

Institutional Effectiveness Report

Name of Program/Department:	Department of Chemistry
Year:	2021-2022
Name of Preparer:	Dr. Jennifer Kelley, Chair

Program Mission Statement

The chemistry department at Francis Marion University provides a high standard education in chemistry that equips student 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. 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)

Senior chemistry majors 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 in both oral and written form.
- PLO #2** – Chemistry majors will demonstrate that they can apply critical thinking skills in chemistry.
- PLO #3** – Chemistry majors will demonstrate an understanding of core concepts, methods and limits of scientific inquiry that will allow them to successfully solve integrated problems in chemistry.
- PLO #4** – Chemistry majors will demonstrate that they can adequately apply their knowledge of chemistry.
- PLO #5** – Chemistry majors will demonstrate that they can adequately use the scientific literature.
- PLO #6** – Chemistry majors will demonstrate an understanding of safe laboratory skills and procedures for laboratory experiments that they perform.

PLO #7 – 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

Our mission statement was expanded from last year’s to better align with the university’s mission statement. It now includes information about student research in the classroom and with faculty in the department as well as activities with our ACS student group that enhance our student curriculum. Action items will address these additions in our PLOs and SLOs.

Our Assessment Methods have not previously had baselines or targets. Benchmarks were stated within the SLOs. This report has added baselines using data from last year’s IE report and the benchmarks are listed as stated in the SLOs. The faculty will determine the targets for the SLOs in the fall semester.

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 2021-2022. Achievement of our senior chemistry majors 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 presentation
- (4) a written chemistry term paper
- (5) a chemical safety exam
- (6) an exit questionnaire and interview.

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.

The three senior students enrolled in our spring 2022 Chemistry 499 Senior Capstone course were not assessed using the previous capstone writing assignments due to a miscommunication and change in instructors. SLO #1 was not achieved. However, the students did complete writing assignments based on a journal article of their interest and an assignment that teaches them to create their own bibliography/reference database. The students scored a 98.16% average on these two assignments. The students were given ACS Study Guides for General Chemistry, Organic Chemistry and Physical Chemistry to help them review materials for those courses but were not assessed on this material.

Students in the Chemistry 499 Senior Capstone course were administered the Diagnostic of Undergraduate Chemical Knowledge (DUCK) 2018 standardized exam. This was a newer version of the exam that does not yet have representative percentile performance rankings however, preliminary norms have been provided. This prevents determination of achievement of SLO #2 until more data are included. However, the average raw score on the exam was 33 out of 60 questions that puts the class average at the 62nd percentile using the preliminary data.

Students in Chemistry 499 Senior Capstone performed, on average, at the 83% level 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 goal for SLO #3 was 80%. Therefore, our baseline was exceeded and our benchmark was achieved for two out of the three students on their term paper.

Students taking the Chemistry 499 Senior Capstone, on average, performed at the 84% level 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 benchmark for SLO #4 was 80%. Therefore, our baseline was exceeded and our benchmark was achieved.

All students (88) 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 goal for SLO #5 was for all students to achieve a score of 70% on the safety exam. Therefore, our baseline was matched and our benchmark was achieved.

Although no Gen Ed Assessment Exam (SLO #7) was administered due to Covid-19 course changes, the Department's SLO #7 (Gen Ed Assessment Goal 5) was assessed through SLO #2. The results for SLO #2 show that Gen Ed Assessment Goal 5 (Appendix VII) benchmark was achieved.

Review of students' attitudes about the Department of Chemistry (SLO #6) shows satisfaction that the Department of Chemistry's program is at or above the level considered to be favorable.

