Institutional Effectiveness Report

Name of Program/Department:	**Department of Chemistry**
Year:	**2024-2025**
Name of Preparer:	**Dr. Jennifer Kelley, Chair**

Program Mission Statement

The chemistry department at Francis Marion University provides a high standard of education in chemistry that equips students with the knowledge and skills to be successful in their professional careers. To better serve students in our state and region who have a broad range of preparation and ability, the department offers introductory, foundation, and in-depth chemistry courses that satisfy natural sciences requirements for general education, pre-professional programs, the traditional chemistry degree, and the American Chemical Society (ACS) approved chemistry degree program. Within the traditional chemistry degree, students may choose chemistry in general or more focused options in forensics or pre-pharmacy. Intellectual inquiry is promoted through student research in the classroom and through laboratory research with faculty members outside of the classroom. These types of research enhance a student's ability to think and communicate and often leads to presentations on-campus or in the broader chemistry community and in some cases, to publications. The department also supports professional development, outreach and networking through our American Chemical Society student group.

Program Learning Outcomes (PLOs)

Chemistry students at Francis Marion University will be characterized by the following qualities or attitudes:

PLO #1 – Chemistry majors will demonstrate that they have the knowledge and skills needed that will allow them to communicate chemistry effectively by presenting an oral literature research presentation and submitting a written literature research paper.

PLO #2 – Chemistry majors will demonstrate that they can apply critical thinking skills based on an understanding of core concepts and methods, as well as understanding the limits of scientific inquiry, that will allow them to successfully solve integrated problems in chemistry.

PLO #3 – Chemistry students will demonstrate that they can adequately apply their knowledge of chemistry through course-based class projects and/or independent research projects with faculty.

PLO #4 - Chemistry majors will demonstrate that they can adequately use the scientific literature.

PLO #5 - Chemistry students will demonstrate an understanding of safe laboratory skills and procedures for laboratory experiments that they perform.

PLO #6 – Chemistry majors will have accrued over the period of their undergraduate studies, an overall favorable view of the Department of Chemistry's quality of instruction, advising, and facilities.

Executive Summary of Report

A sentence was added to the mission statement to acknowledge the offering of a forensic option and a pre-pharmacy option within the traditional chemistry major. These options focus on courses to better prepare students for employment or further education in these areas.

A benchmark and target could not be set for SLO #6 because the instructor inadvertently gave the old version of the exit interview questionnaire. The old questionnaire is not quantifiable so there is no baseline for this year as well. The benchmark and target will have to be determined in 2025-2026. .

For SLO #7, students had an average score of 48% (Appendix IX) on the questions that focused on application of fundamental math skills. This is below the baseline average of 59%. The benchmark was set at 52% with a target of 55% over the next three years (through 2027-2028) based on these and previous year's results.

For SLO#8, students had an average score of 35% (Appendix IX) on the questions that focused on scientific principles. This is below the average baseline of 47%. The benchmark was set at 39% with a target of 43% in three years (through 2027-2028) based on these and previous year's results.

For SLO #9, we were able to set a baseline, benchmark and target using the REAL (Ready to Experience Applied Learning) survey students are required to fill out as part of the evaluation process for the grant that provides funding for conference attendance. This survey (Appendix XI) is quantifiable, whereas ours is not. We will continue to use feedback from the chemistry department survey for student comments but use the REAL survey to give an indirect measure of student's ability to apply their knowledge of chemistry through course-based class projects and/or independent research projects by focusing on results from statement 2 (While participating in this activity, I applied knowledge and/or ideas that I learned in university classes.) and statement 7 (Participation in this activity made a meaningful contribution to my educational experience at Francis Marion University.) from the survey.

Presented in this report are the Chemistry Department's Mission, Program and Student Learning Outcomes, the assessment and results of each, and action items for the academic year 2024-2025. Achievement of our chemistry students on their chemistry concept knowledge and critical thinking skills, and on communication skills were assessed with the following:

(1) writing assignments
(2) the standardized American Chemical Society (ACS) *Diagnostic of Undergraduate Chemical Knowledge* (DUCK) Exam
(3) an oral literature research presentation
(4) a written chemistry literature research paper
(5) a chemical safety exam
(6) a general education assessment (chemistry quiz)
(6) an exit questionnaire and interview
(7) a survey for those who attended and/or presented research at a conference

The knowledge and skills assessments (SLO #1-4 and 6) were carried out in our senior Chemistry Capstone course (Chem 499), while lab safety skills assessment (SLO #5) was carried out in our Organic Chemistry 201 (Chem 201) course. Fundamental math skills and principles (SLO #7) application scientific principles to critically analyze experimental evidence and reach conclusions (SLO #8) were assessed in our Chemistry 112 courses. Application of knowledge (SLO #9) was shown by students who attended and/or presented research at the Southeast Regional Meeting of the American Chemical Society (SERMACS) and completed the surveys.

The senior students enrolled in our spring 2025 Chemistry 499 Senior Capstone course were assessed on writing assignments based on a journal article of their interest, an assignment that teaches them to create their own bibliography/reference database (Appendix III), a half-life your message assignment that forces students to focus on the subject of their research paper (Appendix III), and a research paper outline, rough draft and final paper. The students scored 84% on average on these assignments which is below the average of 94% for last three years but exceeds the benchmark (80%) and is just below the target (85%) for SLO #1.

For SLO #2, the students in the Chemistry 499 Senior Capstone course were administered the Diagnostic of Undergraduate Chemical Knowledge (DUCK) 2018 standardized exam. The average score for the class was 35 out of 60 giving an average percentile of 63. Three students performed well above the 50th percentile and one below, giving 75% above the 50th percentile but only one student (25% at the 88th percentile) was above the baseline for the previous year (50% at 85th percentile). The class achieved the benchmark (50% at 50th percentile) and target (55% at 55th percentile) with 75% above the 50th percentile.

The students in Chemistry 499 Senior Capstone performed at the 73% level on average when demonstrating competency in presenting technical information through their written communication skills on a chemistry topic of their choosing that was approved by the chemistry faculty (SLO #3). Our baseline (88%), benchmark (80%) and target (85%) were not met this year but the average over the last four years puts the baseline at 81% which exceeds the benchmark and approaches the target.

The students taking the Chemistry 499 Senior Capstone performed at the 86% level on average when demonstrating competency in presenting technical information through their oral communication skills on the same chemistry topic in SLO #3 that they chose and that was approved by the chemistry faculty (SLO #3). Our baseline was not met (87%, based on past 3 years average), but our benchmark (80%) and target (82%) were exceeded for SLO #4.

All fifty-seven students enrolled in Chemistry 201 demonstrated an adequate level of knowledge of laboratory safety procedures and practices at or above the 70% level (SLO #5). Our minimum for SLO #5 remains that 100% of students achieve a score of 70% or higher to remain in the course. This static SLO was changed to a baseline of 76% scoring at 90% or higher based on last year's results. Of the fifty-seven students taking the exam, 84% scored at 90% or higher. This exceeds the baseline (76% scoring at 90% or higher), benchmark (78% scoring at 90% or higher) and target (80% scoring at 90% or higher).

An updated and quantifiable exit survey/questionnaire was developed in 2022-2023 for SLO #6. This year, the instructor inadvertently gave the older version of the questionnaire, which is not quantifiable so, we have no baseline for next year and can't set a benchmark and target. These will need to be set during 2025-2026.

Students administered the General Education Assessment (SLO #7 and #8) Chemistry quiz in Chemistry 112 averaged 48% on the application of fundamental math skills and 35% on questions focused on scientific principles. This is the third year for this assessment. For SLO #7, this is below the baseline average of 59% over the past two years. The benchmark was set at 52% with a target of 55% over the next three years (through 2027-2028). The average for SLO #8 is below the average baseline of 47% over the past two years. The benchmark was set at 39% with a target of 43% in three years (through 2027-2028).

For SLO #9, students who attended and/or presented their research at a conference completed a survey that requires them to summarize research posters and presentations they attend, to meet new people, to reflect on their future goals, to reflect on their subject knowledge compared peers, what they learned about themselves and the city they visited. See Appendix X for an example survey. Students were also required to complete the REAL (Ready to Experience Applied Learning) survey (Appendix XI). We focused on statements 2 and 7 for this SLO. The results of the REAL survey for statement 2 was a 4.29 mean out of 5 for the seven students who completed the survey showing that students agreed that the conference required them to apply knowledge and ideas they have learned in chemistry courses. The results for statement 7 also had a mean of 4.29 out of 5 indicating that students felt that attending the conference was meaningful to their educational experience. Using these results, we have set a baseline of 4.29 mean for the 2025-2026 report for statements 2 and 7 from the REAL survey. Our benchmark will be to achieve a 4.5 mean for the statements with a target of 4.5 for the next 3 years.

