

## Program-Level Assessment: Annual Report

Program Name (no acronyms): BS Chemistry	Department: Chemistry
Degree or Certificate Level: Undergraduate	College/School: School of Science and Engineering
Date (Month/Year): September 2023	Assessment Contact: Rob Perkins (rob.perkins@slu.edu)
In what year was the data upon which this report is based collected? 2021-23 (3 year cycle) and 2018-23 (all time)	
In what year was the program's assessment plan most recently reviewed/updated? 2023	
Is this program accredited by an external program/disciplinary/specialized accrediting organization or subject to state/licensure requirements? No	

### 1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please provide the complete list of the program's learning outcome statements and **bold** the SLOs assessed in this cycle.)

We are currently in year 3 of our 3 year assessment cycle, which focuses on Research-related SLOs. The following program student learning outcome was assessed in this annual assessment cycle (Year 3):

**Outcome 4: Communicate scientific results effectively.**

**Outcome 5: Design and conduct independent research.**

These outcomes were assessed in the context of Chemical Literature (CHEM 3100, Outcome 4) and Undergraduate Research (CHEM 3970, Outcome 4 and 5).

### 2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please describe the artifacts in detail, identify the course(s) in which they were collected, and if they are from program majors/graduates and/or other students. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

**Outcome 4: Communicate scientific results effectively.**

*Chemical Literature (CHEM 3100):* Score on the final oral presentation based on a standard rubric (attached). This data is collected for all majors in this course.

*Undergraduate Research (CHEM 3970):* Average score on rubric criteria on the **student's final written research thesis**, analyzed by student's PI. Each criterion is graded on a score of 1-3 (1=needs development, 2=meets expectations, 3=mastery). This data is collected for graduating seniors.

**Outcome 5: Design and conduct independent research.**

*Undergraduate Research (CHEM 3970):* Average score on rubric criteria on the student's evaluation of in-lab work and knowledge, analyzed by student's PI. Each criterion is graded on a score of 1-3 (1=needs development, 2=meets expectations, 3=mastery). This data is collected for graduating seniors.

All data collected and reported are from majors and do not include any data from graduate or non-major students.

All the relevant courses were offered in-person, with the exception of CHEM 3100 in the second half of Spring of 2020. Data from Madrid was not collected. Only general chemistry and organic chemistry are offered in Madrid, and these courses very rarely include majors.

### 3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tool(s) (e.g., a rubric) used in the process and **include them in/with this report document** (please do not just refer to the assessment plan).

Raw scores were provided by the instructors of the courses to the department assessment coordinator. These raw scores were determined using the attached rubrics to provide a total score for each artifact. The raw scores were then converted to “exceeds” “meets” “approaching” and “does not meet” evaluations or “needs development” “meets expectations” and “mastery” evaluations for Chemical literature (CHEM 3100) and Undergraduate Research (CHEM 3970) courses, respectively.

*Chemical Literature (CHEM 3100):* **Percentage** on Chem Lit Final oral presentation (Outcome 4)

-Score (percentage) on the final oral presentation based on a standard rubric (attached). 90% exceeds, 80-89% meets, 70-79% approaching, <70% does not meet

*Undergraduate Research (CHEM 3970):*

Average score on rubric criteria (attached) for student’s written research thesis, evaluated by their PI. (Outcome 4)

-Average score: >2.5 Mastery, between 1.5 and 2.5 = Meets Expectations, <1.5 Needs Development

Average score on rubric criteria (Inquiry and Analysis rubric, attached) on the student’s evaluation of in-lab work and knowledge, analyzed by student’s PI. (Outcome 5)

-Average score: >2.5 Mastery, between 1.5 and 2.5 = Meets Expectations, <1.5 Needs Development

### 4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

#### Outcome 4: Communicate scientific results effectively.

*Chemical Literature (CHEM 3100):* Score on the final oral presentation based on a standard rubric (attached). This data is collected for all majors in this course.