Student Learning Outcomes (SLOs)

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level, on a pass/fail basis, on capstone writing assignments that assess their understanding of key chemical concepts. (PLO #2 and #5)

SLO# 2.0: 80% of graduating Chemistry students will, on average, perform at or above the 50th percentile on their understanding of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. (PLO #3)

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to present technical information through written communication. (PLO #1 and #5)

SLO #4.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level on their ability to present technical information through oral communication. (PLO #1 and #5)

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. (PLO #6)

SLO #6.0: 95% of 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. (PLO #7)

SLO #7.0: 75% of students will demonstrate proficiency in Gen Ed Goal 5 by scoring a raw score of at least 40% on the American Chemical Society (ACS) Diagnostic of Undergraduate Chemical Knowledge (DUCK) exam. (Gen Ed Goal 5, Appendix VII)

Assessment Methods

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at or above the 80% level, on a pass/fail basis, on capstone writing assignments that assess their understanding of key chemical concepts.

Baseline: 2020-2021 68% pass rate

Benchmark: 80% pass rate

Target: to be determined by faculty in the Fall 2022

Assessment: Direct

Assessment Method for SLO# 1.0: The six writing assignments used in the previous year to assess SLO #1 were not administered to the three students enrolled in the chemistry capstone course (Chem 499) for the spring of 2022 semester. This was due to a miscommunication between the former and current course instructor.

SLO# 2.0: 80% of graduating Chemistry students will, on average, perform at or above the 50th percentile on their understanding of integrated chemical concepts based on their performance on a nationally standardized chemistry exam (DUCK).

Baseline: 2020-2021 class average 32nd percentile

Benchmark: 80% of students at the 50th percentile

Target: to be determined by faculty in the Fall 2022

Assessment: Direct

Assessment Method for SLO# 2.0: Three 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 2022 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 question 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 present technical information through written communication.

Baseline: 2020-2021 81%

Benchmark: 80%

Target: to be determined by faculty in the Fall 2022

Assessment: Direct

Assessment Method for SLO# 3.0: To assess their written communications skills, three students enrolled in the Chemistry Senior Capstone course wrote a term paper near the end of the spring semester of 2022, 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 present technical information through oral communication.

Baseline: 2020-2021 77%

Benchmark: 80% pass rate

Target: to be determined by faculty in the Fall 2022

Assessment: Direct

Assessment Method for SLO# 4.0: To assess their oral communications skills, three students enrolled in the Chemistry Senior Capstone course delivered an oral presentation near the end of the spring of 2022 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 scientific term papers. 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.

Baseline: 2020-2021 100% scoring at 70% or higher

Benchmark: 100% scoring at 70% or higher

Target: to be determined by faculty in the Fall 2022

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 course at the beginning of the fall 2020 semester. This was followed by their taking a comprehensive and cumulative lab safety exam that is produced and administered by the Organic Chemistry Department faculty. As students must score at least 70% on this safety exam to remain in this required course and thus major in chemistry. 100% of chemistry majors will have completed this outcome before they become senior chemistry students.

SLO #6: 95% of 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, programs, and facilities.

Baseline: N/A

Benchmark: N/A

Target: to be determined by faculty in the Fall 2022

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 questionnaire and an exit interview (Appendix VI & VII) to its senior chemistry majors enrolled in the senior capstone course.

SLO #7.0: 75% of students will demonstrate proficiency in Gen Ed Goal 5 by scoring a raw score of at least 40% on the American Chemical Society (ACS) Diagnostic of Undergraduate Chemical Knowledge (DUCK) exam.

Baseline: 2020-2021 100% of class at 40% or higher

Benchmark: 75% of class at 40% or higher

Target: to be determined by faculty in the Fall 2022, return to pre-covid Gen Ed testing

Assessment: Direct

Assessment Method for SLO# 7.0: 75% of students taking the ACS DUCK exam will demonstrate proficiency in Gen Ed Goal 5 by scoring a raw percentage score of at least 40% on the exam.

Assessment Results

SLO# 1.0: Students in the Chemistry Senior Capstone course, on average, will perform at the 80% level, on a pass/fail basis or above, on capstone writing assignments that assess their understanding of key chemical concepts.

