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| **Assurance of Student Learning Report****2021-2022** |
| Ogden College of Science and Engineering | Department of Chemistry |
| Chemistry, Ref. 623 |
| Les Pesterfield, Professor, Department of Chemistry |

***Is this an online program***? [ ]  Yes [x]  No

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| ***Use this page to list learning outcomes, measurements, and summarize results for your program. Detailed information must be completed in the subsequent pages.*** |
| **Student Learning Outcome 1:**  Our graduates will have the ability to communicate effectively in written form. |
| **Instrument 1** | **Laboratory reports from CHEM 451 (Physical Chemistry Lab)** |
| **Based on your results, check whether the program met the goal Student Learning Outcome 1.** | **[x]  Met** | **[ ]  Not Met** |
| **Student Learning Outcome 2:**  Our graduates will have the ability to read and interpret data about chemical systems. |
| **Instrument 1** | **American Chemical Society Exam in Analytical Chemistry** |
| **Based on your results, check whether the program met the goal Student Learning Outcome 2.** | **[x]  Met** | **[ ]  Not Met** |
| **Student Learning Outcome 3:**  Our graduates will have an understanding of structure-property-function relationships for a variety of molecules. |
| **Instrument 1** | **American Chemical Society Exam in Organic Chemistry** |
| **Based on your results, check whether the program met the goal Student Learning Outcome 3.** | **[ ]  Met** | **[x]  Not Met** |
| **Program Summary (Briefly summarize the action and follow up items from your detailed responses on subsequent pages.)**  |
| 1. Rubric for lab reports was refined to reflect input from multiple faculty evaluators.
2. A question analysis was performed on the national ACS exams for Quantitative Analysis and the Organic Chemistry sequence. Based on the content analysis, individual questions were developed by faculty and used to assess student understanding over the duration of the semester. This is opposed to the end-of-the-semester national exam assessment. An increase in student performance was observed for both courses.
3. The faculty explored the use of a combination of in-term and end-of-term assessments to gauge student short term vs long term understanding and performance during the Fall 2021 semester. Results from the Fall semester in-term and end-of-term assessments showed that student performance was better on in-term assessments than on end-of-term assessments. This is probably due to the fact that the in-term assessments focus on a smaller amount of material and the material was recently covered in class. The end-of-term assessments require students to recall and apply significantly larger amounts of material.
4. Evaluation of other outcomes is planned for the future, though evaluation of the current outcomes will continue for at least another year.
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| **Student Learning Outcome 1** |
| **Student Learning Outcome**  | Our graduates will have the ability to communicate effectively in written form. |
| **Measurement Instrument 1**  | **Laboratory reports from CHEM 451 (Physical Chemistry Lab)**The lab report for the Crystal Violet (CVL) and Adiabatic Expansion (AEL) Laboratories were chosen, as it requires students to collect and analyze data and report on the results of the experiment in a clear fashion. Students are expected to analyze the data and arrive at accurate (reasonable) conclusions from this data. They are further required to communicate these results in a clear and effective way in scientific writing. The AEL is perform early in the semester and the CVL is performed later in the term.The instrument was assessed in a fashion consistent with the Written Communication VALUE Rubric from AAC&U. Basic parameters for *Context, Content, Conventions, Sources, and Syntax* were rated on the 1 to 4 scale. A maximum score of 20 was possible. |
| **Criteria for Student Success** | Students should score a total of 13 or higher over the 5 areas on the rubric. For the CVL, overall scores ranged from 0 to 20 with an average 15.2 For the AEL, overall scores ranged from 0 to 20 with an average of 14.4. |
| **Program Success Target for this Measurement** | 75% | **Percent of Program Achieving Target** | 88% for CVL 77% for AEL |
| **Methods**  | All 26 students in CHEM 451 course in AY 2021-2022 were scored on the two lab reports.The reports were all assess/rated by the instructors of record of the course for Fall 21 and Spring 22. |
| **Based on your results, highlight whether the program met the goal Student Learning Outcome 1.** | **[x]  Met** | **[ ]  Not Met** |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.) |
| A wide range of writing ability continues to be observed in the students. The use of example reports has shown to help students avoid formatting errors. However on an individual basis, students continue to struggle with stylistic/syntax errors.  |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) |
| The rubric will continue to be evaluated and refined for appropriateness for scientific writing. Sample reports will continue to be used to provide students with examples from which to work. Students having difficulties with syntax/grammar will be referred to the university Writing Center.Students do show improved performance on the writing assignments over time, as observed in the increase in the percent of students achieving the target going from 77% to 88% during the semester. Having multiple writing assessments allows students to review and correct their mistakes. |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) |
| We plan to assess this outcome again next year using a slightly refined rubric.AY 22-23, submitted student laboratory reports, CHEM 451, instructors of record for CHEM 451  |