Chemical Literature (CHEM 3100)	Presentation	Most Recent Cycle (FL 2020 - SP 2023)	All Time (FL 2018 - SP 2023)
			n = 21
	Exceeds	66.7%	52.9%
	Meets	28.6%	44.1%
	Approaching	4.8%	2.9%
	Does Not Meet	0%	0%

*Undergraduate Research (CHEM 3970):* Average score on rubric criteria on the **student’s final written research thesis**, analyzed by student’s PI. Each criterion is graded on a score of 1-3 (1=needs development, 2=meets expectations, 3=mastery). This data is collected for graduating seniors.

Undergraduate Research (CHEM 3970)	Written Research Thesis	Most Recent Cycle (FL 2020 - SP 2023)	All Time (FL 2018 - SP 2023)
			n = 11
	Mastery	81.8%	70.8%
	Meets	18.2%	20.1%
	Needs Development	0%	8.3%

**Outcome 5: Design and conduct independent research.**

*Undergraduate Research (CHEM 3970):* Average score on rubric criteria on the student's evaluation of in-lab work and knowledge, analyzed by student's PI. Each criterion is graded on a score of 1-3 (1=needs development, 2=meets expectations, 3=mastery). This data is collected for graduating seniors.

<b>Undergraduate Research (CHEM 3970)</b>	<b>Lab Work and Independence</b>	<b>Most Recent Cycle (FL 2020 - SP 2023)</b>	<b>All Time (FL 2018 - SP 2023)</b>
			<b>n = 11</b>
	<b>Mastery</b>	90.9%	75%
	<b>Meets</b>	9.1%	16.7%
	<b>Needs Development</b>	0%	8.3%

**5. Findings: Interpretations & Conclusions**

What have you learned from these results? What does the data tell you? Address both a) learning gaps and possible curricular or pedagogical remedies, and b) strengths of curriculum and pedagogy.

In both outcomes and both courses assessed, the percentage of students exceeding expectations or with mastery in their research has increased in the most recent cycle compared to all time numbers. It appears that in general more students are in the exceeding tier, with less of them in the meeting expectations tier. We have also had 0% of students not meeting expectations in both courses in the most recent 3 year cycle.

While n values are low and may not lead to statistically meaningful data, these results in our literature and lab research-based courses seem to suggest that our students are doing quite well at meeting or exceeding our expectations with regards to the indicated learning outcomes, and it appears results have improved within the last 3 year cycle compared to prior years.

**6. Closing the Loop: Dissemination and Use of Current Assessment Findings**

**A.** When and how did your program faculty share and discuss the results and findings from this cycle of assessment?

Data was compiled and discussed at the most recent Chemistry Department Faculty retreat in August 2023. Faculty were prompted to review the data and look for any trends prior to the retreat, and an in-person discussion was held during the retreat.

**B.** How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies

- Course content
- Teaching techniques
- Improvements in technology
- Prerequisites
- Course sequence
- New courses
- Deletion of courses
- Changes in frequency or scheduling of course offerings

Changes to the Assessment Plan

- Student learning outcomes
- Artifacts of student learning
- Evaluation process
- Evaluation tools (e.g., rubrics)
- Data collection methods
- Frequency of data collection

Please describe the actions you are taking as a result of these findings.

No actions are being taken at this time.

If no changes are being made, please explain why.

Our results show that are students are doing very well, and arguably that our undergraduate research program for our BS majors has improved over the past few years. No specific actions need to be taken.

## 7. Closing the Loop: Review of Previous Assessment Findings and Changes

### A. What is at least one change your program has implemented in recent years as a result of previous assessment data?

While no changes have been made directly to the assessment criteria or courses, we have made some minor changes early on in the major course sequence that could have consequences on research objectives later in the program.

In order to give our majors more exposure to our department's research program and to improve connections between course material and real lab research, the General Chemistry Laboratory section for majors has instituted short pre-lab talks from research faculty connecting each day's topic with a research topic within the department.