Assessment Results for SLO# 1.0: Students in 499 Chemistry Senior Capstone were not administered the six writing assignments due to a miscommunication between the former and current instructor. The SLO #1 benchmark was not achieved nor was the baseline met. However, the three students did complete writing assignments based on a journal article of their interest and an assignment that teaches them to create their own bibliography/reference database (Appendix III). The students scored a 98% average on these two assignments. The three students were also given ACS Study Guides for General Chemistry, Organic Chemistry and Physical Chemistry to help them review materials for those courses but were not assessed on this material.

SLO# 2.0: 80% of graduating chemistry students will, on average, perform at the 50th percentile or above when demonstrating their understanding of integrated chemical concepts based on their performance on a nationally standardized chemistry exam. The exam, which is the ACS (American Chemical Society) Diagnostic of Undergraduate Chemical Knowledge (DUCK) exam, consisted 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 three senior FMU chemistry majors had an average score of 53% for the three students enrolled in the senior capstone course. The course instructor administered a new version (2018 vs 2013 version) of the DUCK exam for the spring 2022 semester. At this time, percentile rankings are not available for this new exam because not enough scores have been submitted nationwide (Appendix II). Therefore, it cannot be determined if this SLO has been met until this data becomes available from the ACS. The ACS did however provide preliminary data (Appendix II). The average raw score for the class was 33 out of 60 questions. Based on the preliminary data and the average raw score, this would place the class in the 62nd percentile. Individually, the students would rank 87th, 46th, and 41st percentiles so only 33% of the class would have achieved the benchmark based.

SLO #3.0: Students in the Chemistry Senior Capstone course, on average, will perform at the 80% level or above when demonstrating competency in presenting technical information through written communication in the form of a chemistry term paper.

Assessment Results for SLO# 3.0: Three students enrolled in spring 2022 Chem 499 Senior Capstone, on average, performed at the 83% level on their chemistry term paper as graded by the Chemistry 499 Capstone instructor using a standard scientific term paper rubric (Appendix IV). Our benchmark for SLO # 3 was 80%, therefore, our benchmark was achieved and our baseline was exceeded for these three students.

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

Assessment Results for SLO# 4.0: The three students in 499 Chemistry Senior Capstone, on average, performed at the 84% level on their chemistry oral presentation as graded by the chemistry faculty using a

standard scientific, department-generated rubric (Appendix V). Our benchmark was achieved and our baseline was exceeded.

SLO #5.0: 100% of students enrolled in Chemistry 201 will demonstrate an adequate or above understanding of laboratory safety procedures at or above the 70% level.

Assessment Results for SLO# 5.0: Eighty-eight (100%) 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 target for SLO #5 was 100% of students achieving a score of 70% or higher to remain in the course. Therefore, our benchmark was achieved and our baseline was matched.

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 quality of instruction, programs, and facilities.

Assessment Results for SLO # 6.0: To help assess the quality of its instruction, advising, and facilities, the Department of Chemistry administered a questionnaire as well as an exit interview (Appendix VI & VII) to the three chemistry majors enrolled in the senior capstone course. The questionnaire is grouped into questions pertaining to the quality of its programs, resources, and instructions. The Exit Interview is a face-to-face interview. The majority of the student responses from the questionnaire and the exit interview were viewed as favorable. This is an indirect assessment with no assessable baseline, benchmark or target. There were some constructive comments on how to make our program better. The most repeated constructive criticisms included:

- students not being aware of ACS certified degree offering
- Calc 3 (Math 203) is not as useful as Multivariable Calculus (Math 306) but Calc 3 is a prereq for Multivariable
- need better synchronization of lab and lecture for PChem 1 and Instrumental courses
- not many chem majors
- lab facilities/rooms need updating, air handler loud in classrooms

Gen Ed Assessment (SLO 7)

SLO #7.0: 75% of students will demonstrate proficiency in Gen Ed Goal 5 by scoring a raw score of at least 40% on the American Chemical Society (ACS) Diagnostic of Undergraduate Chemical Knowledge (DUCK) exam.

