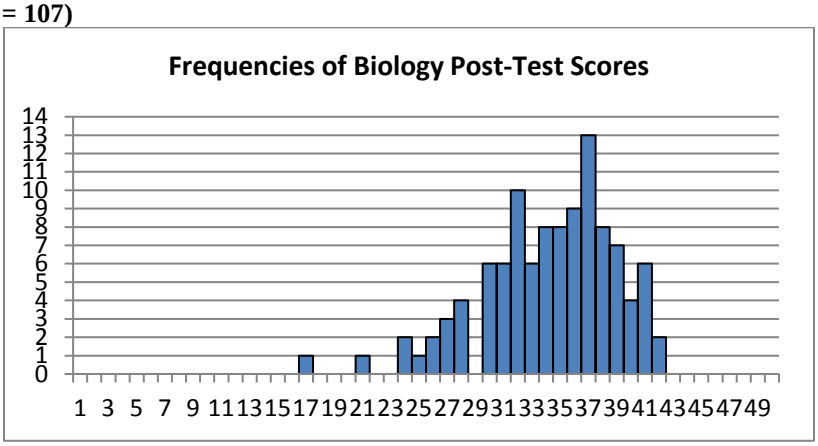

The department has tentatively assigned the following standards for post-test scores: Mean score no lower than 31/50 and no individual score lower than 24/50. Although these criteria were met this year, the fact that additional questions were added to this exam will require the department to set adjusted standards for the newer version of this test. Cumulative institutional average and median scores for the past 7 cohorts of graduates are summarized below in Table 12 and Chart 9.

**Table 12: In-house Biology Post-Test Data for Spring 2010 – Spring 2016 cohorts*.**

| | *Average* | *Median* | *Range* | *St. Dev.* |
|---|---|---|---|---|
| Spring 2010 | 34.93 | 36 | 24 – 41 | 4.88 |
| Spring 2011✠ | 35.92 | 36 | 24 – 42 | 4.68 |
| Spring 2012♦ | 35.82 | 37 | 27 – 42 | 4.42 |
| Spring 2013✞ | 34.37 | 36 | 25 – 41 | 4.46 |
| Spring 2014 | 32.11 | 32 | 21 − 37 | 4.07 |
| Spring 2015 | 34.07 | 35 | 17 – 41 | 5.82 |
| Spring 2016 | 33.67 | 33 | 26 – 40 | 4.56 |
| Cumulative Institutional | 34.30 | 35 | 17 – 42 | 4.75 |

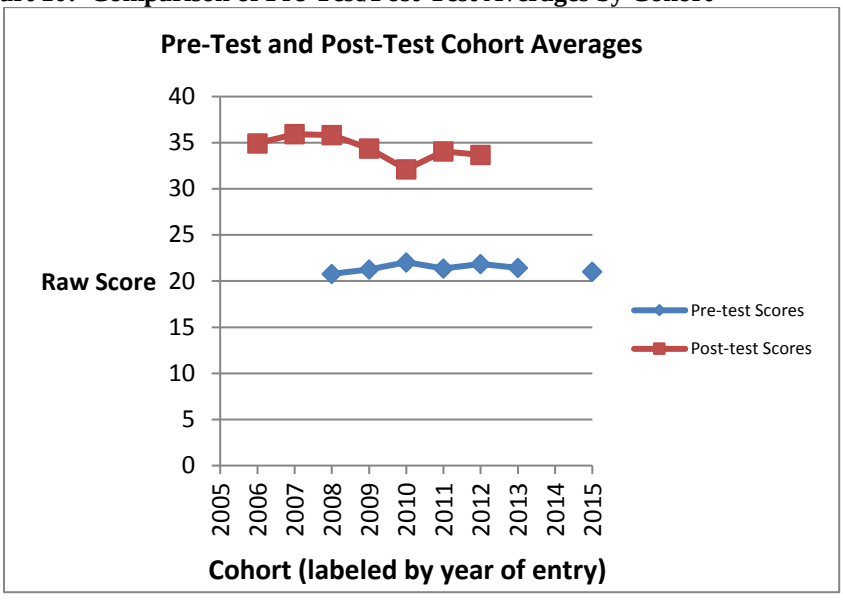
*Sample size is 107
✠Two individuals in this cohort graduated in December of 2011
♦One individual in this cohort graduated in December 2012
✞Three individuals in this cohort graduated in December 2013

**Chart 9: Cumulative Score Frequencies on Biology Post-Test (Springs 2010–2016 : *n* = 107)**




Although this in-house exam has been used as a post-test for the 4-year biology curriculum since Spring 2010, it was first used as a pre-test in Fall 2008. Therefore, only five years of post-test data have been collected that are capable of showing true improvement for a specific cohort over 4 years of instruction (i.e., cohort entering Fall 2008 and exiting Spring 2012, the 2009-2013 cohort, the 2010-2014 cohort, the 2011-2015 cohort, and the 2012-2016 cohort). It is now clearly demonstrable that student learning is occurring when pre-test and subsequent post-test scores are plotted as a function of cohort (see Chart 10). The 2012 cohort which graduated in 2016 demonstrated an increase in both average and median scores (21.86 to 33.67 and 21 to 33 respectively). These represent increases of 54% and 57%. In the past, improvements in the average/median score has approached the mid-70s. These results are lower than we would like them.

**Chart 10: Comparison of Pre-Test/Post-Test Averages by Cohort**



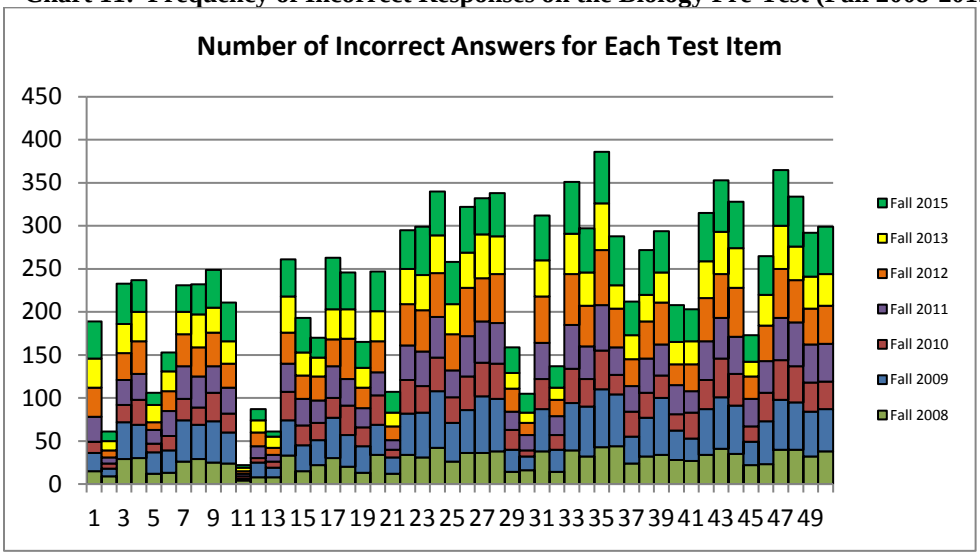

The department has not yet set a criterion of "minimum improvement" for the biology exam. It would certainly seem reasonable that the lowest score of a graduating senior

should be higher than the average incoming freshman score. In addition, the best incoming freshman should not score as well on this exam as the average out-going senior. This year, we note that the lowest post-test score (26 in Spring 2016) was significantly higher than that cohort's average pre-test score (21.86 in Fall 2012) while the average post-test score (33.67 in Spring 2016) was higher than all pre-test scores for the Fall 2012 except one (a single student scored a 35).

This year, the lowest post-test score (26) was significantly higher than that of previous years. Our lowest post-test scores ever (17 in Spring 2015 and 21 in Spring 2014) were problematic for us and prompted concerns that were expressed in previous assessment reports — "it is still possible for some poor students to navigate through our biology programs without reaching an acceptable level of competency". The score of 26 for the low is a significant move in the right direction.

Another significant concern mentioned in last year's report was that the "assessment instrument itself may need to be examined for its appropriateness." Although A&P questions have been added to this exam, we also noted last year that "future alterations are also anticipated". Since the biology pre-test/post-test was constructed in-house at a time when the department was rather novice in its assessment strategies, we have come to realize that this exam has two significant flaws. First, a significant number of questions on this instrument were implemented that have insignificant probative power. Chart 11 below is able to show at a glance that questions 2, 11, 12, 13, and to a lesser extent questions 29, 30, 32, and 45 are all answered exceptionally well by the freshmen. There remains very little room for improvement on these 8 questions by the time these students graduate, so they are not very useful to us.

**Chart 11: Frequency of Incorrect Responses on the Biology Pre-Test (Fall 2008-2015)**




Sample size = 413

Secondly, whereas some of the questions are apparently too easy to gain insight into the knowledge gained by each cohort, other questions pose the opposite problem: they are

too apparently too *difficult* to be of any probative power. We have noted for several years that questions 33, 42, 35, 36, and 27 are routinely missed by over half of our graduating seniors. Last year's report used the following language: "It is possible that these most frequently missed questions were simply too difficult for the post-test or inappropriate in some other way." This means that of the 50 original questions, 13 have very little value in actually documenting student improvement. With such significant room for improvement in the instrument itself, we believe it is time for several of the questions to be replaced with questions of greater utility. Fall 2018 is a realistic timeline for these edits.

With the anticipated overhaul, this may be the last report in which cumulative institutional data on this instrument is displayed. The cumulative pre-test/post-test comparisons show a jump in the average from 21.34 to 34.30 (nearly 61% increase), a jump in the median from 21 to 35 (a 67% increase), a jump in the minimum score from 9 to 17 (89% increase), and an increase in the maximum from 39 to 42 (nearly 8%) as shown in Table 13 below.

**Table13: Historical Improvement in In-House Biology Exam Scores When Administered as a Pre-Test (Falls 2008–2015) and Again As a Post-Test (Springs 2010-2016).**

| | Pre-Test | Post-Test |
|---|---|---|
| Sample Size: | 415 | 107 |
| Averages: | 21.34 | 34.30 |
| Medians: | 21 | 35 |
| St. Deviations: | 5.16 | 4.73 |
| Minimum: | 9 | 17 |
| Maximum: | 39 | 42 |

*Data from ETS Major Field Tests*

In the spring of 2003, we started using the ETS Major Field Test in Biology to test our junior and senior Biology majors, and in the spring of 2004, we began using the ETS Major Field Test in Chemistry for assessing our Chemistry majors. Nevertheless, the extremely small sample size for many of our cohorts makes it impossible to draw any meaningful conclusions based on the performance of a single cohort. Since 10 years have now passed since data collection began, we believe we do have meaningful and significant data. One caution is still worth considering, however. Several of our majors will not have exposure to all of the courses necessary to perform well on all sub-sections of the ETS. For example, our Biology-Clinical Lab Science majors are not to be expected to perform well on questions pertaining to ecology since this course is not required for these students. Additional examples could be cited. To address this issue, the department, beginning in our "Fall 2007 – Fall 2008" reporting cycle, began investigating certain sub-scores in lieu of the composite score for certain majors that legitimately may not be prepared to perform well on all sub-sections of the ETS exam. The specifics of which sub-scores will be examined for each student are described elsewhere in this report when appropriate.

In Spring 2016, 15 students took the ETS major field test in biology. The ETS Field Test in Biology evaluates students in these four content areas: Cell Biology, Molecular Biology and Genetics, Organismal Biology, and Evolution-Ecology-Population Biology. In this particular reporting period, all of the students taking the ETS exam in biology had completed the standard biology core and requisite coursework for inclusion in all sub-score averages and should be expected to perform satisfactorily in all 4 content areas. The scaled composite scores with percentile rankings are provided in Table 14 below and the scaled sub-scores with their respective percentile rankings are provided in Table 15.