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| **Student Learning Outcome 2** |
| **Student Learning Outcome**  | Our graduates will have the ability to read and interpret data about chemical systems. |
| **Measurement Instrument 1** | **American Chemical Society Exam in Analytical Chemistry**This is a nationally-normed 50-question multiple choice exam given at the conclusion of the CHEM 330 (Quantitative Analysis) course (required of all majors and minors).  |
| **Criteria for Student Success** | 50%-tile ranking or higher |
| **Program Success Target for this Measurement** | 50% of students taking the exam | **Percent of Program Achieving Target** | 53% |
| **Methods**  | Assessments were given to all students in the course. |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 2.** | **[x]  Met** | **[ ]  Not Met** |
| **Actions** (Describe the decision-making process and actions planned for program improvement. The actions should include a timeline.) |
| Course content is being evaluated in the context of exam topics. This exam is made available in an updated version approximately every two years. This update cycle allows the exam to reflect the current topical content recommended by the exam committee.A question level analysis was completed for the Fall 2021 semester. Specific content areas identified and assessed were acid/base chemistry, statistics, electrochemistry, chromatography and spectrophotometry. |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) |
| It is proposed that the decrease in the percentage of students achieving the target percentile of content mastery (73% AY 20/21 to 53% AY 21/22) is a function of the student’s lack of mastery of content material from previous coursework. Faculty observed that students for AY 21/22 were not as well grounded in the fundamental content material. The lack of mastery of previous contant material is most likely an after effect of switching course modalities from face-to-face to primarily online. Faculty have decided to include more review type exercises at the beginning of the course so that students can identify their content weaknesses and review those areas early in the ocurse. |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) |
| We plan to assess this outcome again next year.AY 22-23, ACS exam in Analytical Chemistry, CHEM 330, instructors of record for CHEM 330 |

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| **Student Learning Outcome 3** |
| **Student Learning Outcome**  | Our graduates will have an understanding of structure-property-function relationships for a variety of molecules. |
| **Measurement Instrument 1** | **American Chemical Society Exam in Organic Chemistry**This is a nationally-normed 50-question multiple choice exam given at the conclusion of the CHEM 342 (Organic Chemistry 2) course. |
| **Criteria for Student Success** | 50%-tile ranking or higher |
| **Program Success Target for this Measurement** | 50% of students taking the exam | **Percent of Program Achieving Target** | 39% |
| **Methods**  | Assessments were taken by all students in the course. |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 3.** | **[ ]  Met** | **[x]  Not Met** |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.) |
| Course content is being evaluated in the context of exam topics. This exam is made available in an updated version approximately every two years. This update cycle allows the exam to reflect the current topical content recommended by the exam committee.A question level analysis was completed for the Fall 2021 semester. Specific content areas identified and assessed were acid/base chemistry of organic molecules, sterochemistry, electrophilic substitution reactions, reactions of alcohols, ethers and carboxylic acids. |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) |
| It is proposed that the decrease in the percentage of students achieving the target percentile of content mastery (69% AY 20/21 to 39% AY 21/22) is a function of the student’s lack of mastery of content material from previous coursework. Faculty observed that students for AY 21/22 were not as well grounded in the fundamental content material. The lack of mastery of previous contant material is most likely an after effect of switching course modalities from face-to-face to primarily online. Faculty have decided to include more review type exercises at the beginning of the course so that students can identify their content weaknesses and review those areas early in the ocurse. |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) |
| We plan to reassess this outcome next year.AY 22-23, ACS exam in Organic Chemistry, CHEM 342, instructors of record for CHEM 342 |

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| **Program name:** | B.S. in Chemistry (Ref. 623) |   |  |  |  |  |
| **Department:** | Chemistry |   |   |  |  |  |  |
| **College:** | Ogden College of Science and Engineering |   |  |  |  |  |
| **Contact person:** | Kevin Williams |   |  |  |  |  |
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| **KEY:** |  |  |  |  |  |  |
| **I = Introduced** |  |  |  |  |  |  |
| **R = Reinforced/Developed** |  |  |  |  |  |  |
| **M = Mastered** |  |  |  |  |  |  |
| **A = Assessed** |  |  |  |  |  |  |
|  |  |  | **Learning Outcomes** |
|  |  |  | **LO1:** | **LO2:** | **LO3:** | **LO4:** | **LO5** |
|   |  |  | Effectively communicate findings through written reports | Describe the relationships between structure and chemical property | Apply various bonding theories to describe the formation of molecules | Apply nomenclature rules to produce chemical names and formulas  | Apply fundamental principles to predict rate and spontaneity of a reaction |
| **Course Subject** | **Number** | **Course Title** |   |   |   |   |   |
| CHEM | 120 | College Chemistry I |  | I | I |   | I |
| CHEM | 121 | College Chemistry Laboratory I | I | I |   | I |   |
| CHEM | 222 | College Chemistry II |   | R |   |   | R,A |
| CHEM | 223 | College Chemistry Laboratory II | I  |  |   | R,A |   |
| CHEM  | 320 | Inorganic Chemistry I |  | R | R | R |   |
| CHEM  | 330 | Quantitative Analysis | R  |   |   |   | R, A |
| CHEM | 340 | Organic Chemistry I |  | R | R | R | R |
| CHEM | 341 | Organic Chemistry Laboratory I | R | R  |   |   |   |
| CHEM  | 342 | Organic Chemistry II |  | R,A | R,A | R | R |
| CHEM | 343 | Organic Chemistry Laboratory II | R  | R |   |   |   |
| CHEM | 398 | Undergraduate Seminar |   |   |   |   |   |
| CHEM  | 446 | Biochemistry I |  | M  |   |   | R |
| CHEM | 450 | Physical Chemistry I |  |   | M |   | M,A |
| CHEM  | 451 | Physical Chemistry Laboratory | M,A |   |   |   |   |

AACU VALUE rubric for Written Communication