Student Learning Outcomes (SLOs)

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above 80% on capstone writing assignments that assess their ability to summarize chemical concepts. (PLO #2 and #4)

SLO# 2.0: 50% of graduating Chemistry students will perform at or above the 50th percentile on their analysis of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. (PLO #2)

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to analyze technical information through written communication. (PLO #1 and #4)

SLO #4.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to articulate technical information through oral communication. (PLO #1 and #4)

SLO #5.0: 100% of students enrolled in Chemistry 201 will demonstrate at least an adequate level of 70% on their understanding of laboratory safety procedures and a "to be determined percentage" will perform at a level of 80%. (PLO #5)

SLO #6.0: Chemistry majors will have accrued over the period of their undergraduate studies, an overall favorable view of the Department of Chemistry's program, instruction, and facilities determined by their rating of these areas in an exit survey. (PLO #6)

SLO #7.0: Students who have completed Chemistry 111 will have the ability to apply fundamental math skills and principles in various applications. (Gen Ed Goal #4)

SLO #8.0: Students who have completed Chemistry 111 will have the ability to describe the natural world and apply scientific principles to critically analyze experimental evidence and reach conclusions. (Gen Ed Goal #5)

.**SLO #9.0:** Students who attended and/or presented research in the scientific community will reflect on the quality of their experience based on survey questions. (PLO #3)

Assessment Methods

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above 80% on capstone writing assignments that assess their ability to summarize chemical concepts. (PLO #2 and #4)

Baseline: 2021-2022 (98%), 2022-2023 (92%), 2023-2024 (93%) **(3 Year Average 94%)**
Benchmark: 80% average
Target: 85% average within 3 yrs (2025-2026)
Assessment: Direct

Assessment Method for SLO# 1.0: assessed on reading journal articles, Zotero assignment on citing research, half-life your message assignment, research paper outline, research paper rough draft, and final research paper,. (See Appendix I and III.)

SLO# 2.0: 50% of graduating Chemistry students will perform at or above the 50th percentile on their analysis of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. (PLO #2)

Baseline: 2022-2023 (100% at the 58th percentile), 2023-2024 (50% at the 98th percentile)

Benchmark: 50% of students at the 50th percentile
Target: 55% of students at the 55th percentile by 2025-2026
Assessment: Direct

Assessment Method for SLO# 2.0: Senior chemistry majors enrolled in the chemistry capstone course (Chem 499) were administered the *Diagnostic of Undergraduate Chemical Knowledge* (**DUCK**) exam (see Appendix II for description) at the end of the spring semester. The DUCK is a standardized exam produced by the American Chemical Society (ACS) designed to assess basic chemistry knowledge for a senior chemistry undergraduate student. Each section on the exam presents a real-world scenario and provides a variety of chemical information related to the scenario that is followed by integrated questions from different areas of chemistry.

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to analyze technical information through written communication. (PLO #1 and #4)

Baseline: 2021-2022 (83%), 2022-2023 (83%), 2023-2024 (88%) **(3 Year Average 85%)**
Benchmark: 80%
Target: 85% in 2024-2025
Assessment: Direct

Assessment Method for SLO# 3.0: To assess written communications skills, students enrolled in the Chemistry Senior Capstone course wrote a chemistry literature research paper in the spring semester, based on a technical chemistry topic they select and then was faculty approved. Each paper was graded by the capstone instructor using a standard, department generated grading rubric for scientific term papers.

SLO #4.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to articulate technical information through oral communication. (PLO #1 and #4)

Baseline: 2021-2022 (83%), 2022-2023 (91%), 2023-2024 (88%) **(3 Year Average 87%)**

Benchmark: 80%
Target: 82% in 2024-2025
Assessment: Direct

Assessment Method for SLO# 4.0: To assess their oral communications skills, students enrolled in the Chemistry Senior Capstone course delivered an oral presentation in the spring semester on the same chemistry topic as their written topic, which is described in SLO #3. Each presentation was graded by all of the available chemistry instructors using a standard, department generated grading rubric for oral presentations. The student's score was an average of all faculty scores.

SLO #5.0: 100% of students enrolled in Chemistry 201 will demonstrate at least an adequate level of 70% on their understanding of laboratory safety procedures and 80% will perform at a level of 90% or higher. (PLO #5)

Baseline: 2023-2024 (76% scored at 90% or higher)
Benchmark: 78% will score at 90% or higher
Target: 80% will score 90% or higher in 3 years (2025-2026)
Assessment: Direct

Assessment Method for SLO# 5.0: All of the students enrolled in Organic Chemistry 201, a foundation course that is prerequisite to taking any higher-level chemistry course, were presented a lab module on chemical safety during the first two weeks of the semester. This was followed by their taking a comprehensive and cumulative lab safety exam that is produced and administered by the Chemistry department faculty. Students must score at least 70% on this safety exam to remain in this required course and thus major or minor in chemistry. The benchmark and target were raised to 78% scoring at 90% and 80% scoring at 90% (respectively) or higher due to the high success rate of 95% scoring at 80% or higher in 2022-2023.

SLO #6.0: Chemistry majors will have accrued over the period of their undergraduate studies, an overall favorable view of the Department of Chemistry's program, instruction, and facilities determined by their rating of these areas in an exit survey. (PLO #6)

Baseline: 2022-2023 (81%), 2023-2024 (91%) (Two Year Average 85%)
Benchmark: N/A (data was not collected in a quantifiable manner)
Target: N/A (data was not collected in a quantifiable manner)
Assessment: Indirect

Assessment Method for SLO# 6.0: To help assess the quality of its instruction, advising, and facilities, the Department of Chemistry administers an associated exit interview questionnaire (Appendix VI) to its senior chemistry majors enrolled in the senior capstone course. This questionnaire was updated in 2022-20223 to make it more quantifiable by including a scaling of 5 to 1 for most questions, with 5 being "strongly agree" to 1 being "strongly disagree". (The older version of the questionnaire was inadvertently given so, no data was collected this year.)

SLO #7.0: Students who have completed Chemistry 111 will have the ability to apply fundamental math skills and principles in various applications.

Baseline: 2022-2023 (56%), 2023-2024 (61%) **(Two Year Average 59%)**
Benchmark: 52%
Target: 55% in 3 years (through 2027-2028)

Assessment: Direct

Assessment Method for SLO# 7.0: Chem 112 students were given a 12-question quiz at the beginning of the semester that spanned the main topics covered in Chem 111. Of the 12 questions, 6 questions were focused on application of fundamental math skills (Goal 4 (Appendix VII) and SLO 7.0). Topics covered were unit conversions, units of temperature, molar mass, balancing equations, stoichiometry, and gas laws. The other six questions were focused on scientific principles (Goal 5 (Appendix VII), SLO 8.0) – atomic structure, nomenclature, acid/base neutralization, valence electrons, electronegativity and Lewis structures.

SLO #8.0: Students who have completed Chemistry 111 will have the ability to describe the natural world and apply scientific principles to critically analyze experimental evidence and reach conclusions.

Baseline: 2022-2023 (45%), 2023-2024 (48%) **(Two Year Average 47%)**
Benchmark: 39%
Target: 43% in 3 years (through 2027-2028)
Assessment: Direct

Assessment Method for SLO# 8.0: Chem 112 students were given a 12-question quiz at the beginning of the semester that spanned the main topics covered in Chem 111. Of the 12 questions, 6 questions were focused on application of fundamental math skills (Goal 4 (Appendix VII) and SLO 7.0). Topics covered were unit conversions, units of temperature, molar mass, balancing equations, stoichiometry, and gas laws. The other six questions were focused on scientific principles (Goal 5 (Appendix VII), SLO 8.0) – atomic structure, nomenclature, acid/base neutralization, valence electrons, electronegativity and Lewis structures.