**Table 14: Spring 2016 ETS Biology Field Test Scaled Scores and Percentile Rankings.***

| Student | Score | Percentile Ranking |
|---|---|---|
| 1 | 176 | 95 %ile |
| 2 | 155 | 55 %ile |
| 3 | 159 | 66 %ile |
| 4 | 148 | 33 %ile |
| 5 | 139 | 13 %ile |
| 6 | 171 | 90 %ile |
| 7 | 151 | 41 %ile |
| 8 | 135 | 7 %ile |
| 9 | 141 | 17 %ile |
| 10 | 158 | 62 %ile |
| 11 | 147 | 31 %ile |
| 12 | 168 | 85 %ile |
| 13 | 143 | 20 %ile |
| 14 | 146 | 27 %ile |
| 15 | 146 | 27 %ile |
| Mean Scaled Score: | **152.2** | **45 %ile** |
| Cohort Mean Compared to National Institutional Mean: | | **46 %ile♦** |

| | |
|---|---|
| National mean: | **153.0** |
| National median: | *153.0* |
| National st. dev.: | *13.0* |

*National Sample size for Biology major field test is 21,334.
♦This percentile ranking is taken from the ETS institutional means ($n$ = 440, mean =151.9, median = 152, standard deviation = 7.5).

**Table 15: Spring 2016 ETS Biology Field Test Scaled Sub-scores***

| Student | Cell Biology Scaled Score / Percentile | Mol. Biology and Genetics Scaled Score / Percentile | Organismal Biology Scaled Score / Percentile | Pop. Biol, Evolution, and Ecology Scaled Score / Percentile |
|---|---|---|---|---|
| 1 | 78 / 96 %ile | 75 / 93 %ile | 73 / 92 %ile | 67 / 85 %ile |
| 2 | 62 / 72 %ile | 54 / 51 %ile | 58 / 60 %ile | 46 / 28 %ile |
| 3 | 49 / 33 %ile | 57 / 58 %ile | 65 / 80 %ile | 58 / 63 %ile |
| 4 | 54 / 50 %ile | 37 / 9 %ile | 50 / 37 %ile | 50 / 39 %ile |
| 5 | 32 / 3 %ile | 57 / 58 %ile | 39 / 12 %ile | 34 / 7 %ile |
| 6 | 70 / 87 %ile | 57 / 58 %ile | 73 / 92 %ile | 71 / 91 %ile |
| 7 | 49 / 33 %ile | 43 / 20 %ile | 46 / 25 %ile | 62 / 73 %ile |
| 8 | 36 / 6 %ile | 20 / 1 %ile | 46 / 25 %ile | 41 / 19 %ile |

| | | | | |
|---|---|---|---|---|
| 9 | 42 / 17 %ile | 37 / 9 %ile | 46 / 25 %ile | 44 / 23 %ile |
| 10 | 57 / 58 %ile | 57 / 58 %ile | 63 / 75 %ile | 52 / 45 %ile |
| 11 | 49 / 33 %ile | 59 / 65 %ile | 46 / 25 %ile | 39 / 14 %ile |
| 12 | 65 / 78 %ile | 62 / 72 %ile | 63 / 75 %ile | 73 / 93 %ile |
| 13 | 42 / 17 %ile | 52 / 43 %ile | 44 / 20 %ile | 41 / 19 %ile |
| 14 | 36 / 6 %ile | 37 / 9 %ile | 56 / 55 %ile | 50 / 39 %ile |
| 15 | 32 / 3 %ile | 54 / 51 %ile | 46 / 25 %ile | 50 / 39 %ile |
| **Mean Sub-score:** | **50.2 / 41 %ile** | **50.5 / 43 %ile** | **54.3 / 49 %ile** | **51.9 / 45 %ile** |
| **Cohort Mean Compared to National Institutional Mean:** | **33 %ile♦** | **41 %ile♦** | **53 %ile♦** | **50 %ile♦** |
| **National Sub-score mean:** | **53.0** | **52.7** | **53.3** | **52.1** |
| **National Sub-score median:** | **51** | **52** | **54** | **52** |
| **National Standard Deviation:** | **12.9** | **13.3** | **12.9** | **13.3** |

*National Sample size for Biology major field test is 21,334.
♦These percentile rankings are based on ETS institutional means ($n$ = 440, mean =52.2, 52.0, 52.2, and 51.1 respectively; median = 52.0, 52.0 53.0, and 51.0 respectively; standard deviation = 6.3, 6.7, 7.0, and 7.2 respectively).

The performance of this cohort was very near the national average with a composite score in the 46$^{th}$ percentile. This data appears satisfactory, though it represents a significant decline from last year (89$^{th}$ percentile). Four students scored poorly with scores in the lowest quartile (7$^{th}$, 13$^{th}$, 17$^{th}$, and 20$^{th}$ percentile) while only one student scored in the lowest quartile last year. It is worth noting that 2 of the 4 students with poor composite scores (students 5 and 8 in Tables 14 and 15) were transfer students and did not complete their entire biology curriculum at Malone. Student number 5 transferred in 6 biology courses while student number 8 transferred in 5 biology courses.

This cohort produced sub-scores that were near the national average in 3 of the 4 sub-categories (41$^{st}$, 50$^{th}$, 53$^{rd}$ percentile) but performance in the "Cell Biology" category was noticeably lower (33$^{rd}$ percentile). Last year's cohort had scores that were significantly higher across the board (53$^{rd}$, 80$^{th}$, 85$^{th}$, and 88$^{th}$ percentile) for the 4 sub-categories. The historically average-to-above-average scores that we have been obtaining at Malone lead us to believe that this particular cohort's lower sub-scores should not be particularly concerning at this time unless a prolonged downward trend manifests itself. This is especially true given that 2 of the 3 lowest sub-scores were obtained by students who transferred in large numbers of biology courses and did not take the full complement of Malone biology courses.

Our program's criterion for success on the ETS exams is a mean score "no lower than half a standard deviation below the national mean with no student falling below –1.5 $\sigma$." If these criteria are applied, then this cohort's performance at the composite score level was acceptable (see Table 16 below).

| Table 16: Individual Spring 2016 Composite Scores Relative to National Standard Deviation.* | | |
|---|---|---|
| **Student** | **Score** | $\frac{individual\ score - national\ mean}{\sigma}$ |
| 1 | 176 | +1.77 |
| 2 | 155 | +0.15 |
| 3 | 159 | +0.46 |
| 4 | 148 | –0.38 |
| 5 | 139 | –1.08 |
| 6 | 171 | +1.38 |
| 7 | 151 | –0.15 |
| 8 | 135 | –1.38 |
| 9 | 141 | –0.92 |
| 10 | 158 | +0.38 |
| 11 | 147 | –0.46 |
| 12 | 168 | +1.15 |
| 13 | 143 | –0.77 |
| 14 | 146 | –0.54 |
| 15 | 146 | –0.54 |
| Mean Scaled Score: | **152.2** | **–0.06** |
| Comparison with Institutional Mean: | | **+0.04** † |

*Sample size for Biology major field test is 21,334
★Shaded cells, if present, indicate missed criterion; there are none this year.
†This value was calculated using the ETS institutional values ($n$ = 440, mean =151.9, median = 152, standard deviation = 7.5).

At the level of sub-scores, the average sub-scores met the departmental standard (i.e., ≥ –0.5 σ) but three of the individual sub-scores failed to meet the departmental criterion for success (i.e., ≥ –1.5 σ) (see Table 17 below).

| Table 17: Spring 2016 ETS Biology Field Test Scaled Sub-scores Relative to σ★ | | | | |
|---|---|---|---|---|
| **Student** | **Cell Biology** | **Mol. Biology and Genetics** | **Organismal Biology** | **Pop. Biol, Evolution, and Ecology** |
| 1 | +1.94 | +1.68 | +1.53 | +1.12 |
| 2 | +0.70 | +0.10 | +0.36 | –0.46 |
| 3 | –0.31 | +0.32 | +0.91 | +0.44 |
| 4 | +0.08 | –1.18 | –0.26 | –0.16 |
| 5 | –1.63 | +0.32 | –1.11 | –1.36 |
| 6 | +1.32 | +0.32 | +1.53 | +1.42 |
| 7 | –0.31 | –0.73 | –0.57 | +0.74 |
| 8 | –1.32 | –2.46 | –0.57 | –0.83 |
| 9 | –0.85 | –1.18 | –0.57 | –0.61 |
| 10 | +0.31 | +0.32 | +0.75 | –0.01 |
| 11 | –0.31 | +0.47 | –0.57 | –0.98 |
| 12 | +0.93 | +0.70 | +0.75 | +1.57 |
| 13 | –0.85 | –0.05 | –0.72 | –0.83 |
| 14 | –1.32 | –1.18 | +0.21 | –0.16 |
| 15 | –1.63 | +0.10 | –0.57 | –0.16 |
| Mean Sub-score: | **–0.22** | **–0.17** | **+0.08** | **–0.02** |
| Comparison with Institutional Means: | **–0.32** † | **–0.22** † | **+0.30** † | **+0.11** † |

*National Sample size for Biology major field test is 21,334.
★Shaded cells, if present, denote missed criterion.
†These values were calculated using ETS institutional means ($n$ = 440, mean =52.2, 52.0, 52.2, and 51.1 respectively; median = 52.0, 52.0 53.0, and 51.0 respectively; standard deviation = 6.3, 6.7, 7.0, and 7.2 respectively).

We have examined average data over the last several years in order to see if specific and significant trends emerge (see Table 18 below). The population biology-evolution-ecology and organismal sub-categories continue to be our students' stronger content areas and the cell biology and molecular biology/genetics content seems to be our students' weaker areas. This year's results are no exception. These observations merit two comments. First, the institutional success that Malone has enjoyed particularly in the population biology-evolution-ecology and organismal sub-categories is to be expected given the emphasis that our Zoo and Wildlife Biology program places on organismal and ecology content. Second, the fact that our students' cell biology knowledge is not as well developed should then be rectifiable with additional attention in the curriculum in terms of extra course(s) dedicated to this content. Unfortunately, the Zoo and Wildlife Biology program is already an intensive program (up to 74 hours) and expanding the curriculum with additional courses does not seem feasible. More subtle changes are perhaps our best approach for shoring up areas which, though relatively low, are still acceptable and meet departmental criteria.

In Fall 2012, the department added an additional hour of credit to the Introduction to Cell Biology class in an effort to begin addressing the relatively weaker performances of our graduates on the cell biology component of the ETS exam. Impetus for the increase in cell biology content was also supported by noting that introductory cell biology courses at peer institutions are generally 4-credit classes while ours was only 3. This graduating class represents the first cohort that could potentially have been impacted by this curricular change. However, since the cohort as a whole performed more poorly than recent cohorts, it is difficult to draw any meaningful conclusions about the efficacy of this change yet. However, it is interesting that, although this cohort's performance dipped in all 4 sub-categories of the ETS, the dip was smallest in the Cell Biology content.

**Table 18: Malone University Biology ETS Mean Sub-scores Over Last 11 Years***

| **Content Area:** | **Cell Biology** | **Mol. Biology and Genetics** | **Organismal Biology** | **Pop. Biol, Evolution, Ecology** |
|---|---|---|---|---|
| 2006 Student Mean (10 students) | 59.0 | 63.5 | 53.0 | 57.0 |
| 2007 Student Mean (0 students) | No Data | No Data | No Data | No Data |
| 2008 Student Mean (5 students) | 52.6 | 55.2 | 59.8 | 69.0 |
| 2009 Student Mean (19 students) | 51.8 | 51.9 | 54.4 | 59.4 |
| 2010 Student Mean (5 students) | 66.0 | 64.2 | 69.8 | 65.6 |
| 2011 Student Mean (13 students) | 51.5 | 56.3 | 65.0 | 56.8 |
| 2012 Student Mean (12 students) | 54.1 | 51.3 | 61.9 | 55.8 |

| | | | | |
|---|---|---|---|---|
| 2013 Student Mean (19 students) | 51.1 | 53.8 | 57.9 | 61.8 |
| 2014 Student Mean (23 students) | 48.6 | 50.9 | 49.4 | 50.0 |
| 2015 Student Mean (16 students) | 53.9 | 58.8 | 61.1 | 60.4 |
| 2016 Student Mean (15 students) | 50.2 | 50.5 | 54.3 | 51.9 |
| **Cumulative Means:** | **52.48** | **54.43** | **57.14** | **57.29** |
| **Comparison with other Institutional Means:*** | **+0.04σ** | **+0.36σ** | **+0.71σ** | **+0.86σ** |