Additionally, the Organic Chemistry Laboratory section for majors has reserved a lab period for research faculty to give more in-depth talks about their research prior to the students potentially signing up for research in CHEM 3970 the following semester.

The hope is that getting students thinking about research earlier will better prepare them with regards to research expectations in a chemistry lab and to help them find a research group they will thrive in earlier.

### B. How has the change/have these changes identified in 7A been assessed?

The General Chemistry lab talk changes were implemented in Fall of 2021, so those students have yet to have graduated and thus have not been evaluated yet.

### C. What were the findings of the assessment?

N/A

### D. How do you plan to (continue to) use this information moving forward?

We are hoping to see our students continue to exceed expectations in the research lab after these changes.

**Assessment Rubrics for each artifact are attached at the end of this document.**

Presentation Rubric, Chemical Literature (CHEM 3100), Outcome 4

Content \*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Presentation was well organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Material was covered in adequate depth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multiple sources were used and properly referenced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Topic was presented in a way such that I could understand it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Figures were well chosen and useful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Content Score (1 = poor, 2 = fair, 3 = satisfactory, 4 = very good, 5 = excellent) \*

	1	2	3	4	5
Score	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Delivery \*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The speaker held the audience's attention and was confident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The speaker maintained eye contact with and/or engaged the audience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The speaker was audible and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The speaker was prepared and did not just read from the slides	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Written Thesis Rubric, Undergraduate Research (CHEM 3970), Outcome 4

	Mastery (3)	Meets Expectations (2)	Needs Development (1)	Score
Arrangement of thesis	Information and text are arranged in a format that is typical of a publication in the field: Title, Introduction, Procedure, Results, Discussion, Conclusion, and References.	Information and text are arranged in a format that is typical of a publication in the field with only one section out of order or not included.	Information and text are not arranged in a format that is typical of a publication in the field.	
Arrangement of text	Text is arranged in a coherent, logical manner that is appropriate for the topic. Paragraphs are put together well with a coherent “flow.” They are persuasive and connect to surrounding material.	Text is arranged in a logical manner appropriate for the topic. Paragraphs are put together well, but some lack a coherent “flow”. Some are persuasive and connect to surrounding material.	Text is not arranged in a logical manner. Paragraphs lack a coherent “flow.” They are not persuasive and do not connect to the surrounding material.	
Title	The title clearly identifies the <b>topic</b> and the <b>main point</b> of the thesis.	The title identifies the topic and gives a general idea of the main point.	The title does not identify the topic, or there is no title.	
Research Problem	The research problem meets the following criteria: is testable, is predictive, is specific, and looks at a particular question or theory.	The research problem meets all but one of the defined criteria.	The research problem does not meet two or more of the defined criteria.	
Introduction	Information relevant to the given topic is provided. The significance of the topic is clear to the reader.	Information relevant to the given topic is provided, but the significance of the topic is not clear to the reader.	Information provided is not relevant to the given topic. The significance of the topic is not clear to the reader.	
Materials and methods	The procedure is written in paragraph form and can reliably be repeated by another scientist. All materials/methods used in the laboratory are clearly indicated.	The procedure is written in paragraph form and can usually be repeated by another scientist. Most materials/methods used in the laboratory are clearly indicated.	The procedure is not written in paragraph form. Details are missing, and the procedure cannot be repeated by another scientist. Some materials/methods used in the laboratory are clearly indicated.	
Results	The results section describes all quantitative and qualitative observations from the laboratory. The data is tabulated and/or graphed in a way that is easy to comprehend. All tables and graphs are numbered, titled, and referenced.	The results section describes some quantitative and qualitative observations from the laboratory. The data is tabulated and/or graphed in a way that is potentially confusing. Tables and graphs are titled and referenced. Graphs are not always provided where applicable.	Significant quantitative and qualitative observations from the laboratory are missing. The data is tabulated and/or graphed in a way that is not easily comprehensible. Graphs of the given data are not provided where applicable.	
Discussion	All results and outside evidence are properly introduced and thoroughly discussed. Clear connections are built between all important pieces of information.	All results and some outside evidence are presented, but the discussion is not completely convincing. Some connections are built between important pieces of information.	Results and outside evidence are mentioned but not thoroughly discussed. No connections are built between important pieces of information.	
Conclusion	The conclusion is strong and well summarized. It leaves the reader with a clear and thorough understanding.	The conclusion is well summarized. It leaves the reader with a general understanding.	The conclusion is present but not well summarized. It leaves the reader without an understanding.	
Grammar/Spelling Error	The thesis is free from spelling and grammar errors; 0-5 errors can be identified.	The thesis is generally free from spelling and grammar errors; 6-10 errors can be identified.	The thesis has many spelling and grammar errors.	