SLO #9.0: Students who attended and/or presented research in the scientific community will reflect on the quality of their experience based on survey questions. (PLO #3)

Baseline: N/A (No quantifiable baseline until 2025-2026, wrong survey given)
Benchmark: 4.5 mean for statements 2 and 7 on REAL Survey
Target: 4.5 mean for statements 2 and 7 on REAL Survey for next 3 years
Assessment: Indirect

Assessment Method for SLO #9: Students who attended and/or presented their research at a conference completed a survey that requires them to summarize research posters and presentations they attend, to meet new people, to reflect on their future goals, to reflect on their subject knowledge compared peers, and what they learned about themselves and the city they visited. See Appendix X for an example of the chemistry department survey. The REAL (Ready to Experience Applied Learning) committee also requires students to fill out a survey as part of the evaluation process for the grant we use to attend the conference. See Appendix XI. This survey is quantifiable whereas ours is not. We will continue to use feedback from the chemistry department survey for student comments but use the REAL survey to give an indirect measure of student's ability to apply their knowledge of chemistry through course-based class projects and/or independent research projects by focusing on results from statement 2 (While participating in this activity, I applied knowledge and/or ideas that I learned in university classes.) and statement 7 (Participation in this activity made a meaningful contribution to my educational experience at Francis Marion University.) from the survey.

Assessment Results

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above 80% (benchmark) on capstone writing assignments that assess their ability to summarize chemical concepts. (PLO #2 and #4)

Assessment Results for SLO# 1.0: The four students who completed assignments in the Spring 2025 Chemistry Senior Capstone (Chem 499) were assessed on writing assignments (Appendix I) based on a journal article of their interest, an assignment that teaches them to create their own bibliography/reference database (Appendix III), a half-life your message assignment that forces students to focus on the subject of their research paper (Appendix III), and a research paper outline, rough draft and final paper. The students scored an 84% average on these assignments. This is below the average baseline (94%) for the last three years but is above the benchmark (80%) and only slightly below target (85%).

SLO# 2.0: 50% of graduating Chemistry students will perform at or above the 50th percentile (benchmark) on their analysis of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. (PLO #2) The exam, which is the ACS (American Chemical Society) Diagnostic of Undergraduate Chemical Knowledge (DUCK) exam, consists of several chemistry scenarios testing integrated chemical concepts, each of which is followed by several multiple-choice questions based on the given scenario. There are 60 questions in all.

Assessment Results for SLO# 2.0: The course instructor administered the 2018 version of the DUCK exam for the spring 2025 semester. National percentile rankings are included in Appendix II. The four senior chemistry majors who completed the DUCK exam in the capstone course scored a 42, 39, 39, and 20 out of 60 questions. This resulted in percentiles of 88, 79, 79 and 4. The average score for the class was 35 out of 60 giving an average percentile of 63. Three students performed well above the 50th percentile and one below, giving 75% above the 50th percentile but all students except one (25% at 88th percentile) were below the baseline for the previous year (50% at 85th percentile). The class achieved the benchmark (50% at 50th percentile) and target (55% at 55th percentile) with 75% above the 50th percentile.

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% (benchmark) level on their ability to analyze technical information through written communication. (PLO #1 and #4)

Assessment Results for SLO# 3.0: The four students who participated in spring 2025 Chem 499 Senior Capstone, scored 73% on average on their chemistry research paper as graded by the Chemistry 499 Capstone instructor using a standard scientific research paper rubric (Appendix IV). Our baseline (3-year average of 85%), benchmark (80%) and target (85%) were not met this year but the average for this year and the last three years puts the baseline at 81% which exceeds the benchmark and approaches the target.

SLO #4.0: Students in the Chemistry Senior Capstone course, on average, will perform at the 80% (benchmark) level or above when demonstrating competency in articulating technical information through oral communication.

Assessment Results for SLO# 4.0: The four students in the Chemistry Senior Capstone course (Chem 499), performed at 86% average on their chemistry oral presentation as graded by the chemistry faculty using a standard scientific, department-generated rubric (Appendix V). We did not meet our baseline (87%, based on past 3 years average) but exceeded the benchmark (80%) and target (82%) for SLO #4.

SLO #5.0: All students enrolled in Chemistry 201 will demonstrate at least an adequate level of 70% on their understanding of laboratory safety procedures and a baseline of 76% will perform at a level of 90% or higher was set last year.

Assessment Results for SLO# 5.0: All fifty-seven students enrolled in Chemistry 201 demonstrated an understanding of laboratory safety procedures at the 70% level or above based on a comprehensive and cumulative lab safety exam that was produced and administered by the Chemistry Department. Respective lab instructors graded the lab safety exams. Our minimum for SLO #5 remains that 100% of students achieve a score of 70% or higher to remain in the course and a baseline was set of 76% scoring 90% or higher. Of the fifty-seven students taking the exam, 84% scored at 90% or higher. This exceeds the baseline (76% scoring at 90% or higher), benchmark (78% scoring at 90% or higher) and target (80% scoring at 90% or higher).

SLO #6.0: Chemistry majors will have accrued over the period of their undergraduate studies, an overall favorable view of the Department of Chemistry's program, instruction, and facilities determined by their rating of these areas in an exit survey. (PLO #6)

Assessment Results for SLO # 6.0: To help assess the quality of its instruction, advising, and facilities, the Department of Chemistry administered an exit interview questionnaire (Appendix VI) to the chemistry majors enrolled in the senior capstone course. The questionnaire is grouped into questions pertaining to the courses, advising and instruction, facilities and equipment, and a section for comments about the program. Opinion questions were assigned a value of 5 for "strongly agree" to 1 for "strongly disagree" to allow quantifiable results for the questionnaire. The maximum value for the questionnaire is 160. This year, the instructor inadvertently gave the older version (also in Appendix VI) of the questionnaire, which is not quantifiable so, we have no baseline for this year and can't set a benchmark and target. For this reason, these will need to be set during 2025-2026.

In reviewing the old survey that was given, the students gave overall positive responses to departmental questions about courses, instruction, facilities, equipment and the faculty. All four students expressed ways to improve Physical Chemistry II (Chem 302); these included having more exams, more homework assignments and more review of equations in class. The majority of the students expressed the importance of research to the program.

Gen Ed Assessment (SLO #7 and SLO #8)

SLO #7.0: Students who have completed Chemistry 111 will have the ability to apply fundamental math skills and principles in various applications.

Assessment Results for SLO #7.0: Chem 112 students were given a 12-question quiz (Appendix VIII) at the beginning of the semester that spanned the main topics covered in Chem 111. Of the 12 questions, 6 questions were focused on application of fundamental math skills (Goal 4 (Appendix VII) and SLO 7.0). Topics covered were unit conversions, units of temperature, molar mass, balancing equations, stoichiometry, and gas laws. The other six questions were focused on scientific principles (Goal 5 (Appendix VII), SLO 8.0) – atomic structure, nomenclature, acid/base neutralization, valence electrons, electronegativity and Lewis structures. Students had an average score of 48% (Appendix IX) on the questions that focused on application of fundamental math skills. This is below the baseline average of 59%. The benchmark will be set at 52% which is above this year's baseline with a target of 55% (based on the average of this year and the last two years) over the next three years (through 2027-2028).

SLO #8: Students who have completed Chemistry 111 will have the ability to describe the natural world and apply scientific principles to critically analyze experimental evidence and reach conclusions.

Assessment Results for SLO #8.0: Chem 112 students were given a 12-question quiz (Appendix VIII) at the beginning of the semester that spanned the main topics covered in Chem 111. Of the 12 questions, 6 questions were focused on application of fundamental math skills (Goal 4 (Appendix VII) and SLO 7.0). Topics covered were unit conversions, units of temperature, molar mass, balancing equations, stoichiometry, and gas laws. The other six questions were focused on scientific principles (Goal 5 (Appendix VII), SLO 8.0) – atomic structure, nomenclature, acid/base neutralization, valence electrons, electronegativity and Lewis structures. Students had an average score of 35% (Appendix IX) on the questions that focused on scientific principles. This is below the average baseline of 47%. The benchmark will be set at 39% which is above this year's baseline with a target of 43% (based on the average of this year and the last two years) in three years (through 2027-2028).

SLO #9.0: Students who attended and/or presented research in the scientific community will reflect on the quality of their experience based on survey questions. (PLO #3)

Students who attended and/or presented their research at a conference completed a survey that requires them to summarize research posters and presentations they attend, to meet new people, to reflect on their future goals, to reflect on their subject knowledge compared peers, and what they learned about themselves and the city they visited. See Appendix X for an example of the chemistry department survey. The REAL (Ready to Experience Applied Learning) committee also requires students to fill out a survey as part of the evaluation process for the grant we use to attend the conference. See Appendix XI. This survey is quantifiable, whereas ours is not. We will continue to use feedback from the chemistry department survey for student comments but use the REAL survey to give an indirect measure of student's ability to apply their knowledge of chemistry through course-based class projects and/or independent research projects by focusing on results from statement 2 (While participating in this activity, I applied knowledge and/or ideas that I learned in university classes.) and statement 7 (Participation in this activity made a meaningful contribution to my educational experience at Francis Marion University.) from the survey.