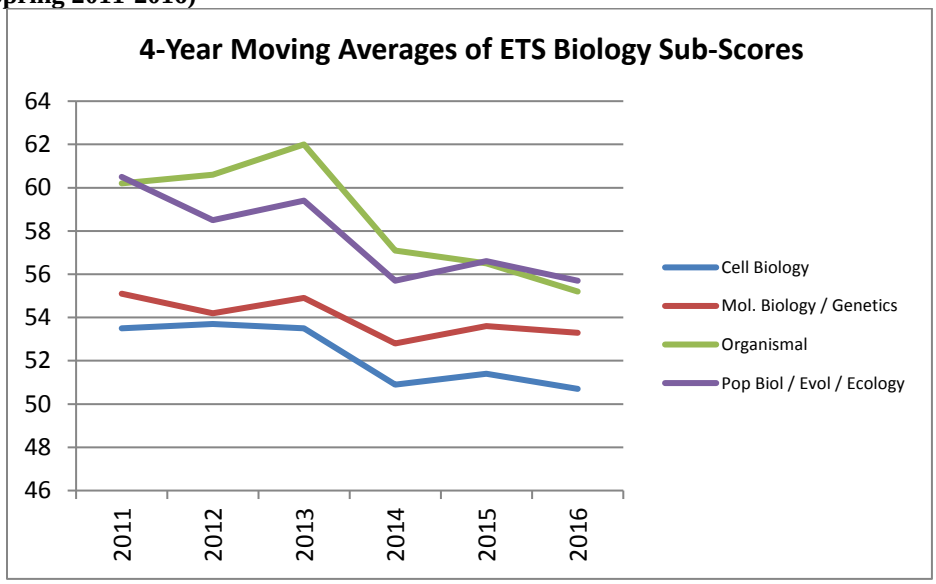
*The ETS exam is changed every several years. Therefore, data prior to the 2006 administration at Malone is not directly compared to the later data, data from 2006-2010 are not directly comparable to other periods, data from 2011-2014 are not directly comparable to other periods, and data from spring 2015-2016 are not directly comparable to other periods. However, the national means for all sub-scores across these periods were very similar and the standard deviations were also very similar. Therefore, all of the data in the table above has been included in the cumulative means as though they were directly comparable. The national means and national σs used in the last row of the table are from the newer 2016 testing period.

As is the case this year, we have in recent years had the occasional single student who still successfully navigated our biology curriculum only to perform extremely poorly on the ETS exam. In most of these cases, the results were more or less predictable based on chronic poor performances in classes with multiple retakes occurring in several instances. We have made reference to this in previous reports and it remains a concern for us. In this particular case, although none of our students had composite scores that were unacceptable, four scores were borderline. As mentioned earlier, two of the four students with borderline scores were transfer students who transferred in large numbers of biology courses (5 and 6 respectively) and aren't products of the full Malone biology education. The other two, though they performed poorly on the ETS exam, did show improvement in the In-House Biology Test (17 to 26 and 25 to 32).

Although this cohort's scores were a little lower than we would like, the average-to-above-average scores achieved by Malone cohorts on the ETS biology exam over the last several years suggest that curricular changes are not warranted at this time. We remain concerned, however, about the occasional student who performs extremely poorly even after successfully completing the program. In previous reports we have pointed out that it is each faculty member's individual responsibility for maintaining adequate course rigor and assigning grades that accurately reflect the degree of content mastery. As mentioned I previous assessment reports, it seems possible that we could address this issue in several ways. For example, the department could establish minimum grades in lower level classes as prerequisites for upper level courses; establish minimum grades in the 4 "pillar" courses of Intro to Cell Biology, Ecology, Genetics, and Vertebrate Zoology; set a maximum number of repeats as was done for our AYA science education programs; raise the minimum major GPA for select programs; or establish a minimum grade on the In-House Biology test for graduation. These approaches have been discussed informally within the department, but no action was deemed necessary at this time.

The Chart 12 below is a fairly new instrument for our departmental reports and shows the moving average of ETS biology sub-scores over time. The trend seems to be obviously downward for all 4 sub-scores since about 2008. Although the reasons aren't known for certain, we do not believe it is due to ineffective curricular changes. Instead, the drop in cohort performance seems to us to coincide with the rapid growth in the popularity of the program and the increased number of students drawn to program. Growing pains can be good, but we will want to watch this in the future to make certain that the program health is not further compromised by additional growth.

**Chart 12: 4-Year Moving Averages of Sub-scores in the ETS Biology Major Field Test (Spring 2011-2016)***




*For example, the 4 sub-score averages for 2016 are institutional averages for the 2013–2016 period.

The ETS major field test in chemistry evaluates students in these four content areas: Physical Chemistry, Organic Chemistry, Inorganic Chemistry, and Analytical Chemistry. Only two students completed the ETS major field test in chemistry in Spring 2016. With an average composite score in the 63rd percentile and sub-scores in the 57th, 76th, 66th, and 41st percentile, the department has reason to be encouraged. This year marks the second year that we have chosen to include a comparison of this cohort's average composite score to the average composite score for other institutions that submit data to ETS. In this regard, Malone's cohort average composite score places Malone in the 69th percentile nationally. At the level of sub-scores, Malone's cohort average sub-scores place Malone in the 54th, 87th, 69th, and 33rd percentile for the four content areas respectively. All scores are reproduced below in Tables 19 – 22.

**Table 19: Spring 2016 ETS Chemistry Field Test Scaled Score and Percentile Ranking***

| Student | Score | Percentile Ranking |
|---|---|---|
| 1 | 149 | 56 %ile |
| 2 | 154 | 67 %ile |
| Mean Scaled Score: | **151.5** | **63 %ile** |

| | | |
|---|---|---|
| Cohort Mean Compared to National Institutional Mean: | | **69 %ile♦** |

| | |
|---|---|
| National mean: | **148.0** |
| National median: | 146 |
| National st. dev.: | 14.6 |

*National Sample size for Chemistry major field test is 8,836.
♦This percentile ranking is taken from the ETS institutional means ($n$ = 220, mean =147.7, median = 148, standard deviation = 9.5).

**Table 20: Spring 2016 ETS Chemistry Field Test Scaled Sub-scores***

| **Student** | **Physical Chemistry** Scaled Score / Percentile | **Organic Chemistry** Scaled Score / Percentile | **Inorganic Chemistry** Scaled Score / Percentile | **Analytical Chemistry** Scaled Score / Percentile |
|---|---|---|---|---|
| 1 | 39 / 27 %ile | 57 / 71 %ile | 56 / 66 %ile | 39 / 26 %ile |
| 2 | 58 / 70 %ile | 60 / 76 %ile | 49 / 52 %ile | 50 / 56 %ile |
| **Mean Sub-score:** | **48.5 / 57 %ile** | **58.5 / 76 %ile** | **52.5 / 66 %ile** | **44.5 / 41 %ile** |
| **Cohort Mean Compared to National Institutional Mean:** | **54 %ile♦** | **87 %ile♦** | **69 %ile♦** | **33 %ile♦** |
| **National Sub-score mean:** | **48.0** | **48.3** | **48.3** | **48.0** |
| **National Sub-score median:** | **45** | **47** | **46** | **47** |
| **National Standard Deviation:** | **15.1** | **14.3** | **14.8** | **14.5** |

*National Sample size for Chemistry major field test is 8,836.
♦These percentile rankings are based on the ETS institutional means ($n$ = 220, mean =47.9, 47.6, 48.4, and 48.0 respectively; median = 48, 48, 48, and 48 respectively; standard deviation = 9.1, 8.7, 8.9, and 8.7 respectively).

Our program's criteria for success on the ETS exams is a mean score "no lower than half a standard deviation below the national mean with no student falling below –1.5 σ." If these criteria are applied, then this cohort's performance at the composite score level is acceptable with a cohort average score of +0.24σ and the lowest individual score of +0.07σ. Results at the sub-score level are also acceptable with cohort average scores of +0.03σ, +0.71σ, +0.28σ, and –0.24σ . The lowest individual score in any of the 4 content areas was –0.61σ. See Tables 21 and 22 below for raw data.

**Table 21: Individual Spring 2016 Composite Score Relative to Standard Deviation.***

| **Student** | **Score** | $\frac{individual\ score - national\ mean}{\sigma}$ |
|---|---|---|
| 1 | 149 | +0.07 |
| 2 | 154 | +0.41 |
| Mean Scaled Score: | **151.5** | **+0.24** |
| Comparison with Institutional Mean: | | **+0.40** |

*National Sample size for Chemistry major field test is 8,836.
★Shaded cells, if present, indicate missed criterion.
†This value was calculated using the ETS institutional values ($n$ = 220, mean =147.7, median = 148, standard deviation = 9.5).

| Table 22: Spring 2016 ETS Chemistry Field Test Scaled Sub-scores Relative to σ* | | | | |
|---|---|---|---|---|
| **Student** | **Physical Chemistry** | **Organic Chemistry** | **Inorganic Chemistry** | **Analytical Chemistry** |
| 1 | –0.60 | +0.61 | +0.52 | –0.62 |
| 2 | +0.66 | +0.82 | +0.05 | +0.14 |
| Mean Sub-score: | **+0.03** | **+0.71** | **+0.28** | **–0.24** |
| Comparison with Institutional Means: | **+0.07** | **+1.25** | **+0.46** | **–0.40 σ** |

*National Sample size for Chemistry major field test is 8,836.

★Shaded cells, if present, denote missed criterion.

†These values were calculated using the ETS institutional values ($n$ = 220; mean =47.9, 47.6, 48.4, and 48.0 respectively; median = 48, 48, 48, and 48 respectively; standard deviation = 9.1, 8.7, 8.9, and 8.7 respectively).

The chemistry program has had very small enrollments since its inception, therefore, drawing any conclusions about the strength of the curriculum from the limited number of composite scores is not statistically sound. Some individuals have performed extremely well while others have performed extremely poorly. The range of percentile rankings over the timeframe that ETS results have been acquired extends from 4th to 96th. The same hesitancy should be applied to sub-scores. Nevertheless, with over 10 years of data collection, we have begun drawing tentative conclusions about the relative strengths of the chemistry program content areas in recent assessment reports. The institutional scores over the last several years for the ETS chemistry exam are summarized below (Table 23).

| Table 23: Malone University Chemistry ETS Mean Sub-scores Over Last 11 Years* | | | | |
|---|---|---|---|---|
| **Content Area:** | **Physical** | **Organic** | **Inorganic** | **Analytical** |
| 2006 Student Mean (2 students) | 51.0 | 50.0 | 58.0 | 39.5 |
| 2007 Student Mean (0 students) | No Data | No Data | No Data | No Data |
| 2008 Student Mean (1 student) | 33 | 37 | 38 | 33 |
| 2009 Student Mean (1 student) | 60 | 42 | 84 | 68 |
| 2010 Student Mean (0 students) | No Data | No Data | No Data | No Data |
| 2011 Student Mean (◊0, 0, 2, 2 scores respectively)◊ | No Data | No Data | 47.5 | 46 |
| 2012 Student Mean (◊2, 1, 3, 2 scores respectively)◊ | 53 | 55 | 56.7 | 55.5 |
| 2013 Student Mean (◊3, 4, 4, and 3 scores respectively) | 49.3 | 53.0 | 52.0 | 58.7 |
| 2014 Student Mean (5 students) | 47.2 | 48.0 | 53.8 | 51.4 |
| 2015 Student Mean (3 students) | 51.7 | 61.0 | 56.7 | 50.7 |