Because of Covid-19 class restructuring, we replaced our normal Gen Ed assessment exam that is usually administered to our General Chemistry students, with the DUCK exam score, as described above, that is administered to only capstone students for the 2021-2022 Academic Year.

Assessment Results for SLO # 7.0: The scores from the DUCK exam for the three capstone students show that our Gen Ed goal was met Gen Ed Goal 5, with all the students answering correctly at least 48% (29 out of 60) of the questions on this nationally standardized exam. Both the baseline and benchmark were exceeded for this SLO.

Action Items

Our mission statement was expanded from last year's to better align with the university's mission statement. It now includes information about student research in the classroom, research with faculty in the department, and activities with our ACS student group that enhance our student curriculum. These additions will be addressed through updates and improvements in our PLOs and SLOs.

PLO #2 and PLO #3 will be combined because both are assessed through the DUCK exam (SLO #2).

PLO #4 does not align with any of the current SLOs. PLO #4 will be reworded and improved to show application of knowledge through research. A corresponding SLO will be developed to ascertain this PLO if needed.

SLO #2 will be clarified as to whether the average of the class should meet the percentile or if only a percentage of the class should meet the percentile.

SLO #5 needs to be improved. Currently all (100%) organic students are required to achieve a 70% or higher on the safety exam to remain in the course. This is a static SLO and needs to be restated to allow for improvement.

We will improve SLO #6 by developing an Exit Survey for the capstone students that will provide a quantifiable evaluation of student satisfaction with our chemistry instruction, advising, and facilities.

SLO #7 is our Gen Ed Assessment. For the last two years, we have used the DUCK exam to satisfy this SLO due to Covid-19 course changes. This SLO needs to be re-evaluated by the faculty to include an assessment that is targeted to the general population of students taking our Chem 111 course. The Gen Ed assessment should ideally be given at the beginning of the semester for Chem 112 students who have successfully completed Chem 111. The faculty will determine these changes at the beginning of the fall semester.

Our Assessment Methods have not previously had baselines or targets. Benchmarks were stated within the SLOs. This report has added baselines based data from last year's IE report and the benchmarks are listed as stated in the SLOs. The faculty will determine the targets for the SLOs in the fall semester.

Based on these Department Exit Interview and Questionnaire given to capstone students this spring 2022 we will review the math requirement for chemistry majors. Students believe that the current required Math 203 is of little importance for the basic chemistry major, and that it should be eliminated or replaced by a more flexible option so that they may choose among several math course options.

Appendices

- I. 2021-2022 IE Knowledge/Skills Instruments Measured and Student Scores
- II. DUCK Exam Information and 2018 DUCK Preliminary Norms
- III. Capstone Writing Assignments
- IV. Chemistry Term Paper Rubric
- V. Chemistry Oral Presentation Rubric
- VI. Exit Questionnaire
- VII. Exit Interview Questions
- VIII. Gen Ed Goals 2020-2021

Appendix I: 2021-2022 IE Knowledge/Skills Instruments Measured and Student Scores

<u>Student</u>	<u>Journal Assignment</u>	<u>Zotero Assignment</u>	<u>Average of Journal & Zotero Assignments</u>	<u>Oral Research Presentation</u>	<u>Written Research Presentation</u>	<u>2018 DUCK Exam Raw Score 60 Questions</u>	<u>2018 DUCK Exam%</u>
1	95.00	100.00	97.50	91.22	86.00	40.00	66.67
2	98.00	100.00	99.00	79.00	87.00	30.00	50.00
3	96.00	100.00	98.00	81.67	77.00	29.00	48.33
Class Average	96.33	100.00	98.17	83.96	83.33	33.00	55.00