Eight students and three faculty attended the Southeast Regional Meeting of the American Chemical Society (SERMACS) in Atlanta from Oct 23-26, 2024. Of those attending, six students presented research posters, and one faculty completed an oral presentation. Below are pertinent comments from the student surveys of those who attended:
- "Yes, this experience made me want to go to graduate school for solar energy and help the world."
- "I achieved my networking goals and talked to many graduate schools"
- "I found it interesting that most of the scientists were studying their variety of topics in order to gain more knowledge that would further benefit and advance society. It surprised me to learn about all the important applications such as drug development, allergenic understanding, etc."
- "I gained a greater respect for what I have been studying for the past 3 years…"
- "I 100% agree, going (to SERMACS) introduces you to what all you can do with your major."
- "Many of the posters and oral presentations I attended spoke on research that involved applications I learned in analytical and general chemistry."
- "One of the oral presentations that I found interesting was one given by Dr. Cary Supalo where he, as a blind man, collaborated in several projects to help expand access to chemistry and other STEM fields to blind students."
- "Yes, it showed that some people want to truly help the world and build community."

The results of the REAL survey for statement 2 was a 4.29 mean out of 5 for the seven students who completed the survey showing that students agreed that the conference required them to apply knowledge and ideas they have learned in chemistry courses. The results for statement 7 also had a mean of 4.29 out of 5 indicating that students felt that attending the conference was meaningful to their educational experience. Using these results, we have set a baseline of 4.29 mean for statements 2 and 7 from the REAL survey. Our benchmark will be to achieve a 4.5 mean for the statements with a target of 4.5 for the next 3 years. Comments to statements 2 and 7 from the REAL survey are also included in Appendix XI.

Action Items

The focus of the Chemistry Department Annual Planning Retreat in May was learning more about the purpose of the IE Report, reviewing data for a more in-depth analysis of our program, students and faculty, and looking at ways to improve. A major issue is that five of our nine SLOs are dependent on our Capstone course which typically has five or less students enrolled annually. The data from this small number of students in this one course may not be truly reflective of our program progress. At our first meeting in the fall, we will consider changing or adding some SLOs to span other courses in the program that contain a larger number of students to give a better reflection of student progress.

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above 80% (benchmark) on capstone writing assignments that assess their ability to summarize chemical concepts. (PLO #2 and #4)

The students scored an 84% average on these assignments. This is below the average baseline (94%) for the last three years but is above the benchmark (80%) and only slightly below target (85%). We will make adjustments to the benchmark and target in 2025-2026.

SLO# 2.0: 50% of graduating Chemistry students will perform at or above the 50th percentile (benchmark) on their analysis of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. (PLO #2)

The average score for the class was 35 out of 60 giving an average percentile of 63. Three students performed well above the 50th percentile and one below, giving 75% above the 50th percentile. All students except one (25% at 88th percentile) were below the baseline for the previous year (50% at 85th percentile). The class achieved the benchmark (50% at 50th percentile) and target (55% at 55th percentile) with 75% above the 50th percentile. Adjustments to the benchmark and target will be determined based on data for the upcoming year (2025-2026).

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% (benchmark) level on their ability to analyze technical information through written communication. (PLO #1 and #4)

The students scored 73% on average on their chemistry research paper . Our baseline (3-year average of 85%), benchmark (80%) and target (85%) were not met this year but the average for this year and the last three years puts the baseline at 81% which exceeds the benchmark and approaches the target. These scores were lower than expected this year so we will focus on improving in this area for the upcoming year and will discuss setting a new benchmark and target based on these results.

SLO #4.0: Students in the Chemistry Senior Capstone course, on average, will perform at the 80% (benchmark) level or above when demonstrating competency in articulating technical information through oral communication.

The students performed at 86% average on their chemistry oral presentation. We did not meet our baseline (87%, based on past 3 years average) but exceeded the benchmark (80%) and target (82%) for SLO #4. Improvements in oral presentations have been noted by having the students present midsemester rather than end of semester. We will evaluate if the benchmark and target should be raised for the next report.

SLO #5.0: All students enrolled in Chemistry 201 will demonstrate at least an adequate level of 70% on their understanding of laboratory safety procedures and a baseline of 76% will perform at a level of 90% or higher was set last year.

Our minimum for SLO #5 remains that 100% of students achieve a score of 70% or higher to remain in the course and a baseline was set of 76% scoring 90% or higher. Of the fifty-seven students taking the exam, 84% scored at 90% or higher. This exceeds the baseline (76% scoring at 90% or higher), benchmark (78% scoring at 90% or higher) and target (80% scoring at 90% or higher). Adjustments to the benchmark and target will be determined next year.

SLO #6.0: Chemistry majors will have accrued over the period of their undergraduate studies, an overall favorable view of the Department of Chemistry's program, instruction, and facilities determined by their rating of these areas in an exit survey. (PLO #6)

This year, the instructor inadvertently gave the older version of the questionnaire, which is not quantifiable so, we have no baseline for this year and can't set a benchmark and target. For this reason, these will need to be set during 2025-2026 when we have more data from the correct questionnaire.

SLO #7.0: Students who have completed Chemistry 111 will have the ability to apply fundamental math skills and principles in various applications.

Students had an average score of 48% on the questions that focused on application of fundamental math skills. This is below the baseline average of 59%. The benchmark will be set at 52% which is above this year's baseline with a target of 55% (based on the average of this year and the last two years) over the next three years (through 2027-2028).

SLO #8: Students who have completed Chemistry 111 will have the ability to describe the natural world and apply scientific principles to critically analyze experimental evidence and reach conclusions.

Students had an average score of 35% on the questions that focused on scientific principles. This is below the average baseline of 47%. The benchmark will be set at 39% which is above this year's baseline with a target of 43% (based on the average of this year and the last two years) in three years (through 2027-2028).

SLO #9.0: Students who attended and/or presented research in the scientific community will reflect on the quality of their experience based on survey questions. (PLO #3)

Students attended a conference completed a chemistry department survey and a REAL grant survey. The chemistry department survey comments in the assessment illustrate the positive effects of participating in and being exposed to research. We used the quantifiable results of the REAL survey for statement 2 and statement 7 for this SLO. Using these results, we have set a baseline of 4.29 mean for statements 2 and 7. Our benchmark will be to achieve a 4.5 mean for the statements with a target of 4.5 for the next 3 years.

Appendices

I. 2024-2025 IE Knowledge/Skills Instruments Measured and Student Scores
II. DUCK Exam Information and 2018 DUCK Preliminary Norms
III. Example Capstone Writing Assignments
IV. Chemistry Term Paper Rubric
V. Chemistry Oral Presentation Rubric
VI. Exit Interview Questionnaire 2022 Version and Old Version
VII. General Education Goals 2024-2025
VIII. General Education Goals Chemistry Quiz
IX. Data for General Education Chemistry Quiz
X. Chemistry Conference Survey
XI. REAL Grant Survey

Appendix I: 2024-2025 IE Knowledge/Skills Instruments Measured and Student Scores

Student	Average of Written Assignments	Oral Research Presentation	Written Research Presentation	2018 DUCK Exam Raw Score 60 Questions	2018 DUCK Percentile
1	94.8	90.7	83	42	88
2	56.5	85.5	44	39	79
3	95.5	94.7	95	39	79
4	90.0	74.5	70	20	4
Class Average	**84.2**	**86.4**	**73**	**35**	**63***

*Not an average, based on data provided by ACS (see appendix II)

Appendix II. DUCK Exam Information

Description of DUCK Exam taken from ACS webpage

The Diagnostic of Undergraduate Chemistry Knowledge (DUCK) exam is designed to be taken at or near the end of a four-year undergraduate curriculum. All items on the exam are part of scenarios that require knowledge from more than one traditional area of chemistry, so students are less likely to segment their knowledge into such areas and be successful on this exam.