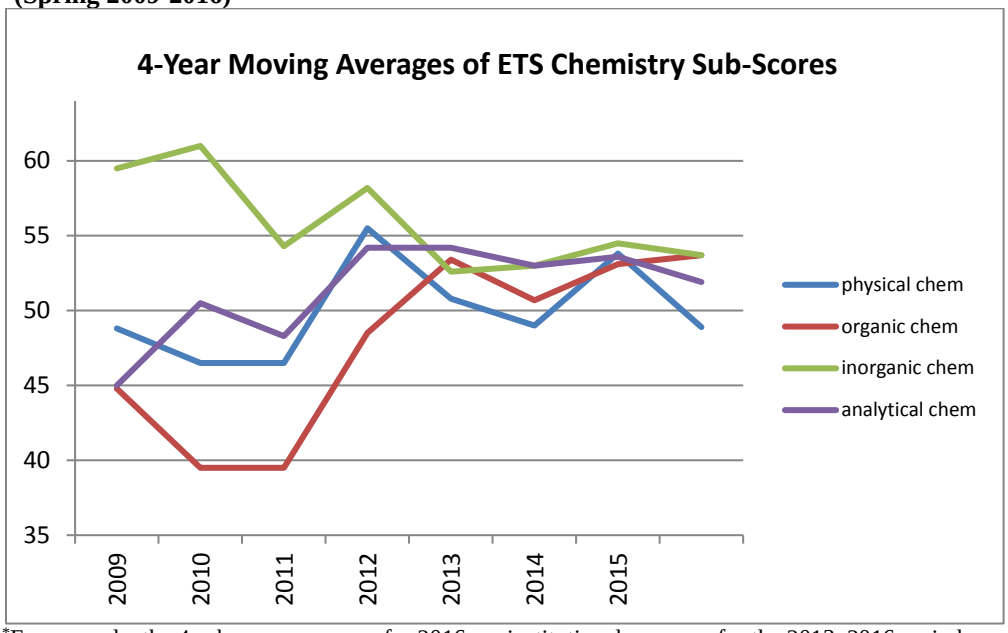
| | | | | |
|---|---|---|---|---|
| 2016 Student Mean (2 students) | 48.5 | 58.5 | 52.5 | 44.5 |
| **Cumulative Means:** | **49.3** | **51.9** | **54.6** | **50.3** |
| **Comparisons with σ:** | **+0.09** | **+0.25** | **+0.43σ** | **+0.16** |
| **Comparison with other Institutional Means:** | **+0.15** | **+0.49** | **+0.70** | **+0.26** |

*The ETS exam is changed every several years. Therefore, data prior to the 2006 administration at Malone is not directly compared to the later data, data from 2006-2011 are not directly comparable to other periods, and data from 2012-2016 are not directly comparable to other periods. However, the national means for all sub-scores across these periods were very similar and the standard deviations were also very similar. Therefore, all of the data in the table above has been included in the cumulative means as though they were directly comparable. The national means and national σs used in the last row of the table are from the 2012–2016 testing period.

The organic chemistry instructor altered the course content for the organic chemistry sequence in Fall 2010 – Spring 2011 in an effort to increase what he perceived to be low organic sub-score data in 2009. In addition, the instructor employed an "inverted classroom" since Fall 2011 in the first semester course of the sequence. If these changes could stimulate better performances on the organic section of the ETS, the results should be evident for the first time beginning in Spring 2015. It is heartening to note that the average organic sub-scores in both Spring 2015 and 2016 are the highest they have been in 10 years. Last year, one student achieved an organic sub-score of +2.26σ placing this student in the 97$^{th}$ percentile nationally. Although no single individual was quite as spectacular this year, this year's organic sub-score average was still very good (+0.71σ). When this cohort's average organic sub-score is compared to other institutional averages for the organic sub-score, the comparison is particularly impressive (+1.25σ). It can't be emphasized enough, though, that this is an extremely small class size (2 students this year). Although it is too early to say if the pedagogical changes in organic chemistry are responsible for these strong increases, the recent improvement seems promising. The results seem to warrant the implementation of an "inverted classroom" in the second semester as well. The professor has begun preparing for a switch to an "inverted classroom" in the second semester, but this change is realistically several years away from being implemented.

Chart 13 below is relatively new in these assessment reports and shows the moving average of chemistry ETS sub-scores over time. This type of chart might enable us to more quickly ascertain changes in the effectiveness of different components of our chemistry curriculum.

**Chart 13: 4-Year Moving Averages of Sub-scores in the ETS Chemistry Major Field Test (Spring 2009-2016)***




*For example, the 4 sub-score averages for 2016 are institutional averages for the 2013–2016 period.

*Data from the ACS General Chemistry Exam*

The Chemistry Review team of 2006 recommended ACS standardized exams as a supplemental means assessing our chemistry program. A direct result of this review has been the implementation of ACS standardized exams in our General Chemistry and Organic Chemistry sequences. The Organic Chemistry test covers two semesters of content while the General Chemistry test is primarily focused on the 2nd semester content of a typical introductory chemistry sequence. These tests have been administered since Spring 2007. Raw scores for the most recent General Chemistry exam are presented below in Table 24.

**Table 24: Spring 2016 ACS General Chemistry Exam Raw Scores[❀]**

| Student | Score | Score relative to σ |
|---|---|---|
| 1 | 39 | +0.10 |
| 2 | 37 | –0.08 |
| 3 | 52 | +1.29 |
| 4 | 26 | –1.09 |
| 5 | 41 | +0.28 |
| 6 | 21 | –1.55 |
| 7 | 21 | –1.55 |
| 8 | 22 | –1.46 |
| 9 | 27 | –1.00 |
| 10 | 47 | +0.83 |
| 11 | 43 | +0.46 |
| 12 | 22 | –1.46 |
| 13 | 16 | –2.00 |
| 14 | 39 | +0.10 |
| 15 | 22 | –1.46 |
| 16 | 47 | +0.83 |
| 17 | 33 | –0.45 |
| 18 | 18 | –1.82 |
| 19 | 22 | –1.46 |

| | | |
|---|---|---|
| 20 | 30 | –0.72 |
| 21 | 23 | –1.36 |
| 22 | 57 | +1.75 |
| 23 | 20 | –1.64 |
| 24 | 53 | +1.38 |
| 25 | 38 | +0.01 |
| 26 | 27 | –1.00 |

| | | |
|---|---|---|
| **Cohort Mean Score:** | **32.42** | **–0.50** |
| **Cohort Median Score:** | **28.5** | |
| ***National mean:** | **37.91** | |
| **National stand. dev.:** | **10.93** | |

*National Data drawn from 1315 students in 16 colleges
*Shaded cells, if any, indicate missed criteria set by the department

Last year's average ACS Gen Chem II Exam score was the lowest obtained at any point in the last 10 years (29.14) at Malone, and we have discussed perennially low scores on this instrument in several assessment reports in recent years. The student mean on the ACS Gen Chem Exam this year (32.42) is a significant improvement over last year (up to 32nd percentile) but it is still below the national average and has been so consistently for the last ten years. This by itself is not as troublesome to us as it was several years ago for at least 5 reasons. First, California Chemistry Diagnostic Test data collected at Malone for a three-year period (Fall 2008 – Fall 2010) have shown that our incoming freshman chemistry students score well below the national average on standardized chemistry placement exams before the course even starts. It therefore seems reasonable that our course completers will be below the national average as well, even if significant improvement occurs during the course sequence. Second, our general chemistry sequence has been a catch-all course for a wide variety of majors. As mentioned elsewhere in this report, the department will be implementing an alternative second semester chemistry course for Zoo & Wildlife biology majors beginning in Spring 2017. When this course is implemented, we expect that the ACS Gen Chem II exam scores will rise as it begins to test a more relevant body. Third, we can now say conclusively that significant improvement is occurring in this sequence now that we have been using the ACS Gen Chem II exam as a pre-test / post-test for the sequence. Fourth, the national data for the ACS General Chemistry II exam only involves data from 16 colleges and might not be the most valid instrument for making national comparisons. Finally, the ETS major field test in chemistry, a more widely utilized test, suggests that our chemistry students finish close to the national average if not slightly above. A summation of data from the last 10 years is presented below in Tables 25 and 26.

**Table 25: Average Scores on ACS Gen Chem II Exam and CCDT* at Malone (Spring 2007 – Spring 2016).**

| Year | Average ACS Gen Chem II Score (percentile) | Cohort's Score on CCDT for previous Fall Semester |
|---|---|---|
| Spring 2007 | 34.58 (41st %ile) | |
| Spring 2008 | 29.84 (27th %ile) | |
| Spring 2009 | 29.32 (24th %ile) | 19.72 (22nd %ile) |
| Spring 2010 | 35.06 (41st %ile) | 20.42 (30th %ile) |
| Spring 2011 | 30.08 (27th %ile) | 16.30 (12th %ile) |

| | | |
|---|---|---|
| Spring 2012 | 30.36 (27th %ile) | |
| Spring 2013 | 35.50 (44th %ile) | |
| Spring 2014 | 32.18 (32nd %ile) | |
| Spring 2015 | 29.14 (24th %ile) | |
| Spring 2016 | 32.42 (32nd %ile) | |
| **Cumulative Institutional Average** | 31.88 (32nd %ile) | 20.13 (30th %ile) |
| *The CCDT was last used in Fall 2010 and has been supplanted with the ACS Gen Chem II exam as a pre-test (see also Table 26). | | |

**Table 26: Comparison of Average Pre-Test/Post-Test ACS Gen Chem II Exam Scores**

| Year | Average Pre-Test ACS Gen Chem II Score (percentile) | Average Post-Test ACS Gen Chem II Score (percentile) |
|---|---|---|
| 2006-2007 | -- | 34.58 (41st %ile) |
| 2007-2008 | -- | 29.84 (27th %ile) |
| 2008-2009 | -- | 29.32 (24th %ile) |
| 2009-2010 | -- | 35.06 (41st %ile) |
| 2010-2011 | -- | 30.08 (27th %ile) |
| 2011-2012 | 17.62 (2nd %ile) | 30.36 (27th %ile) |
| 2012-2013 | 17.91 (2nd %ile) | 35.50 (44th %ile) |
| 2013-2014 | 18.09 (2nd %ile) | 32.18 (32nd %ile) |
| 2014-2015 | 18.81 (3rd %ile) | 29.14 (24th %ile) |
| 2015-2016 | 18.35 (2nd %ile) | 32.42 (32nd %ile) |
| 2016-2017 | 18.71 (3rd %ile) | **IN PROGRESS** |
| **Cumulative Institutional Average** | **18.28 (2nd %ile)*** | **31.85 (32nd %ile)♦** |
| *Sample size of Pre-test takers = 365<br>♦Sample size of Post-test takers = 353 | | |

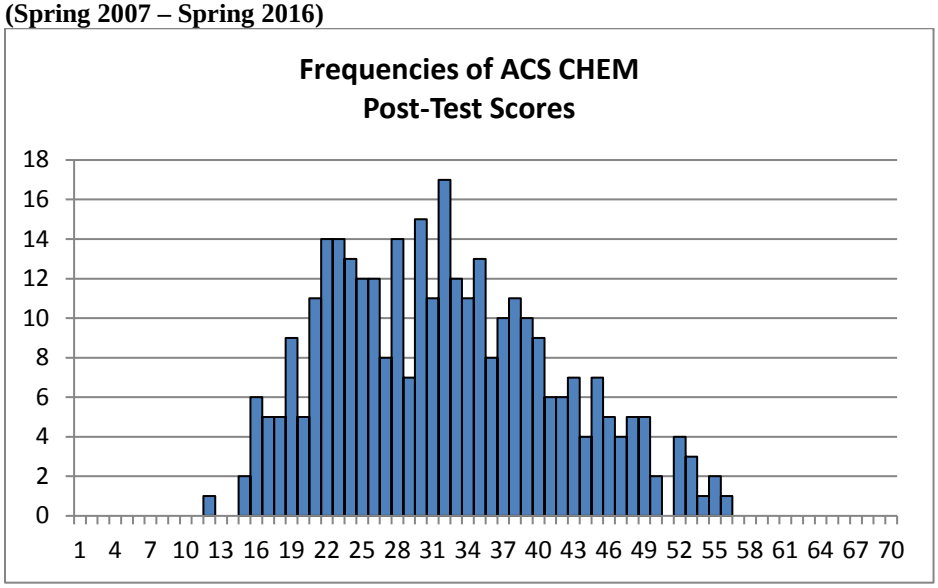
As seen above, the Malone General Chemistry students have shown a significant improvement in their average ACS Gen Chem II exam scores from the 2nd percentile to the 32nd percentile. It occurred to us, though, that the improvement in the average score might be due to the poorer students taking the ACS Gen Chem exam as a pre-test, pulling the pre-test average down, and then not completing the second half of the sequence. This would leave only the better students in the course to take the ACS Gen Chem II exam as a post-test. To address this possibility, Table 27 below shows only the pre-test and post-test scores of these who have completed both courses in the sequence at Malone. Still, the average improves (3rd percentile to 30th percentile). It is clear, now, that the improvement in the percentile rankings is due, in part, to the instruction they receive at Malone.

| Table 27: Comparison of the Average Pre-Test/Post-Test ACS Gen Chem II Exam Scores for Sequence Completers Only | | | |
|---|---|---|---|
| **Year** | **Number of Completers in Cohort** | **Average Pre-Test ACS Gen Chem II Score (percentile)** | **Average Post-Test ACS Gen Chem II Score (percentile)** |
| 2011-2012 | 36 | 17.47 (2nd %ile) | 30.36 (27th %ile) |
| 2012-2013 | 32 | 20.22 (5th %ile) | 35.13 (41st %ile) |
| 2013-2014 | 37 | 18.57 (3rd %ile) | 30.59 (28th %ile) |
| 2014-2015 | 36 | 19.67 (5th %ile) | 28.78 (24th %ile) |
| 2015-2016 | 23 | 18.26 (2nd %ile) | 33.52 (38th %ile) |
| 2016-2017 | 21 | 18.90 (3rd %ile) | **In Progress** |
| **Cumulative Institutional Average*** | | **18.85 (3rd %ile)♦** | **31.44 (30th %ile)*** |

*Sample size is 164 through completion of Spring 2016.
♦Sample size is 185 for fall pre-test cumulative data.