Appendix II. DUCK Exam Information



American Chemical Society
Division of Chemical Education
Examinations Institute

MEMORANDUM

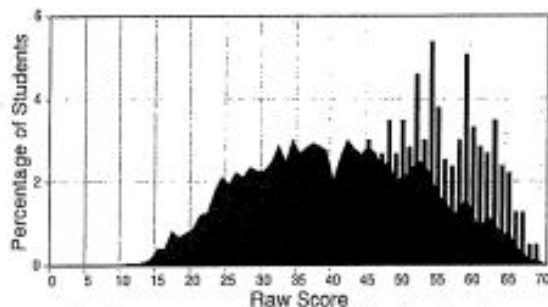
RE: 2018 Diagnostic of Undergraduate Chemistry Knowledge Exam

Dear Colleague:

Thank you for purchasing the latest version of the ACS DUCK exam. Since this is a new exam, we at the Examinations Institute need your help in obtaining data to establish norms. Will you please return the attached Examiner's Report Form? You are welcome to use the enclosed answer sheet (printing as many copies on plain paper as you would like). If you use these or any other answer sheets, we would also appreciate your sending us those (either a scanned pdf emailed to me at kmurphy@uwm.edu or send in hardcopies); this allows us to compute item statistics in addition to overall examination norms. If you would like your answer sheets returned, simply check "Yes" on the Examiner's Report Form. When sufficient data has been received, we will compile it and compute norms.

We also have an interactive component on our web site that will provide instant feedback – comparing your scores with those of the rolling national sample. Our staff will contact you after you have submitted the scores to verify that you sent them. To participate in this process, visit us at: <http://uwm.edu/acs-exams/instructors/exam-statistics/score-reporting/>

Note that all information will be kept confidential. Schools who supply data for norms are acknowledged in the norming sheets distributed with every examination, but the performance of students at a particular institution cannot be gleaned from the norming data. As soon as the norms are ready for distribution, we will send you a complimentary copy. We also supply statistical information (mean, standard deviation, median, reliability, standard error of measurement) back to your individual school and include a histogram (such as the one in the figure) displaying your students' performances as an overlay on the norming population.



Please remember that we need as large a return as possible. If only those schools whose students do well supply norming data, then the norms are skewed upward and give a false picture of what to expect for reasonable performance by average students. Thank you for your participation in this important activity!

Sincerely,

Kristen Murphy, Director

Attachments: Examiner's Report Form

Description of DUCK Exam taken from ACS webpage

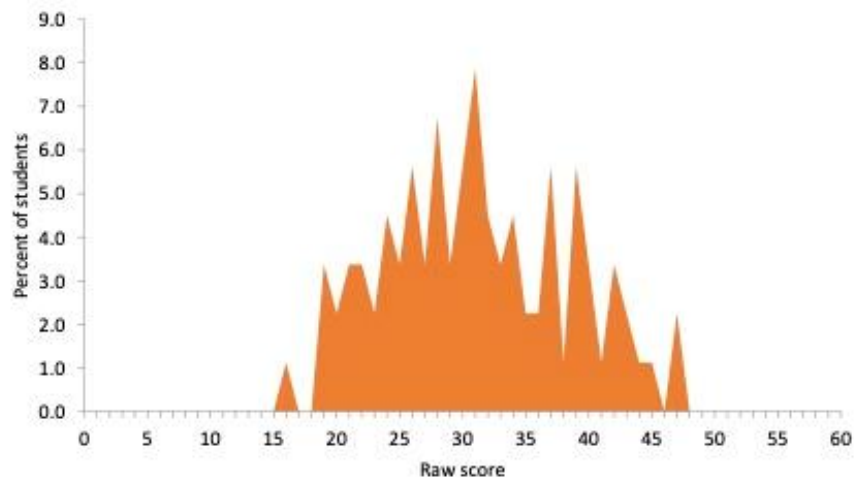
<https://uwm.edu/acs-exams/exams/diagnostic-of-undergraduate-chemistry-knowledge-2013/>

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.