(https://uwm.edu/acs-exams/exams/2018-diagnostic-of-undergraduate-chemistry-knowledge-exam/)

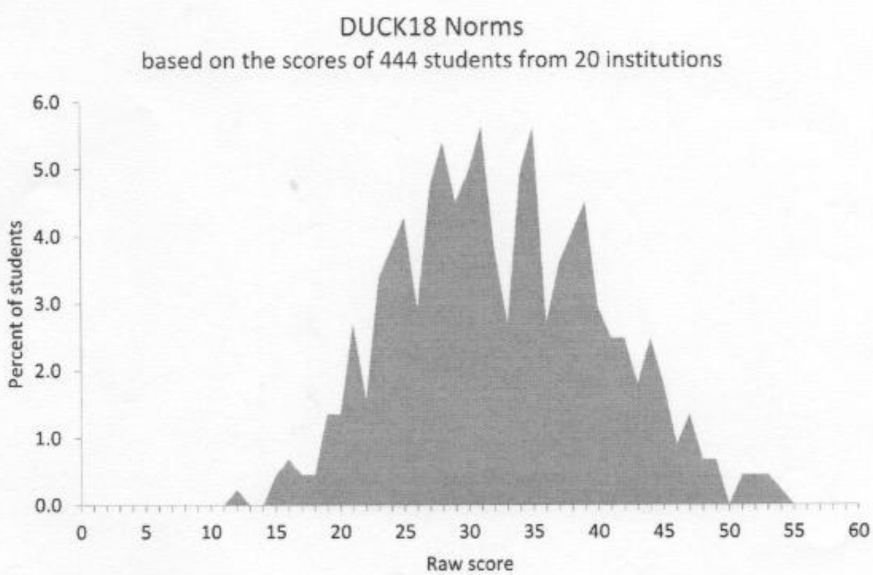
American Chemical Society Division of Chemical Education
Composite Norms
Diagnostic of Undergraduate Chemistry Knowledge 2018 (DUCK18)

Score	Percentile
60	100
59	100
58	100
57	100
56	100
55	100
54	100
53	100
52	99
51	99
50	98
49	98
48	97
47	96
46	95
45	94
44	92
43	90
42	88
41	85
40	82
39	79
38	74

Score	Percentile
37	70
36	67
35	63
34	58
33	54
32	51
31	46
30	41
29	36
28	31
27	26
26	22
25	19
24	15
23	11
22	8
21	6
20	4
19	3
18	2
17	2
16	1
15	0

Score	Percentile
14	0
13	0
12	0
11	0
10	0
9	0
8	0
7	0
6	0
5	0
4	0
3	0
2	0
1	0
0	0

Mean	32.5
Std. deviation	7.8
Median	32
KR-21 reliability	0.77
Std error/meas	3.76



Appendix III: Example Capstone Writing Assignments

Journal Article Assignment

Find and read the article then provide the following information:

1. Give the bibliographical reference for the paper. (title, authors, journal, volume, pages, publish date).

2. Give a one-paragraph summary of the experiment (in your words – not the abstract).

3. Find 10 chemistry/science related words that you do not know and find out what they mean. List them and give "your definition" and relate how it applies to the paper. (Can't be something used in number 3.)

4. Discuss any one chemical technique and one instrumental technique used and explain the technique and how it was used in the research. (Can't be something used in number 2.)

5. Briefly discuss a finding that you found interesting and that you would like to research further.

6. What did you like about this research paper? What didn't you like?

Zotero Assignment

Zotero is a program that allows you to collect, store and share research. For this assignment, we will use it to store references in order to create a bibliography for a "research paper".
Download the free Zotero software to your computer by going to www.zotero.org. You will need to set up a username and password in order to sync Zotero with another computer. Your library can be available to you on any computer with the software. Once the software is downloaded, you will also need to download the macro to use this program with Microsoft Word. You should be prompted to do so once you have downloaded and open Zotero.

Once you have done this, open Zotero on your computer. Go to the library website and find the journal article of interest. Save the article to your computer and then drag and drop the file into Zotero. This will create a citation for the paper as well as save the pdf file.

Complete this process for the four more journal articles – you can use your classmates' articles and two other references from the paper you chose. Therefore, you should have five references in Zotero when you are done.
Once all the articles are in Zotero, go to Word and type in the first sentence of the first paragraph in one of the papers. At the end the sentence, reference the paper it comes from by clicking on Zotero from the menu in Word. A new menu will pop up. Click on Add/Edit Citation. You will be asked to choose your citation style. Choose the American Chemical Society style. After choosing this, an entry bar will pop up. You can type in the author's last name to choose the article or click on the arrow to see the list in your Zotero library (classic view) and choose the appropriate paper this way. Repeat this process for the other four journals creating a paragraph with your sentences.

The last sentence of your paragraph will be, "All of these journal articles are laboratory experiments." For this sentence, reference all five at once. To do this, click on Add/Edit Citation. Click on the pull-down menu for the classic view. Click on Multiple Sources and choose the articles needed by clicking on the title and then the green arrow to add them to the citation box. When you have chosen the ones you need, click ok and multi-numbered citation will be added to the sentence.

Once you have typed in all of your sentences, space down from your text and click on add/edit bibliography. Your references will appear numbered as they are in your text.

To change citation styles to something other than ACS, highlight the bibliography and go to document preferences and choose a different style.

If the style you want is not on the list, go to “manage styles” and then to “get additional style” and type in the journal whose citation style you would like to follow or scroll down the list for it. For example, in manage styles, type in Science and add the citation style to the list. Then highlight your bibliography and click on document preferences, choose Science and your bibliography and document should update.

Turn in two pages. One page with your paragraph and a bibliography in ACS citation style and one with our paragraph with the bibliography in Science citation style.

Chem 499 Senior Chemistry Capstone
Half-Life Your Message

Purpose: This assignment adapts a technique from improvisational theatre to help students refine their choice of research paper topic and practice delivering information in a concise, effective manner that focuses on the most important points.

Task: This will be an in-class speaking assignment. Before the assignment, students will be given a brief (~5 min) window to consider and outline their talk. Students will be given two minutes to explain their topic. They will then repeat the process, but this time with only one minute allotted to speak. Finally, the student will repeat the process a third time but with a thirty second timer. After the assignment, students will submit a brief one paragraph reflection on what they learned through the process and how it has affected their approach to their research topic. Students are encouraged to consider whether they are satisfied with the message they were able to convey, and how they will continue to refine their ideas as they prepare their research paper outline.

Criteria for Success: The successful presentation will make full use of the time allotted while presenting as complete an idea as possible. As students iterate on their talk, the successful presentation will become more focused on the core idea at the heart of their project topic. The final reflection step is crucial to reaping the full benefits of the process.

Appendix IV. Chemistry Term Paper Rubric

Chemistry 499 Capstone Research Paper Rubric

Student's Name ___________________ Faculty Reviewer ____________________

	Category	Scoring Criteria	Score Range	Reviewer's Score
1	**Abstract**	(a) Main points are briefly presented, (b) keywords accurately describe information in report, (c) abstract is less than 200 words long	**0-5** 5 being the highest	
2	**Introduction**	(a) effectively communicates the purpose and importance of the research topic in the context of chemistry, (b) supplies and demonstrates understanding and proper use of needed information and terms, (e) lays out the framework for the rest of the paper (f) includes visual aids such as graphs, tables, equations, and schemes, etc. (g) each type of visual aid must be cited in text and in consecutive numerical order, (h) each table or graph must have an appropriate descriptive caption or title	**0-15** 15 being the highest	
3	**Body**	(a) shows command of topic, (b) chemistry content is sufficient (c) describes experimental procedures and results and makes valid interpretation of results, (d) contains accurate information, (e) draws on multiple areas, (f) content backed up by multiple, refereed, and credible sources, (g) includes visual aids such as graphs, tables, equations, and schemes, etc., (h) each type of visual aid must be cited in text and in consecutive numerical order, (i) each table or graph must have an appropriate descriptive caption or title	**0-25** 25 being the highest	
4	**Conclusion**	(a) Communicates a logical conclusion that follows from the body, (b) summarizes and evaluates the major points, strengths and possible weaknesses of the research, (c) discusses further research needed in the area	**0-20** 20 being the highest	
5	**References and Appendices**	(a) Cite at least six references from at least three different peer review journals, (b) references are complete and numbered, (c) references follow acceptable format (see ACS Style Guide or the reference style of one of the journals cited, (d) supplementary materials are located at the back of report, (e) sources of information including tables, graphics, and other visual aids are appropriately cited and referenced	**0-10** 10 being the highest	
6	**Appearance and Format**	(a) makes effective use of headings and subheadings, (b) pages are numbered and bound in a folder, (c) uses appropriate font sizes, the height of the letters must not be smaller than 10-point type density or larger than 12 point, (d) uses normal 1" margins.	**0-5** 5 being the highest	
7	**Writing Style and Grammar**	(a) writing is coherent, clear, concise, engaging, and gets point across (b) no sentence fragments, comma splices, or fused sentences, (c) no errors in punctuation , spelling, and/or in the placement of words, (d) makes good use of strong nouns and action verbs	**0-10** 10 being the highest	
8	**Other Relevant Factors**	(a) term paper should be around 5-10 pages including visual aids, (b) Title is sufficiently narrowed down and reflects the content of the paper (c) shows some understanding of other relevant areas outside of chemistry, (d) engaging, (e) good choice of topic, (e) new and interesting ideas	**0-10** 10 being the highest	
9	**Faculty Comments and Recommendations for Rubric Improvements**		**100 Pts maximumm**	**Reviewer's Total Score**