A frequency plot for ACS Gen Chem exam scores accumulated over the last 10 years is provided below (Chart 14).

**Chart 14: Score Frequencies on ACS Gen Chem Standardized Exam (Spring 2007 – Spring 2016)**




**Sample Size = 353**
**Institutional Average: 31.85**
**Institutional Median: 31**

By the departmental standards for success on nationally normed instruments, no student should score lower than 21.5 on the ACS Gen Chem Exam (i.e., $-1.5\sigma$). This year, 5 students fell short of this standard and the chart above clearly shows that a very large number of students have failed to meet this criterion over the last 10 years (44 students out of 353 ; 12.5% ). As we have mentioned previously, we now believe that this instrument is not providing us with valid nationally normed data. This instrument remains, however, a relatively inexpensive means of demonstrating improvement or decline in the quality of individual cohorts and/or instruction over time in the General Chemistry sequence. Therefore, the number of students failing to meet the

–1.5σ minimum is no longer important to us in absolute terms. Rather, we will be using this number merely as it reflects institutional changes. We would like to see this number drop over time, or, at worst, hold steady.

One way that we could potentially cause improvement in these numbers was addressed by the department this year. The department approved an alternative second semester chemistry course for our Zoo & Wildlife Biology students. There have been delays in the anticipated first-offering of this course, but the course has now been officially scheduled for Spring 2017. The apparent bimodality of the chart above is further support that this approach is probably warranted. The impact of this curricular change will be available beginning in the 2017 Assessment Report.

*Data from ACS Organic Chemistry Exam*

Data generated by the most recent ACS Organic Chemistry exam is presented below in Tables 28 and 29.

**Table 28: Spring 2016 ACS Organic Chemistry Exam Raw Scores***

| Student | Score | Score relative to σ |
|---|---|---|
| 1 | 19 | –1.66 |
| 2 | 39 | –0.02 |
| 3 | 37 | –0.18 |
| 4 | 21 | –1.50 |
| 5 | 35 | –0.35 |
| 6 | 35 | –0.35 |
| 7 | 26 | –1.09 |
| 8 | 45 | +0.48 |
| 9 | 40 | +0.06 |
| 10 | 34 | –0.43 |
| **Mean Score:** | **33.10** | **–0.50** |

**National mean:** **39.22***
**National stand. dev.:** **12.16***

**The National Sample size for the ACS Organic Chem exam is 3592.*
▾*Shaded cells, if any, indicated missed criterion.*

**Table 29: Average Scores on ACS Organic Chem Exam at Malone for Last 10 Years.**

| Year | Average ACS Organic Chem Score | Cohort's score relative to national standard deviation |
|---|---|---|
| Spring 2007 | 38.43 (48th %ile) | –0.06 |
| Spring 2008 | 36.71 (45th %ile) | –0.21 |
| Spring 2009 | 31.88 (32nd %ile) | –0.60 |
| Spring 2010 | 32.89 (34th %ile) | –0.52 |
| Spring 2011 | 40.71 (55th %ile) | +0.12 |
| Spring 2012 | 35.00 (40th %ile) | –0.35 |
| Spring 2013 | 40.17 (53rd %ile) | +0.08 |
| Spring 2014 | 35.92 (42nd %ile) | –0.27 |
| Spring 2015 | 36.45 (42nd %ile) | –0.23 |
| Spring 2016 | 33.10 (34th %ile) | –0.50 |

| | | |
|---|---|---|
| **Cumulative Institutional Average** | **36.39 (45th %)** | **–0.20** |

n = 102

The Spring 2016 data fell shy of one departmental criterion on this instrument. Although the class average barely met the standard for the cohort in the aggregate (i.e., cohort average of –0.50σ), one student score was pretty low (–1.66σ) missing the standard for individuals. The Spring 2016 cohort average of –0.50σ means that the cohort average has exceeded or just met this departmental criterion for success for the last 6 years in a row. This information, coupled with the average-to-above-average performance on the ETS organic section for the last 6 years in a row is encouraging. However, our optimism is being held in check for the following reason. Note that the strong performances *by seniors* on the chemistry ETS major field test in Spring 2015 and Spring 2016 is expected in light of their work *as sophomores* on the Spring 2013 and Spring 2014 ACS Organic Exam. The lower performance on the ACS Organic Exam this spring intimates that Spring 2018 ETS scores might dip. We will be watching for this.

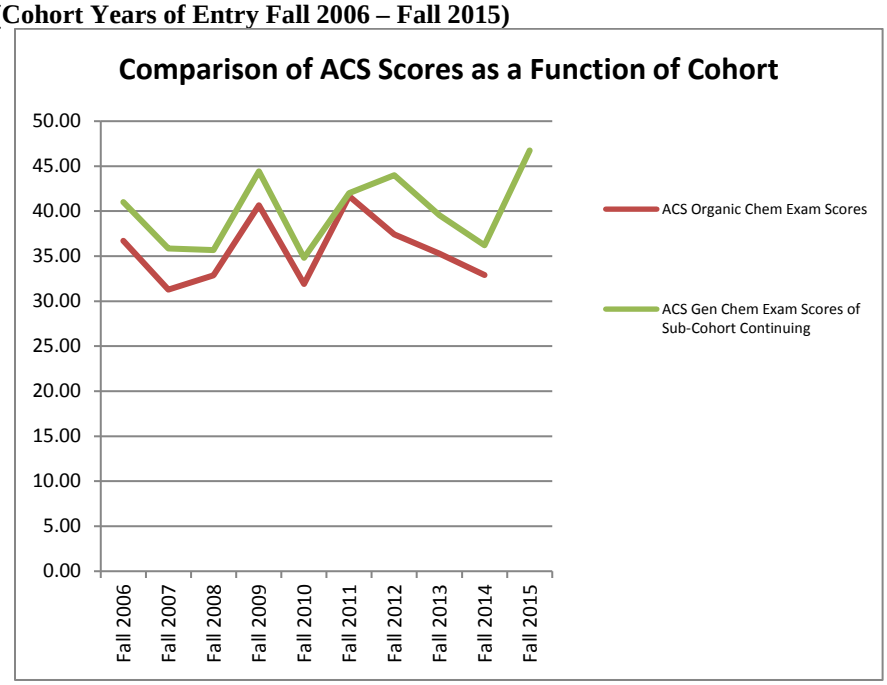
For several years, now, we have also been tracking the performance of a given chemistry cohort through their first 2 years. When the average score of each cohort on the ACS Organic Chem Exam is compared to their ACS Gen Chem II score, a clear pattern has emerged (see Table 30). The relative strengths of each cohort are clearly seen with the weaker cohorts in general chemistry going on to become relatively weak cohorts in organic chemistry and stronger cohorts in general chemistry going on to become relatively strong cohorts in organic chemistry. When the ACS Gen Chem Exam scores of those students continuing on into organic chemistry are extracted from the aggregate ACS Gen Chem II scores, averaged, and plotted alongside the ACS Organic Chem Exam average as in Chart 15 below, the pattern becomes even clearer. This relationship has established a baseline against which the impact of the "inverted classroom" pedagogy might be evident.

**Table 30: Comparison of Cohort Average Scores on ACS Organic Chem Exams and Gen Chem II Exams for Last 10 Years.**

| Cohort Year of Entry | Cohort's Score on ACS Gen Chem II Exam (percentile) | Cohort's Score on ACS Organic Chem II Exam (percentile) |
|---|---|---|
| Fall 2006 | 34.58 (41st %ile) | 36.71 (45th %ile) |

| | | |
|---|---|---|
| Fall 2007 | 29.84 (27th %ile) | 31.29 (29th %ile) |
| Fall 2008 | 29.32 (24th %ile) | 32.89 (34th %ile) |
| Fall 2009 | 35.06 (41st %ile) | 40.67 (55th %ile) |
| Fall 2010 | 30.08 (27th %ile) | 31.91 (32nd %ile) |
| Fall 2011 | 30.26 (27th %ile) | 41.67 (58th %ile) |
| Fall 2012 | 35.12 (41st %ile) | 37.43 (45th %ile) |
| Fall 2013 | 32.18 (32nd %ile) | 35.29 (40th %ile) |
| Fall 2014 | 29.14 (24th %ile) | 33.10 (34th %ile) |
| Fall 2015 | 32.42 (32nd %ile) | **IN PROGRESS** |

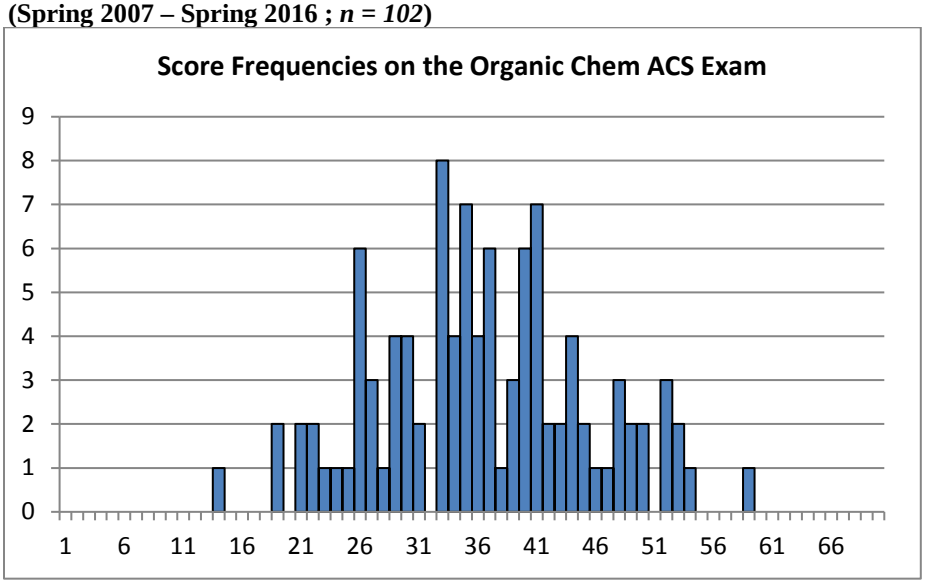
**Chart 15: Comparison of the Average ACS Organic Chem II Exam Score with the Average ACS General Chem II Exam Score for Continuing Students only. (Cohort Years of Entry Fall 2006 – Fall 2015)**




The Fall 2011 cohort showed a spike in the ACS Organic Exam score relative to the expected score based on its ACS General Chemistry Exam score. This was exciting, because this was near the time that the "inverted classroom" pedagogy was implemented in organic chemistry. However, the anomalous drop in the ACS Organic Chem Exam score the following year has tempered our enthusiasm. The Fall 2013 cohort produced an ACS Organic Chem Exam score closer to the baseline expectation. We expect that the Spring 2017 ACS Organic Exam scores will increase given this cohort's performance on the Gen Chem II exam this spring semester. It might take a few more years to see if the undulations stabilize at a new normal or not. If a negative trend develops, the "inverted classroom" pedagogy may need to be dropped or altered in some way. Before we would do this however, we would want confirmatory evidence in the ETS exams that the "inverted classroom" has not been successful.

Cumulative institutional score frequencies for the last 10 years of data are summarized in Chart 16 below.