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

Score	Percentile	Score	Percentile	Score	Percentile
60	100	37	76	14	0
59	100	36	72	13	0
58	100	35	70	12	0
57	100	34	66	11	0
56	100	33	62	10	0
55	100	32	58	9	0
54	100	31	52	8	0
53	100	30	46	7	0
52	100	29	41	6	0
51	100	28	36	5	0
50	100	27	31	4	0
49	100	26	26	3	0
48	100	25	22	2	0
47	99	24	18	1	0
46	98	23	15	0	0
45	97	22	12		
44	96	21	8	Mean	31.1
43	94	20	6	Std. deviation	7.2
42	92	19	3	Median	31
41	89	18	1	KR-21 reliability	0.73
40	87	17	1	Std error/meas	3.79
39	83	16	1		
38	79	15	0		

DUCK18 Preliminary Norms
based on the scores of 89 students from 6 institutions



Appendix III: 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 reference 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.

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 maximum	Reviewer's Total Score

Appendix V. Chemistry Oral Presentation Rubric

Chemistry 499 Capstone Course 2022 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	Chemistry Content	(a) Describes experimental procedures and results relating to chemistry, (b) contains accurate information, (c) draws on multiple areas, (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	Knowledge of 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) discusses further 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 minute (not counting Q&A's) allotted time	0-10 10 being the highest	
6	Other Relevant Factors	(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 maximum	Reviewer's Total Score _____

Appendix VI. Exit Questionnaire 2022

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 _____

CHEMISTRY COURSES

1. 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)

2. Does the department offer a sufficient variety of courses?
Yes No Comments:

3. Do you find that the lab exercises improved your understanding of Chemistry?
Yes No Comments:

4. Do you get enough “hands-on” experience in the lab?
Yes No Comments:

5. Do you find the lower-level Chemistry courses to be a good foundation for the upper-level courses?
Yes No Comments:
6. Were you able to take chemistry courses or labs at acceptable times of the day or week?
Yes No Comments:

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

Yes No Comments:

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

Yes No Comments:

9. Should a senior research project be required of all Chemistry majors?

Yes No Comments:

10. After graduation, do you intend to:

Teach High School Go to Graduate School Take a Job Other_____

11. Do you feel adequately prepared for your career after graduation?

Yes No Comments:

12. 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

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

Comments:

2. How would you rate the effectiveness of the use of equipment in lecture demonstrations in terms of helping you master the course material?

Excellent Good Acceptable Poor Inadequate

Comments:

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

Excellent Good Acceptable Poor Inadequate

Comments:

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

Excellent Good Acceptable Poor Inadequate

Comments:

5. Would you say the department's laboratory equipment is sufficiently up to date?

Yes No Comments:

6. Would you say the department's laboratory equipment is sufficiently maintained?

Yes No Comments:

7. Are instruments available in sufficient number for the labs?
Yes No 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
 Comments:
9. Would you say the department's computer facilities/software are sufficiently up to date?
Yes No Comments:
10. Would you say the department's computer facilities are sufficiently maintained?
Yes No Comments:
11. If you were involved in a research project, how would you rate the department in terms of obtaining any equipment necessary for your project?
Excellent Good Acceptable Poor Inadequate
 Comments:
12. How would you rate the department in terms of availability and proper use of safety related equipment?
Excellent Good Acceptable Poor Inadequate
 Comments:
13. 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?

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

2. 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:
3. If you are going to teach, do you feel prepared to teach your major subject?
Yes No N/A Comments:
4. Which Chemistry courses would you like to have removed or modified in the curriculum? Why?
5. Which Physics courses would you like to have removed or modified in the curriculum? Why?
6. Are there changes would you like to recommend for the required mathematics courses?
7. What recommendations would you make concerning computers and their uses at FMU?
8. What changes would you like to see in the Chemistry major at FMU?
9. What other suggestions for improvement in the Chemistry program would you like to make?
10. The best thing about the Chemistry program is:
11. The worst thing about the Chemistry program is:
12. Any other comments?

Appendix VIII. Gen Ed Goals 2020-2021 and 2021-2022 (taken from Course Catalogs)

2020-2021 General Education Goals	
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.