Appendix V. Chemistry Oral Presentation Rubric

Chemistry 499 Capstone Course

Chemistry Oral Presentation Rubric

Student's Name ____________________________

Faculty Reviewer ___________________________

	Category	Scoring Criteria	Score Range	Reviewer's Score
1	**Introduction**	(a) Good opening statement, (b) effectively communicates the purpose and importance of the talk and research in the context of chemistry, (c) supplies and demonstrates understanding of background information, (d) lays out the framework for the rest of talk	**0-10** 10 being the highest	
2	**Chemistr y Content**	(a) Describes experimental procedures and results relating to chemistry, (b) contains accurate information, (c) draws on multipleareas, (d) good use and explanation of visual aids (e.g., data charts, illustrations, and drawings), (e) content backed up by multiple, refereed, and credible sources	**0-30** 30 being the highest	
3	**Knowledg eof Topic**	(a) Understands basic chemical terms and principles relevant to the research for the level of senior chemistry majors, (b) evaluates the research (e.g., strong and weak points) at the level of senior chemistry majors, (c) answers questions adequately without a distractive use of notes, internet, or other persons	**0-30** 30 being the highest	
4	**Conclusion**	(a) Communicates a logical conclusion, (b) summarizes the major points, strengths and possible weaknesses of the research, (c) discussesfurther research needed in the area	**0-10** 10 being the highest	
5	**Delivery**	(a) Speaks clearly and presentation does not seem to be read from a scripted text, (b) well organized, (c) effective and smooth transitions, (d) dresses appropriately, (e) good body language, (f) delivers presentation adequately and generally not reading from prepared notes (g) does not go to internet to answer questions from the audience, (h) presentation done within the 15 minutes (not counting Q&A's) allotted time	**0-10** 10 being the highest	
6	**Other Relevan tFactors**	(a) Adequately understands other relevant areas outside of chemistry, (b) engaging; (c) creativity; (d) topic choice; (e) new and interesting ideas; (f) answers questions adequately without the use of note cards, internet, or other persons	**0-10** 10 being the highest	
7	**Faculty Comments and Recommendations for Rubric Improvements**		**100 Pts maximu m**	**Reviewer's Total Score** _________

Appendix VI. Exit Interview Questionnaire (2022 Version)

Exit Interview Questionnaire

This is an exit questionnaire to determine your response to the department's programs, resources, and quality of instruction.

Name_____________________ **Date** ___________

Major(s)_____________________ **Year Enrolled at FMU** ___________

Minor/Collaterals ____________________

<u>CHEMISTRY COURSES</u>

1. Which Chemistry courses have you taken at FMU? (Check appropriate box.)

- ☐ Chem 150 (Chem for Everyday Life)
- ☐ Chem 101/111 (Gen Chem I)
- ☐ Chem 102/112 (Gen Chem II)
- ☐ Chem 201 (Organic Chem I)
- ☐ Chem 202 (Organic Chem II)
- ☐ Chem 203 (Quant)
- ☐ Chem 204 (Forensic Chemistry)
- ☐ Chem 297 (Intro the Research)
- ☐ Chem 301 (P-Chem I)
- ☐ Chem 302 (P-Chem II)
- ☐ Chem 303 (Instrumental)
- ☐ Chem 313 (Environmental)
- ☐ Chem 402 (Inorganic Chem)
- ☐ Chem 403 (Synthesis & Char)
- ☐ Chem 404 (Biochem I)
- ☐ Chem 408 (Biochem II)
- ☐ Chem 405 (Adv Org)
- ☐ Chem 407 (Intro to Polymer Sci)
- ☐ Chem 497 (Special Studies)
- ☐ Chem 498 (Chem Internship)
- ☐ Chem 499 (Capstone)

2. The department offers a sufficient variety of courses.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

3. The lab courses improved my understanding of principles of chemistry.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

4. There were plenty of "hands-on" experiences in the labs.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

5. I found the lower-level Chemistry courses to be a good foundation for the upper-level courses.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

6. I was able to complete my degree in a standard amount of time (4-5 yrs.). If strongly disagree, please explain in comments.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

7. I completed Chem 297, Chem 497 and/or a paid research project.

Yes No If yes, answer the next question.

8. The independent research project provided a unique opportunity to apply basic knowledge and operate advanced equipment applicable to my project.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

9. The literature research project in Chem 499 (Capstone) enhanced my ability to formulate and compare ideas for my topic.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

10. After graduation, I intend to:

- ☐ Take a teaching position
- ☐ Attend Medical School
- ☐ Attend Graduate School
- ☐ Attend Pharmacy School
- ☐ Attend Dental School
- ☐ Find a Position in Industry
- ☐ Other: _____________

11. I feel adequately prepared for my career after graduation.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

5	4	3	2	1

Comments:

12. I felt that my chemistry courses were comparably challenging to courses I took in other departments.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

13. My chemistry classes prepared me to think independently and apply this knowledge to new situations.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

ADVISING AND INSTRUCTIONAL QUALITY

1. My chemistry advisor was knowledgeable about the Chemistry program (i.e., courses, prerequisites).

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

2. I regularly attended advising appointments with my chemistry advisor.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

3. Overall, my instructors were very effective.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

4. My instructors were appropriately available for help outside the class.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

5. My instructors used a variety of teaching styles (i.e., demonstrations, problem assignments,library assignments, class discussions).

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

6. My instructors were explicit in stating the course objectives and the evaluation methods to be used.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

7. Course materials (textbooks, lab manuals, online homework) were appropriate for the courses (detailed instructions, appropriate background, etc.).

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

8. I had a good relationship with my instructors, and they expressed an interest in my progress in learning.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

FACILITIES AND EQUIPMENT

1. Overall, how would you rate the department's facilities (i.e., classroom space, desks, lighting, temperature control, readable screens and chalkboards, etc.)?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

2. How would you rate the effectiveness of the use of equipment in lecture demonstrations in terms ofhelping you master the course material? (general demos, use of lab equipment)

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

3. How would you rate multimedia and online integration in your chemistry lectures/labs?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

4. How would you rate the department's laboratory equipment in terms of operating condition?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

5. The department's laboratory equipment is sufficiently up to date.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

6. The department's laboratory equipment is sufficiently maintained.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

7. Instruments are available in sufficient number for the labs

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

8. How would you rate the department in terms of access to computers and various types of software (i.e., internet access, Office)

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

9. The department's computer facilities/software are sufficiently up to date.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Comments:

10. The department's computer facilities are sufficiently maintained.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

5	4	3	2	1

Comments:

11. If you were involved in a research project, how would you rate the department in terms of obtainingany equipment necessary for your project?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

12. How would you rate the department in terms of availability and proper use of safety related equipment?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

13. How would you rate the James A. Rogers Library for book holding, facilities, and reference materials, including electronic materials?

Excellent	Good	Acceptable	Poor	Inadequate
5	4	3	2	1

Comments:

FINAL COMMENTS:

Which will you complete?

- ☐ Traditional Chemistry Degree
- ☐ Chemistry Degree with Forensic Option
- ☐ ACS Certified Degree
- ☐ Chemistry Degree with Pharmaceutical Option

Why did you choose your chemistry degree track and/or option?

1. I am going to graduate school/professional school, and I feel adequately prepared in Chemistry.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
5	4	3	2	1	0

Comments:

2. I am going to work in industry, and I feel competent in my technical skills and knowledge of Chemistry.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
5	4	3	2	1	0

Comments:

3. I am going to teach, and I feel prepared to teach Chemistry.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
5	4	3	2	1	0

Comments:

4. Which Chemistry courses do you feel were most beneficial? Why?

5. Which Chemistry courses do you feel were the least beneficial? Why?

6. Which Math courses did you find most beneficial in reinforcing concepts in your chemistry courses? Why?

7. Which Math courses did you find least beneficial in reinforcing concepts in your chemistry courses? Why?

8. Do you have suggestions for improvement in the Chemistry program?

9. The best thing about the Chemistry program is:

10. The worst thing about the Chemistry program is:

Exit Interview Questionnaire (Old Version)

This is an exit questionnaire to determine your response to the department's programs, resources, and quality of instruction.