**Chart 16: Institutional Score Frequencies on ACS Organic Chem II Standardized Exam (Spring 2007 – Spring 2016 ; *n = 102*)**




*Data from the ACS Inorganic Chemistry Exam*

Spring 2016 marked the fourth time that the ACS Inorganic Chemistry exam has been utilized at Malone. Since this course is offered roughly once every other year, data is not accumulated as readily as in the annual courses. The data from the last 4 offerings are presented in Table 31 below. The cohort average score of 26.17 met the departmental criterion for success ($-0.27\sigma > -0.50\sigma$), and all students met the –1.50s criterion.

In spite of these encouraging numbers, the sample size for the nationally administered standardized exam is only 186. Limited conclusions can be drawn from this data at this time.

**Table 31: Spring 2016 ACS Inorganic Chemistry Exam Raw Scores* This table contains no new data.**

| Student | Score | Score relative to σ |
|---|---|---|
| 1 | 22 (24th %ile) | –0.79 |
| 2 | 24 (31st %ile) | –0.54 |
| 3 | 38 (89th %ile) | +1.19 |
| 4 | 26 (41st %ile) | –0.29 |
| 5 | 27 (44th %ile) | –0.17 |
| 6 | 20 (15th %ile) | –1.03 |
| Mean Score: | **26.17 (41st %ile)** | **–0.27** |

| | |
|---|---|
| National mean: | **28.38** |
| National stand. dev.: | **8.10** |

**The Sample size for the ACS Inorganic exam is 186.*

A total of 25 Malone students in 4 cohorts have now completed this exam. The cumulative data for all 4 offerings are shown below in Table 32.

**Table 32: Average Scores on ACS Inorganic Chem Exam at Malone Since Spring 2009.***

| Year | Average ACS Inorganic Chem Score | Cohort's score relative to national standard deviation |
|---|---|---|
| Spring 2009 (*n = 4*) | 28.50 (56$^{th}$ %ile) | +0.01 |
| Spring 2012 (*n = 6*) | 27.67 (49$^{th}$ %ile) | –0.09 |
| Spring 2014 (*n = 9*) | 25.67 (41$^{st}$ %ile) | –0.33 |
| Spring 2016 (*n = 6*) | 26.17 (41$^{st}$ %ile) | –0.27 |
| **Cumulative Institutional Average** | **26.72 (44$^{th}$ %ile)** | **–0.20σ** |

**The Sample size for the ACS Inorganic exam is 186.*

*Data from Instrumental Analysis Assignments*

As mentioned elsewhere in this report, the chemistry program underwent an external review in Fall 2014. Among the changes suggested by the external reviewers, several seemed particularly reachable with minimal effort. For example, the reviewers noted the following:

> *…the faculty should consider revising the assessment plan to address more thoroughly the entire set of equipment chemistry majors get experience with in their studies. Currently, the equipment noted seems primarily connected to organic chemistry. Such assessment could also be very valuable to students in helping them demonstrate their skills as they pursue graduate school or jobs in industry.*

The reviewers correctly noted that the equipment referenced in this assessment instrument (i.e., IR, $^{1}$H–NMR, $^{13}$C-NMR, and MS) were most strongly connected to the organic chemistry sequence. The department therefore responded to the deficiency noted by the reviewers by opting to reword PILO E in last year's assessment report and incorporate additional equipment techniques into its assessment strategy for this PILO. The new wording for PILO E makes reference to GC techniques, UV-VIS, AA, and Gel Electrophoresis.

It has been over a year since the PILO change, and the new assessment instruments have not yet been developed. Their development has been hampered by the fact that one of the professors responsible for developing 2 of these assessment instruments retired this year. The new hire is swamped with the typical duties of a first-year faculty member, so the development of these instruments is expected to take perhaps another couple of years. The two other newer assessment instruments are under development. Therefore, the data below pertain to the original assignments and their iterations.

Since 2007, students in our Chem 322 course (Organic Chemistry II) have been expected to complete 5 assignments (20 points each) related to data interpretation. The assignments underwent some formatting/grading changes in 2012 and "enforcement" was intensified as well. These assignments have consisted of 2 Mass Spectral analysis assignments, 2 NMR Spectral analysis assignment(s), and 1 IR Spectral analysis assignment. These assignments are essentially take-home quizzes because the students are not allowed to work together on the assignments. Prior to 2012, the instructor had the students submit their assignments for grading, and, in the event that the student did not achieve the grade they desired, they were allowed to repeat the assignment as often as they wanted until they performed at a level that met their expectations. Unfortunately, some students would run out of time in the semester and either not complete one of the assignments at all or never achieve grades that the instructor felt were satisfactory. Some students would even opt to not complete an assignment because they had already achieved a grade they were satisfied with. Thus, a minimum grade of 15/20 was instituted for each assignment, and students who failed to obtain 15/20 on each and every assignment were given final grades of "incomplete" until the assignments were acceptable.

Data from Spring 2016 are provided below in Table 33. Although one student missed the minimum criterion on three of the five assignments, this student failed the course. Their individual assignment grades are therefore not included in the cohort average calculations.

**Table 33: Spring 2016 MS/IR/NMR Spectral Analysis Scores***

| *Student* | *IR* | *NMR #1* | *NMR #2* | *MS #1* | *MS #2* |
|---|---|---|---|---|---|
| 1 | 17.5 | 20 | 19 | 19 | 16 |
| 2 | 18.5 | 17.5 | 16 | 18 | 18.5 |
| 3 | 20 | 20 | 20 | 20 | 19.5 |
| 4 | 18.5 | 20 | 19 | 19 | 16 |
| 5 | 20 | 20 | 20 | 20 | 20 |
| 6 | 20 | 20 | 20 | 20 | 19.5 |
| 7 | 20 | 20 | 20 | 20 | 19.5 |
| 8 | 20 | 19.5 | 19 | 19 | 20 |
| 9 | 20 | 20 | 20 | 20 | 20 |
| 10 | 18 | 17.5 | 17.5 | 15.5 | 16.5 |
| 11* | 17 | 0 | 0 | 17.5 | 0 |
| **Averages:** | **19.05** | **19.45♦** | **19.05♦** | **18.91** | **18.55♦** |
| **# of Missed Criteria:** | **1** | **1** | **1** | **1** | **1** |

**Shaded cells, if any, indicate missed criterion under the 2012 criteria.*
*♦The single score that missed the minimum criterion of 15.0 on each of the 3 assignments was omitted from the average since this student failed the course.*

Table 34 below presents data from previous cohorts. It is immediately apparent from the historical cohort averages that many of the students prior to 2012 would not have met the criteria that we have laid out more recently (e.g., cohort average of 8.88 on NMR#1 in 2009). As mentioned earlier, however, not all of the students who contributed to this data set did pass the class. In Tables 34 and Chart 17 below, it is apparent that improvement in these assignments has occurred since about Spring 2011 with the most pronounced

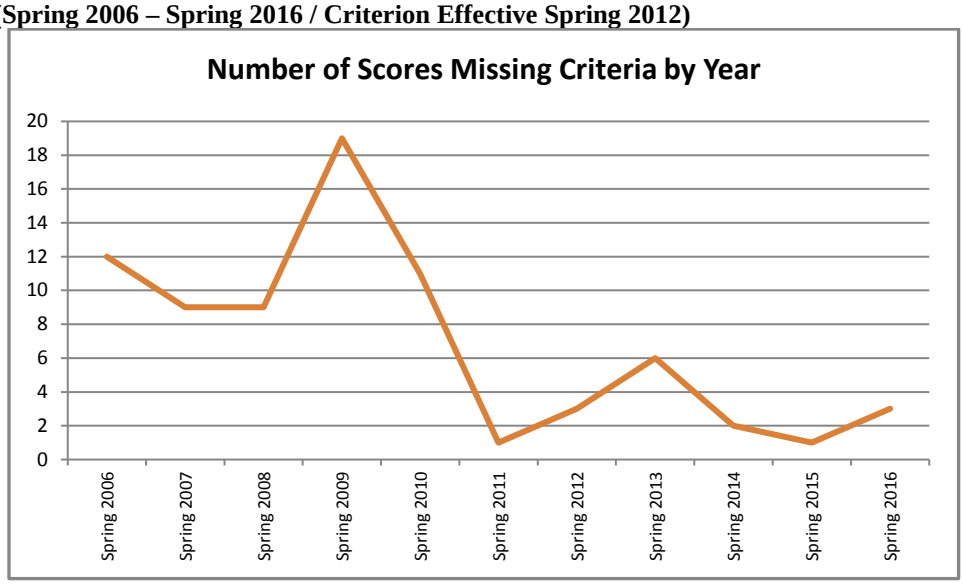
improvement occurring on the NMR assignments. At this point we are happy with the format, rigor, and presentation order of the 5 instruments that have been developed. We eagerly anticipate the development of additional instruments on additional pieces of chemical equipment.

**Table 34: Average Scores on Spectral Analysis Assignments from Spring 2007-2016.**

| | MS #1 | MS #2 | IR | NMR #1 | NMR #2 |
|---|---|---|---|---|---|
| **Spring 2007** | 15.88 | 16.94 | 17.88 | 16.75 | 16.31 |
| **Spring 2008** | 19.34 | 16.37 | 16.36 | 14.09 | 14.09 |
| **Spring 2009** | 18.13 | 16.00 | 16.25 | 8.88 | 8.88 |
| **Spring 2010** | 17.33 | 17.72 | 17.61 | 13.50 | 16.44 |
| **Spring 2011** | 19.21 | 19.43 | 19.46 | 19.21 | 18.36 |
| **Spring 2012** | 19.25 | 18.33 | 19.54 | 18.92 | 18.75 |
| **Spring 2013** | 18.54 | 18.63 | 17.92 | 15.63 | 15.46 |
| **Spring 2014** | 19.21 | 17.00 | 19.21 | 18.92 | 16.92 |
| **Spring 2015**▾ | 18.95 | 17.90 | 19.10 | 18.35 | 19.10 |
| **Spring 2016** | 18.91 | 18.55 | 19.05 | 19.45 | 19.05 |
| **Institutional Averages** | **18.26** | **17.75** | **18.41** | **16.78** | **16.55** |

▾*Note that the order of the assignments changed in Spring 2015 to focus more attention and allow for more iterations on the NMR assignments. The data in the above table are presented in the order that the assignments were assigned historically.*

**Chart 17: Number of Scores Failing to Meet Criterion of 15/20 on MS/IR/NMR Problem Sets (Spring 2006 – Spring 2016 / Criterion Effective Spring 2012)**




*Animal Care Portfolio Data*

Although this portfolio was originally implemented as a means of securing NCATE accreditation for our Adolescent to Young Adult Science Education programs, the even stronger applicability of this portfolio to our Zoo and Wildlife program was immediately apparent and has been adopted by the department as a means of assessing student knowledge in this program as well as meeting a departmental objective for this program:

Even though the Animal Care Portfolio has been implemented since Spring 2012, a variety of circumstances have made data collection extremely difficult for the first several

years (see previous departmental assessment reports for more detail). In addition, the instrument itself has been altered several times. The Animal Care Portfolio currently consists of 4 components (A-D). Each component is sub-divided into distinct assessable criteria (i.e., A1, A2, A3, B1, B2, B3, etc.) with each assessable criterion given a score of 1-4. Overall, students will achieve scores ranging from 12 – 48. The minimum passing score is a 36, with no individual assessable criterion being less than 2.

Spring 2016 data are presented below in Table 35. It is easy to see that several students missed some criteria. Although composite scores are all acceptable, 6 individual criteria were missed. This is a recurring issue. In nearly all cases, these missed criteria are the direct result of students waiting until their senior year, just a week or so prior to graduation, in order to submit their portfolios. The take-away message here is that tracking the portfolios and making sure they are submitted during the junior spring is a must. At the time of the writing of this assessment report, we are already encountering similar problems that will show up in next year's report. As a result, the department is in the process of discussing the future of this instrument. It is fairly onerous to the students, and nearly all procrastinate with this instrument.