Loosely adapted from a rubric in Rachel M. Coon’s “A Compilation of Rubrics to be Used in Chemistry to Emphasize Argumentative Writing in the Science Classroom.” This blank rubric was designed for program assessment. Completed rubrics will not be returned to students nor will they be used to determine semester grades for CHEM 3970.

### In-Lab Research Rubric, Undergraduate Research (CHEM 3970), Outcome 5

	Mastery (3)	Meets Expectations (2)	Needs Development (1)	Score
Knowledge base	Has thorough knowledge of the background and motivation for project. Is familiar with relevant scientific literature.	Has a developing knowledge of the background and motivation for project. Has some familiarity with scientific literature.	Has an inadequate knowledge of the background and motivation for project. Has minimal familiarity with scientific literature.	
Technical skills	Is able to perform technical procedures and use instruments without assistance. Consistently reproduces high quality results.	Is able to perform technical procedures and use instruments with some assistance. Quality of results may be inconsistent.	Needs assistance performing technical procedures and using instruments. Consistently fails to reproduce results.	
Critical thinking and problem solving	Interprets data, draws reasonable conclusions, and proposes the next experiment. Solves problems and displays creativity.	Understands experimental methods and theoretical outcomes but is not able to draw conclusions or propose the next experiment. Needs some help solving problems.	Does not engage in critical analysis of experimental results. Always requires help to solve problems.	
Independence, time management, and planning	Works independently. Plans experiments and manages time proficiently. Always completes experiments in a timely manner.	Sometimes requires assistance planning experiments and managing time. Usually completes experiments in a timely manner.	Unable to work without supervision. Does not plan experiments or manage time proficiently. Does not complete experiments in a timely manner.	
Collegiality and collaboration	Works well with peers and supervisors. Applies constructive criticism to improve performance. Respects different points of view. Helps in the mentoring or training of others.	Works with peers and supervisors with minimal conflicts. Sometimes applies constructive criticism to improve performance. Usually respects different points of view.	Has several conflicts with peers and supervisors. Does not apply constructive criticism to improve performance. Does not respect different points of view.	
Record keeping	Keeps complete, organized, and legible notebook.	Keeps complete notebook, but it is disorganized or has legibility issues.	Does not keep complete notebook. Components are missing or inadequate.	
Terminology	Adheres to correct usage of chemical structures, formulas, equations, and terminology.	Makes minor mistakes in the usage of chemical structures, formulas, equations, and terminology.	Makes major mistakes in the usage of chemical structures, formulas, equations, and terminology.	
Communication	Prepares oral and written presentations that are complete, well-written or delivered, and formatted and referenced appropriately.	Prepares oral and written presentations that have minor errors in delivery, format, grammar, or citation. Improves with feedback and revision.	Prepares presentations that are incomplete, poorly written or delivered, incorrectly formatted, or missing references. Shows little improvement after feedback.	
Laboratory safety	Always follows correct safety procedures in the laboratory.	Follows correct safety procedures in the laboratory with minimal reminders.	Needs to be reminded repeatedly to engage in safe laboratory procedures.	
Productivity	Has made significant progress toward project completion.	Has made progress toward project completion.	Has made little progress toward project completion.	

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