Name____________________ **Date** ___________

Major(s)____________________ **Year Enrolled at FMU** ___________

Minor/Collaterals ____________________

CHEMISTRY

14. Which Chemistry courses have you taken at FMU? (Check appropriate box.)
    - ☐ Chem 150 (Chemistry for Everyday Life)
    - ☐ Chem 101/111 (Gen Chem I)
    - ☐ Chem 102/112 (Gen Chem II)
    - ☐ Chem 201 (Organic Chem I)
    - ☐ Chem 202 (Organic Chem II)
    - ☐ Chem 203 (Quant)
    - ☐ Chem 301 (P-Chem I)
    - ☐ Chem 302 (P-Chem II)
    - ☐ Chem 303 (Instrumental)
    - ☐ Chem 313 (Environmental)
    - ☐ Chem 402 (Inorganic Chem)
    - ☐ Chem 404 (Biochem I)
    - ☐ Chem 408 (Biochem II)
    - ☐ Chem 405 (Adv Meth Org Syn & Char)
    - ☐ Chem 407 (Intro to Polymer Sci)
    - ☐ Chem 297 (Intro the Research)
    - ☐ Chem 497 (Special Studies)
    - ☐ Chem 498 (Chem Internship)
    - ☐ Chem 499 (Capstone)

15. Does the department offer a sufficient variety of courses?

    Yes No Comments:

16. Do you find that the lab exercises improved your understanding of Chemistry?

    Yes No Comments:

17. Do you get enough "hands-on" experience in the lab?

    Yes No Comments:

18. Do you find the lower-level Chemistry courses to be a good foundation for the upper-level courses?

    Yes No Comments:

19. Were you able to take chemistry courses or labs at acceptable times of the day or week?

    Yes No Comments:

20. Did your chemistry classes have an appropriate number of students?

    Yes No Comments:

21. Were the chemistry courses offered on an appropriate semester basis?

Yes No Comments:

22. Should a senior research project be required of all Chemistry majors?
Yes No Comments:

23. After graduation, do you intend to:
Teach High School **Go to Graduate School** **Take a Job** **Other______________**

24. Do you feel adequately prepared for your career after graduation?
Yes No Comments:

25. In comparison with other courses in other departments, how challenging did you find your chemistry courses?
Too demanding **Not challenging enough** **Appropriate in difficulty**
Comments:

ADVISING AND INSTRUCTIONAL QUALITY

1. Was your advisor knowledgeable about the Chemistry program (i.e., sequence, prerequisites)?
Yes No Comments:

2. Did your advisor assist you in long-range planning?
Yes No Comments:

3. How effective overall were the instructors in your Chemistry classes?
Excellent **Good** **Acceptable** **Poor** **Inadequate**
Comments:

4. Were your instructors appropriately available for help outside the class?
Yes No Comments:

5. Did your instructors use a variety of teaching styles? (i.e., demonstrations, problem assignments, library assignments, class discussions)
Yes No Comments:

6. Were the instructors explicit in stating the course objectives and the evaluation methods to be used?
Yes No Comments:

7. Were lab manuals appropriate for the courses (detailed instructions, appropriate background, etc.)?
Yes No Comments:

8. Do you feel that your professors cared about you and your progress in learning?
Yes No Comments:

9. Did your chemistry classes prepare you to think independently and apply this knowledge to new situations?
Yes No Comments:

FACILITIES AND EQUIPMENT

14. Overall, how would you rate the department's facilities (i.e., classroom space, desks, lighting, temperature control, readable screens and chalkboards, etc.)?
Excellent Good Acceptable Poor Inadequate
Comments:

15. How would you rate the effectiveness of the use of equipment in lecture demonstrations in terms ofhelping you master the course material?
Excellent Good Acceptable Poor Inadequate
Comments:

16. How would you rate multimedia and online integration in your chemistry lectures/labs?
Excellent Good Acceptable Poor Inadequate
Comments:

17. How would you rate the department's laboratory equipment in terms of operating condition?
Excellent Good Acceptable Poor Inadequate
Comments:

18. Would you say the department's laboratory equipment is sufficiently up to date?
Yes No Comments:

19. Would you say the department's laboratory equipment is sufficiently maintained?
Yes No Comments:

20. Are instruments available in sufficient number for the labs?
Yes No Comments:

21. How would you rate the department in terms of access to computers and various types of software (i.e., internet access, Office)
Excellent **Good** **Acceptable** **Poor** **Inadequate**
Comments:

22. Would you say the department's computer facilities/software are sufficiently up to date?
Yes **No** Comments:

23. Would you say the department's computer facilities are sufficiently maintained?
Yes **No** Comments:

24. If you were involved in a research project, how would you rate the department in terms of obtainingany equipment necessary for your project?
Excellent **Good** **Acceptable** **Poor** **Inadequate**
Comments:

25. How would you rate the department in terms of availability and proper use of safety related equipment?
Excellent **Good** **Acceptable** **Poor** **Inadequate**
Comments:

26. How would you rate the James A. Rogers Library for book holding, facilities, and reference materials?
Excellent **Good** **Acceptable** **Poor** **Inadequate**
Comments:

FINAL COMMENTS:

Which will you complete? **Traditional Chemistry Degree** (Option _________) or **ACS Certified Degree**

Why did you choose your chemistry degree track and/or option?

11. If you are going to graduate school, do you feel adequately prepared in your major subject?
Yes **No** **N/A** Comments:

12. If you are going to work in industry, do you feel competent in your technical skills and knowledge of your major subject?
Yes **No** **N/A** Comments:

13. If you are going to teach, do you feel prepared to teach your major subject?

Yes No N/A Comments:

14. Which Chemistry courses would you like to have removed or modified in the curriculum? Why?

15. Which Physics courses would you like to have removed or modified in the curriculum? Why?

16. Are there changes would you like to recommend for the required mathematics courses?

17. What recommendations would you make concerning computers and their uses at FMU?

18. What changes would you like to see in the Chemistry major at FMU?

19. What other suggestions for improvement in the Chemistry program would you like to make?

20. The best thing about the Chemistry program is:

21. The worst thing about the Chemistry program is:

22. Any other comments?

Appendix VII. Gen Ed Goals 2024-2025 (taken from Course Catalog, p. 59)

GENERAL EDUCATION GOALS & REQUIREMENTS FMU offers programs of study that encourage students to think critically and creatively, communicate clearly and honestly, develop appreciation of aesthetic values, and be concerned with the common good as well as their own interests. Our educational goals are sustained by the liberal arts tradition and seek to provide all baccalaureate degree students with the following:

Goal 1. The ability to compose effectively with rhetorical awareness, integrate relevant research when appropriate, and produce developed, insightful arguments.

Goal 2. The ability to demonstrate comprehension of different forms of communication.

Goal 3. The ability to explain artistic processes and evaluate artistic product.

Goal 4. The ability to use fundamental math skills and principles in various applications.

Goal 5. The ability to describe the natural world and apply scientific principles to critically analyze experimental evidence and reach conclusions.

Goal 6. The ability to recognize historical processes, to identify historical periodization, and to explain historical connections among individuals, groups, and ideas around the world.

Goal 7. The ability to recognize diverse social and cultural practices and to articulate connections between individual behavior and sociocultural processes.

Goal 8. The ability to describe the governing structures and operations of the United States, including the rights and responsibilities of its citizens.

Goal 9. The ability to apply critical thinking skills to assess arguments and solve problems.

Appendix VIII. General Education Goals (Chemistry Quiz)

Institutional Effectiveness Assessment 2024-2025

1. Convert 20.9 mL to L
    a. 20,900 L
    b. 2,090 L
    c. 0.0209
    d. 0.000209

2. What is the boiling point of water in Kelvin?
    a. 0 K
    b. 273 K
    c. 100 K
    d. 373 K

3. How many electrons are in an ion of ${}^{39}_{19}K^{+}$?
    a. 18
    b. 19
    c. 20
    d. 39

4. What is the name of the chemical compound with the formula Na_2O?
    a. Disodium monoxide
    b. Disodium oxide
    c. Sodium oxide
    d. Sodium (I) oxide

5. What is the molar mass of carbon dioxide?
    a. 28 g/mol
    b. 44 g/mol
    c. 58.9 g/mol
    d. 192 g/mol

6. Provide the coefficients to correctly balance the following equation: $\_C_3H_8 + \_O_2 \rightarrow \_CO_2 + \_H_2O$
    a. $C_3H_8 + 3\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
    b. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
    c. $2\ C_3H_8 + 10\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$
    d. $11\ C_3H_8 + 2\ O_2 \rightarrow 3\ CO_2 + 3\ H_2O$
7. If 6 moles of iron are oxidized with excess oxygen in the following reaction, what is the theoretical yield of iron (III) oxide in moles?