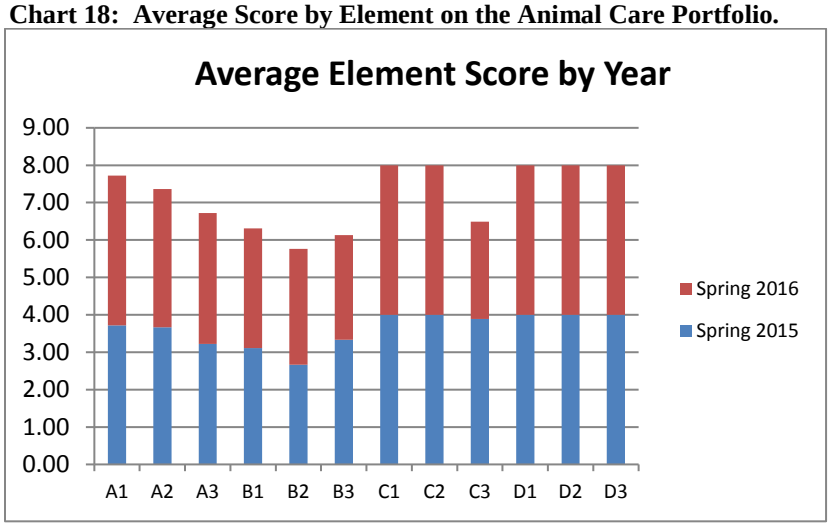
At least one of the advisors of Zoo & Wildlife biology majors has now made the submission of the animal care portfolio something that is tracked during advising sessions along with more traditional curricular requirements. Perhaps a better option, if the instrument is to be retained, is to embed the instrument within a course to ensure its completion.

**Table 35: Animal Care Portfolios Spring 2016 (Individual Sub-scores range from 1 to 4)***

| Student | Al | A2 | A3 | B1 | B2 | B3 | C1 | C2 | C3 | D1 | D2 | D3 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 4 | 4 | 2 | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 43 |
| 2 | 4 | 3 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 45 |
| 3 | 4 | 4 | 4 | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 4 | 4 | 40 |
| 4 | 4 | 4 | 1 | 4 | 4 | 3 | 4 | 4 | 2 | 4 | 4 | 4 | 42 |
| 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 48 |
| 6 | 4 | 4 | 2 | 3 | 2 | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 40 |
| 7 | 4 | 3 | 4 | 1 | 3 | 1 | 4 | 4 | 1 | 4 | 4 | 4 | 37 |
| 8 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 46 |
| 9 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 46 |
| 10 | 4 | 4 | 4 | 4 | 2 | 3 | 4 | 4 | 1 | 4 | 4 | 4 | 42 |
| **Average:** | **4.00** | **3.70** | **3.50** | **3.20** | **3.10** | **2.80** | **4.00** | **4.00** | **2.60** | **4.00** | **4.00** | **4.00** | **42.90** |

***Shaded cells, if any, indicate missed criteria**

**Chart 18: Average Score by Element on the Animal Care Portfolio.**




*Research Design Project*

Although we have dropped the Research Design Project as a means of assessing our AYA programs, the applicability of this project, or something similar, is still probably a valuable means of assessing PILO 'K' for other programs offered by the department.

*Demonstrate the capability of analyzing and reporting empirical data from the biological sciences (K)*

The department has had several unofficial conversations regarding the future assessment of PILO 'K' and research requirements in general, and these conversations have been occurring for several years. A previous assessment report contained the following text:

> *Although the department sees this as a serious omission in our curriculum that needs addressed at the earliest possible time, the department will likely struggle with this for the next several years before curricular changes, associated instruments and rubrics, standards for success, and data collection have all been settled. External reviews for both chemistry and biology are scheduled for the near future (2014-2015 academic year), so these reviews should assist the department substantially toward this goal.*

The external review team for the chemistry program review conducted in Fall 2014 made reference to this shortcoming as well and made several suggestions to incorporate research more comprehensively into the chemistry curriculum. Although the biology programs and the Zoo & Wildlife Biology program were scheduled to undergo an external review in Spring 2015, only the biology programs were reviewed. The department, partly in response to the external review and partly as a result of its own sense of programmatic weaknesses, has made several programmatic changes including the addition of a new course requirement for certain majors — Research Methods in the Natural Sciences (Biol 205). This course was taught for the first time in the 2016-2017 academic year, and at some point will be addressing this PILO. This is the first step in a line of steps that will help us shore up this weakness. The instructor for this course has been contacted and is currently in the process of developing an instrument to be used within the course itself.

*Data from OAE Content Exams*

For many years, we utilized the Praxis II content tests as a supplemental means of assessing the content mastery of our Adolescent to Young Adult (AYA) science education majors. As of 2013, the state of Ohio opted to require licensure candidates to take the Ohio Assessments for Educators (OAE) test rather than the Praxis II. The Department of Science and Mathematics at Malone very rarely has graduates from one of its AYA programs, so data has always been sparse. Since the switch, Malone has only had 2 individuals take the OAE test in the sciences. In addition, the Science and Mathematics department has streamlined its AYA programs by dropping the Integrated Science and Physical Science Education programs. We are retaining only two programs — Life Sciences and Life Science/Chemistry.

No new data have been collected since last year's report. Therefore, the data in Table 36 and Chart 19 are unchanged since last year.

**Table 36: OAE test results**

| Test | Test Date | P/F Status (220 pass score) | Total Scaled Score- Inst. Test Taker | 2014-2015 State Pass Rate | 2014-2015 State Mean Score |
|---|---|---|---|---|---|
| Integrated Science | 2015-03-27 | P | 249 | n=174, 97.13% | 249.47 |
| Biology | 2015-05-12 | F | 213 | n=137, 83.94% | 235.13 |

**Chart 19: OAE Test Results for Spring 2015.**

*Institution Number and Percentage Correct, State Percentage Correct*

| Test Taker | Test | Domain | Objective | # Scorabl | INST # Correct | INST % Correct | STATE % |
|---|---|---|---|---|---|---|---|
| A | Integrated Science (01/14-Present) | 001 Nature of Science | 0001 Scientific inquiry | 7 | 5 | 71.43 | 60.92 |
| | | | 0002 History and nature of science | 8 | 6 | 75.00 | 72.49 |
| | | | 0003 Relationship between sciences and society | 8 | 6 | 75.00 | 77.51 |
| | | 002 Physical Science | 0004 Properties of matter | 8 | 7 | 87.50 | 81.32 |
| | | | 0005 Chemical bonding, chemical reactions | 8 | 7 | 87.50 | 78.52 |
| | | | 0006 Energy characteristics and transformations | 7 | 5 | 71.43 | 68.80 |
| | | | 0007 Force, motion, and energy | 7 | 4 | 57.14 | 78.24 |
| | | | 0008 Mechanical and electromagnetic waves | 7 | 5 | 71.43 | 70.85 |
| | | | 0009 Electricity and magnetism | 7 | 6 | 85.71 | 61.90 |
| | | 003 Life Science | 0010 Cells: characteristics and processes | 7 | 5 | 71.43 | 77.18 |
| | | | 0011 Organisms: classification, characteristics | 8 | 5 | 62.50 | 67.10 |
| | | | 0012 Genetics and evolution | 7 | 4 | 57.14 | 69.54 |
| | | | 0013 Ecosystems and biomes | 8 | 5 | 62.50 | 78.16 |
| | | 004 Earth and Space Science | 0014 Geology, history of Earth | 7 | 5 | 71.43 | 71.59 |
| | | | 0015 Hydrosphere, weather, climate | 8 | 6 | 75.00 | 70.69 |
| | | | 0016 Solar system and the universe | 8 | 5 | 62.50 | 66.02 |
| B | Biology (09/13-Present) | 001 Nature of Science | 0001 Principles of scientific inquiry | 8 | 5 | 62.50 | 80.02 |
| | | | 0002 History and nature of science | 7 | 4 | 57.14 | 64.83 |
| | | | 0003 Relationship between science and society | 9 | 5 | 55.56 | 82.23 |
| | | 002 Biochemistry and Cell Biology | 0004 Chemistry of living systems | 8 | 6 | 75.00 | 82.03 |
| | | | 0005 Cell structure, function, bioenergetics | 8 | 5 | 62.50 | 89.69 |
| | | 003 Genetics and Evolution | 0006 Molecular genetics | 8 | 7 | 87.50 | 75.27 |
| | | | 0007 Patterns and processes of inheritance | 8 | 6 | 75.00 | 74.36 |
| | | | 0008 Mechanisms of biological evolution | 8 | 6 | 75.00 | 81.66 |
| | | | 0009 Scientific evidence for history of life | 8 | 5 | 62.50 | 72.81 |
| | | 004 Biological Unity and Diversity | 0010 Organism structure, function, life cycle | 8 | 6 | 75.00 | 73.72 |
| | | | 0011 Homeostasis | 8 | 6 | 75.00 | 72.08 |
| | | | 0012 Human organ systems anatomy and physiolog | 8 | 7 | 87.50 | 78.65 |
| | | 005 Ecology and Environment | 0013 Populations and communities | 8 | 5 | 62.50 | 79.65 |
| | | | 0014 Ecosystems and biomes | 8 | 4 | 50.00 | 76.28 |
| | | | 0015 Effects of human activities on biosphere | 8 | 5 | 62.50 | 67.43 |

*Safety Projects for Stewardship and Safety in Chemical Practice*
Like so many of our assessment instruments, the "safety projects" were originally introduced to secure NCATE accreditation of our Adolescent to Young Adult science education programs but their applicability and utility in other programs (chemistry programs and biology-clinical laboratory science) for assessing PILO 'D' was immediately apparent.

> *Demonstrate safe laboratory practices and an environmental ethic as it pertains to chemical use and disposal (D)*

These assessment instruments are embedded in a fairly new course entitled Stewardship and Safety in Chemical Practice (Chem 201) that was taught as a tutorial for a single student in Summer 2011 and has been offered every other fall since 2011 (i.e., Fall 2011, Fall 2013, and Fall 2015). Three cycles of data have now been collected. The Tables and Charts displayed below contain no new data from the last report. New data will be collected in Fall 2017 as scheduled.

There are three safety projects. Project #1 has 7 elements and a potential range of scores from 0 to 26. To pass project #1, students must obtain a composite score of at least 20 and no individual elements can receive the lowest score for that element. Project #2 has 6 elements and a potential range of scores from 0 to 36. To pass project #2, students must obtain a composite score of at least 21 and no individual element can receive a score of 1 or lower. Project #3 has 13 elements and a potential range of scores from 0 to 26. To pass project #3, students must obtain a composite score of at least 20 and no individual element score can be 0. Three of the individual elements in project #3 are deemed important enough to require a score of 2.

Data to date are shown below in Tables 37 – 39.

**Table 37: Stewardship and Safety Assessment Project 1 – Safety Contract (Fall 2015 Data)***

| Student | Individual Element Scores (maximum score = 2 or 5 based on element) | | | | | | | ♦Total |
|---|---|---|---|---|---|---|---|---|
| | #1♥ (out of 2) | #2♥ (out of 2) | #3♥ (out of 2) | #4 (out of 5) | #5 (out of 5) | #6 (out of 5) | #7 (out of 5) | |
| 1 | 2 | 2 | 2 | 5 | 5 | 5 | 4 | **25** |
| 2 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | **26** |
| 3 | 2 | 2 | 2 | 5 | 4 | 5 | 3 | **23** |
| 4 | 2 | 2 | 2 | 5 | 4 | 5 | 2 | **22** |
| 5 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | **26** |
| 6 | 2 | 2 | 1 | 5 | 3 | 1 | 5 | **19** |
| 7 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | **26** |
| 8 | 2 | 2 | 2 | 5 | 3 | 5 | 5 | **24** |
| 9 | 2 | 2 | 1 | 5 | 3 | 3 | 5 | **21** |
| **Averages:** | 2.00 | 2.00 | 1.75 | 5.00 | 4.00 | 4.25 | 4.38 | 23.38 |
| **# Missing Criterion:** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** |

*Shaded cells represent a missed criterion.

♦Minimum score of 20 or project must be resubmitted

♥The three elements marked with a heart MUST receive a score of 1 or higher — the remaining elements must receive a score of 2 or higher.

| **Table 38: Stewardship and Safety Assessment Project 2 – SDS/Handling Manual (Fall 2015 Data)*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Student | **Individual Element Scores (maximum score = 5 for each element)** | | | | | | ♦Total |
| | #1 (out of 5) | #2 (out of 5) | #3 (out of 5) | #4 (out of 5) | #5 (out of 5) | #6 (out of 5) | |
| 1 | 5 | 5 | 2 | 4 | 5 | 4 | 25.0 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 | 30.0 |
| 3 | 5 | 4 | 5 | 4 | 4 | 4 | 25.5 |
| 4 | 5 | 5 | 5 | 4 | 4 | 5 | 27.5 |
| 5 | 5 | 5 | 5 | 4 | 4 | 5 | 28.0 |
| 6 | 5 | 5 | 5 | 4 | 5 | 5 | 29.0 |
| 7 | 5 | 5 | 5 | 4 | 4 | 5 | 28.0 |
| 8 | 5 | 5 | 5 | 4 | 4 | 4 | 27.0 |
| 9 | 5 | 5 | 5 | 3.5 | 4 | 4 | 26.5 |
| Averages: | 5.00 | 4.89 | 4.67 | 4.06 | 4.22 | 4.56 | 27.39 |
| # Missing Criterion: | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

*Shaded cells represent a missed criterion

♦Minimum score of 21 or project must be resubmitted.

| **Table 39: Stewardship and Safety Assessment Project 3 – Safety Skills Assessment (Fall 2015 Data)*** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Student | Individual Element Scores (maximum score = 2 for each element) | | | | | | | | | | | | | ♦Total |
| | #1♥ | #2♥ | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13♥ | |
| 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | **25.0** |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 6 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 7 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 8 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| 9 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **26.0** |
| Averages: | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 1.89 | 25.89 |
| # Missing Criterion: | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** |

*Shaded cells represent a missed criterion

♦Minimum score of 20 or individual skills must be performed again.

♥The three skills marked with a heart MUST receive a score of 2 — all others must be 1 or higher.

As can be seen by the shaded cells, the data were not entirely acceptable this year. In last year's report, the department stated that "ALL students, regardless of their major, will be required to redo each assignment until the minimum scores have been met." This has proven more difficult than anticipated. Students in this course have provided quite a bit of constructive feedback. One recurring theme is that the course should be expanded by one hour of credit. The course instructor has taken this under advisement, particularly since the extra hour, among other benefits, would facilitate a more timely completion of these instruments allowing students to redo those components that did not receive minimum scores.

*Science and Faith Instrument*

For the last 7 years, we have been collecting data using an instrument which we've entitled "Faith and Learning Assessment". This instrument was developed to allow us to collect data on departmental objective A:

> *Demonstrate the capability of integrating data and assessing phenomena within a Christian paradigm (A).*

The instrument in its current edition may be described as follows: students are asked to write four 500-word essays in response to four questions. The students' responses are graded using a rubric consisting of 4 elements that would each be awarded a numerical grade between 1 and 5 (maximum score of 20 and minimum of 4). The instrument and rubric have been altered slightly several times over this timeframe.

The minimum criteria for success have been tentatively established as follows: average cumulative score $\geq 12$; minimum cumulative score of 8; and no individual component score less than 2.

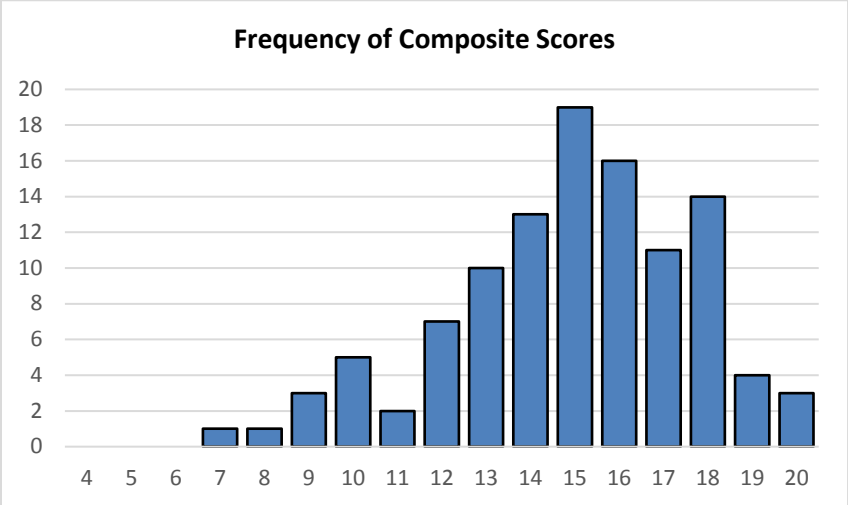
Data for Spring 2016 are given below in Table 40 and cumulative institutional data are reported in Table 41 and Chart 20:

| Table 40: Science and Faith Assessment (Spring 2016)♦ | | | | | |
|---|---|---|---|---|---|
| **Student #** | **Score for Element A (out of 5)** | **Score for Element B (out of 5)** | **Score for Element C (out of 5)** | **Score for Element D (out of 5)** | **Composite Score (out of 20)** |
| 1 | 5 | 4 | 5 | 5 | 19 |
| 2 | 3 | 3 | 5 | 5 | 16 |
| 3 | 4 | 2 | 5 | 4 | 15 |
| 4 | 4 | 5 | 4 | 5 | 18 |
| 5 | 3 | 3.5 | 4 | 4.5 | 15 |
| 6 | 4 | 4 | 2 | 4 | 14 |
| 7 | 4 | 3 | 4 | 4 | 15 |
| 8 | 2 | 3 | 2 | 3 | 10 |
| Average Score: | 3.63 | 3.44 | 3.88 | 4.31 | 15.25 |

♦Shaded cells, if present, indicate a missed criterion.

| Table 41: Science and Faith Assessment (Cumulative Institutional — Spring 2010-Spring 2016) | | | | | |
|---|---|---|---|---|---|
| **Year** | **Score for Element A (out of 5)** | **Score for Element B (out of 5)** | **Score for Element C (out of 5)** | **Score for Element D (out of 5)** | **Composite Score (out of 20)** |
| 2010 (15 students) | 3.65 | 3.47 | 3.78 | 3.40 | 14.30 |
| 2011 (11 students) | 3.68 | 3.93 | 4.14 | 4.23 | 15.98 |
| 2012 (15 students) | 3.77 | 3.65 | 4.47 | 4.27 | 16.15 |
| 2013 (15 students) | 3.23 | 3.07 | 3.60 | 3.57 | 13.47 |
| 2014 (23 students) | 3.50 | 3.46 | 4.33 | 3.96 | 15.24 |
| 2015 (22 students) | 3.41 | 3.45 | 3.95 | 3.59 | 14.41 |
| 2016 (8 students) | 3.63 | 3.44 | 3.88 | 4.31 | 15.25 |
| **Cumulative Means:** | 3.53 | 3.48 | 4.04 | 3.85 | 14.90 |

**Chart 20: Frequency of Composite Scores -- Cumulative Institutional.**




*n=109 ;* Some years, scores with increments of 0.25 and 0.5 were used; these were rounded down and up to generate the whole numbers displayed above.

This year, all students had composite scores that met the minimum criterion set by the department, and all individual element scores were satisfactory as well. One problem was encountered this year during data collection. The sample size of 8 for 2016 is very low. Somehow, some of our student essays were either not graded, submitted, or recorded.

*A&P II Exam Scores*

Several of our programs are designed in such a way that they include Departmental Objectives L and M:

L. *Demonstrate a balanced concept of molecular, micro, and macro levels of biological phenomena in the context of human systems.*
M. *Demonstrate the ability to properly relate biological structure and function in the context of human systems.*

The department has struggled with this set of PILOs for several years. In last year's report, the department indicated that it would likely be adding an additional set of questions to the in-house biology pre-test/post-test that focused on Anatomy and Physiology content. This adjustment of the biology test has recently been concluded and the pilot run of the additional A&P content occurred in the Fall 2016 semester. Data are presented below in Tables 42 and 43:

**Table 42: In-House Biology Test A&P Sub-Scores (Pre-Test administered Fall 2016)**

| Student | Score (out of 12) |
|---|---|
| 1 | 12 |
| 2 | 5 |
| 3 | 6 |
| 4 | 4 |
| 5 | 7 |
| 6 | 9 |
| 7 | 9 |
| 8 | 7 |
| 9 | 6 |
| 10 | 3 |
| 11 | 2 |
| 12 | 1 |
| 13 | 5 |
| 14 | 5 |
| 15 | 7 |
| 16 | 5 |
| 17 | 3 |
| 18 | 8 |
| 19 | 10 |
| 20 | 8 |
| 21 | 7 |
| 22 | 7 |
| 23 | 3 |
| 24 | 3 |
| 25 | 4 |
| 26 | 5 |
| 27 | 6 |
| 28 | 11 |

| | |
|---|---|
| 29 | 10 |
| 30 | 5 |
| 31 | 10 |
| 32 | 3 |
| 33 | 3 |
| 34 | 9 |
| 35 | 8 |
| 36 | 3 |
| 37 | 3 |
| 38 | 4 |
| 39 | 3 |
| 40 | 5 |
| 41 | 6 |
| 42 | 2 |
| 43 | 4 |
| 44 | 4 |
| 45 | 5 |
| 46 | 5 |
| 47 | 12 |
| 48 | 5 |
| 49 | 10 |
| 50 | 4 |
| 51 | 9 |
| 52 | 6 |
| 53 | 4 |
| 54 | 8 |
| 55 | 6 |
| 56 | 4 |
| 57 | 1 |
| 58 | 4 |
| 59 | 2 |
| 60 | 2 |
| 61 | 5 |
| 62 | 10 |
| 63 | 4 |
| 64 | 7 |
| 65 | 10 |
| 66 | 4 |
| 67 | 6 |
| 68 | 10 |
| 69 | 8 |
| 70 | 9 |
| 71 | 7 |
| 72 | 10 |
| 73 | 4 |
| 74 | 11 |
| 75 | 6 |
| 76 | 9 |
| 77 | 4 |
| 78 | 5 |

| | |
|---|---|
| **Mean:** | 5.97 |
| **Median:** | 5.00 |
| **Std. Dev.:** | 2.77 |

| Table 43: In-House Biology Test A&P Question Analysis (Pre-Test administered Fall 2016) | | |
|---|---|---|
| **Question** | **Number of Correct Responses** | **% Correct** |
| 51 | 65 | 83.3 |
| 52 | 25 | 32.1 |
| 53 | 41 | 52.6 |
| 54 | 33 | 42.3 |
| 55 | 29 | 37.2 |
| 56 | 26 | 33.3 |
| 57 | 32 | 41.0 |
| 58 | 68 | 87.2 |
| 59 | 40 | 51.3 |
| 60 | 40 | 51.3 |
| 61 | 33 | 42.3 |
| 62 | 29 | 37.2 |

Although not everyone who graduates with a biology-related degree will have had A&P, it is possible to obtain the scores of these A&P questions for all students while analyzing the scores of only those who have completed the sequence. In addition, the same 12 questions will be administered "post-test" with the exercise science majors (they will not take the remainder of the In-House Biology exam), since they are required to complete the A&P sequence as well. This should give us a much better measure of showing improvement than we have had before.

Some issues did arise during this pilot run that necessitate slight alteration to the instrument. First, we noticed that several students achieved surprisingly high A&P sub-scores on this pre-test (e.g., two had scores of 12/12 while others had scores of 11/12 and 10/12). Upon further examination, we discovered that, although this test was administered in a freshman biology class, several upper-level Exercise Science majors who had previously completed the A&P sequence were taking this entry-level biology class as an elective to finish out their careers at Malone. Thus, their A&P sub-scores should be omitted from this pre-test altogether — they were more appropriate as post-test scores. It was this sub-set of students who had performed so well on the A&P portion of the exam. The instrument has since been altered by adding the statement "*Do NOT take this test unless it is your FIRST college-level biology course*" to the first page of the test. Unfortunately, by the time this glitch was detected, the Fall 2017 administration of this exam had already occurred (see data in next year's assessment report). The good news, of course, is that we have inadvertently been able to document some measure of success at PILOs L and M. Secondly, questions 51 and 58 were answered "too well" by this cohort with 83.3% and 87.2% of test takers responding correctly to these questions respectively. These questions will need to be replaced with more difficult questions in order to improve our success at probing improvement of a given cohort. The questions have been sent back to the A&P instructor for revision. We anticipate having the corrections in place by Spring 2018.

We are aware, though, that a key piece of information that we desire – how our students compare with a national average on A&P content knowledge – cannot be obtained this way.  The current instructor is currently researching to see if such a standardized exam exists and would be applicable in our situation.