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s)$$

    a. 3 mol
    b. 9 mol
    c. 12 mol
    d. 48 mol

8. Predict the products of the acid-base reaction between hydrobromic acid (HBr) and sodium hydroxide (NaOH)
    a. $NaOBr + H_2$
    b. $NaH_2 + BrO$
    c. $H_2O + NaBr$
    d. $NaH + BrOH$

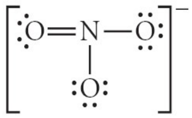
9. When a gas sample with a volume of 12 L at 1 atm is compressed to 2 atm, what is the new volume of the gas?
    a. 24 L
    b. 6 L
    c. 0.167 L
    d. 0.0833 L

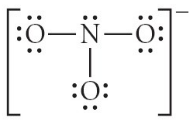
10. How many valence electrons are around the nucleus of a neutral atom of nitrogen?
    a. 7
    b. 14
    c. 8
    d. 5

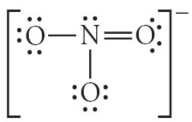
11. Which of the following elements is the most electronegative?
    a. Sodium
    b. Chlorine
    c. Cesium

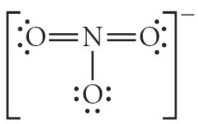
d. Iodine

12. Choose the **best** Lewis structure for the nitrate ion (NO_3^-).

a. 

b. 

c. 

d. 

Appendix IX. Data for General Education Goals Chemistry Quiz

SLO #7:

Fall & Spring	2024-2025	
n=	58	
Question	Topic	%Correct
1	Unit Conversion	58
2	Units of Temperature	26
5	Molar Mass	65
6	Balancing Equations	56
7	Stoichiometry	29
9	Gas Laws	54
	Overall Average	48

SL0 #8:

Fall & Spring	2024-2025	
n=	58	
Question	Topic	%Correct
3	Atomic Structure	32
4	Nomenclature	31

8	Acid/Base Neutralization	54
10	Valence Electrons	40
11	Electronegativity	39
12	Lewis Structures	14
	Overall Average	35

Appendix X. Chemistry Conference Survey

SERMACS 2024 Meeting Survey
Atlanta, GA
October 23--26, 2024

Name:___________________________ Major: ________________

Class Year:_____________

What are your plans or goals upon completion of your degree at FMU?

____

____

Presentations: *You must attend at least 10 oral presentations (only one from FMU) with at least one of them being a plenary lecture. Please fill out the information below for each presentation. The last one is larger and is reserved for the plenary lecture. For the FMU presentation, comment on the differences you saw between the practice and the conference presentation.*

Presentation 1 (Presentation number ________)

Title: ____

Presenter:__________________________ Industry/School Affiliation:_____________________________

Summary:

(Repeat information for Presentation 2-9)

Presentation 10 Plenary Lecture(Presentation number ________)

Title: ____

Presenter:__________________________ Industry/School Affiliation:_____________________________

Summary:

Posters: *You must attend at least 5 poster presentations (not FMU related) and fill out the following information.*

Poster 1 (Poster number ________)

Title: ____

Presenter:________________________ Industry/School Affiliation:___________________________

Summary:

(Repeat information for Posters 2-5)

Please comment on the overall differences you see in oral and poster presentations. Which format did you like best? Which did you learn the most from? Why? Which do you think is more difficult to prepare for?

Meeting New People

Professional: *You must introduce yourself to one professional person, get their business card and complete the following short interview.*

Name:________________________ Industry/School Affiliation:___________________________

Purpose of attending conference:

Level of Education (BS, MS, PhD, schools attended):

Research Interest:

Student: *You must introduce yourself to one student and complete the following short interview.*

Name:________________________ School Affiliation:___________________________

Purpose of attending conference:

Level of Education (BS, MS, PhD, schools attended):

Best thing about their school/program:

Attach Business Card of Professional and a brochure from a Graduate Program below:

Reflection Questions (write complete sentences):

What was your purpose in attending this conference?

Which **oral presentation** was your favorite? Why?

What **poster presentation** was your favorite? Why?

Which presentation\poster had the most chemistry that you understood? Which did you understand the least? What reasons can you give for these differences?

What was the **most interesting** thing you learned at the conference? On this trip?

What was the **most surprising** thing you learned at the conference? on this trip?

What was the **best** part of this trip?

Give an example of a concept or idea from a presentation and how that relates to something you have learned in chemistry class?

How would you rate your knowledge compared to others you met at the conference?

Did you meet a variety of different people on this trip? How are they different from you? What did you have in common with them?

What would have made this trip better? more useful?

If you did not present research at this conference, can you imagine yourself presenting at this conference as an undergraduate, graduate student or young professional in the future? Why or why not?

If you did present research, was this a positive experience? Why or why not? What could you have done to make this experience better?

Has attending this conference encouraged you to reevaluate your career path/goal after graduation?

If you had the opportunity to tour the city, where did you go? What are your impressions of the area?

Did you achieve your purpose in attending this conference (as given on the interest application)?

Please turn in this completed form to Ms. Jenkins and complete the online REAL Student Assessment by Friday November 1st, 2024.

The online Student Assessment Form is on the REAL website at (http://www.fmarion.edu/realgrants). Use SERMACS 2024 as the course number and title.

Appendix XI. REAL Grant Survey

REAL Grant Student Ratings

Principal Investigator: Diana Jenkins

Project Title: Travel Funds for SERMACS 2024, Atlanta, GA from October 23-26

Semester and Year: Fall 2024

	N	Mean	Standard deviation	Min	Max
1. While participating in this activity, I reflected on the significance and implications of my experiences.	7	4.43	0.49	4	5
2. While participating in this activity, I applied knowledge and/or ideas that I learned in university classes.	7	4.29	0.45	4	5
3. While participating in this activity I discovered knowledge and/or ideas beyond what I learned in university classes.	7	4.86	0.35	4	5
4. While participating in this activity, I became more aware of the value systems of other individuals.	7	4.29	0.70	3	5
5. While participating in this activity, I became more aware of my personal value system.	7	4.14	0.64	3	5
6. I achieved my purpose for participating in this activity.	7	4.57	0.49	4	5
7. Participation in this activity made a meaningful contribution to my educational experience at Francis Marion University.	7	4.29	0.45	4	4
8. I would recommend this activity or a similar activity to students in my major.	7	4.86	0.35	4	5

Note: 1 = strongly disagree; 2 = disagree; 3 = undecided; 4 = agree; 5 = strongly agree.

Comments from REAL Survey Question 2

2. While participating in this activity, I applied knowledge and/or ideas that I learned in university classes.

-Previously gained knowledge from my classes were required to understand the material presented at 1
some of the poster and oral presentation.

-Yes I used knowledge from my research experience and classroom experience to help understand

Concepts

-There was posters and oral presentations that were given by other people that applied things that I learned in organic chemistry and biochemistry (i.e. the mechanisms and conditions of an organic chemical reaction), and recognizing them helped me follow what the person presenting was saying easier. Personally, I had an easier time understanding and following information that last year since the highest course I had taken up to SERMACS 2023 was Organic Chemistry I.

-Many of the poster and oral presentations I attended spoke on research that involved applications I learned in analytical and general chemistry

-My knowledge of general molecular structure and orbital nature was used in a quantum sense heavily to partake in the research project necessary for the trip.

-I tried to call back to topics I have learned in previously classes in order to build on that information and try to understand some new ideas that I was unfamiliar with.

-I didn't have a strong understanding of certain principles when starting the research, but I remembered completing some of the same techniques in my cell biology lab and I approached them the same way.

Comments from REAL Survey Question 7

7. Participation in this activity made a meaningful contribution to my educational experience at Francis Marion University.

-I learned more about the activities and research performed by graduate students in my field.

-Yes I talked and got to represent my school nicely

-I think that my experience of going to SERMACS both last year and this year has helped me expand my knowledge on chemical research. I think participating in the graduate research project at USC that I presented at SERMACS gave me exposure to what graduate school is like and some early exposure to inorganic chemistry, since that is what Dr. zur Loye's research is focused on and I haven't taken an inorganic chemistry course, yet.

-If it wasn’t for Dr. Kelley and the Chemistry Department, I would have never had this opportunity, so I’m very grateful for FMU

-This experience enhanced my critical thinking, as I solved many problems along the way outside the scope of the classroom.

-I gained a greater respect for what I have been studying for the past 3 years, and I hope this will contribute to my work ethic and respect for my classes.

-I am truly grateful for the bonds that I've made and the knowledge that I've gained as a result of this experience.