Chemistry Department

COLLEGE OF SCIENCE AND MATHEMATICS

Student Outcomes Assessment Plan (Soap)

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I. Mission Statement

The mission of the Department of Chemistry is to provide students with the appropriate level of modern and comprehensive chemical education required for life and work in our technologically advanced society. To accomplish this the department offers courses for students planning to be professional chemists, for students planning careers in the medical professions and careers in teaching, for students requiring a basic chemical science background for other majors, and for students fulfilling their general education science requirements.

II. Goals and Student Learning Outcomes

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A. Students will demonstrate competency in searching and reading chemical literature
Students will complete a literature search related to one or more areas in chemistry by using common literature search techniques to find recent peer-reviewed journal articles on the topic, critically read these papers to extract useful information, and summarize the significance of these articles to their topic in written or oral form.

B. Students will demonstrate competency in speaking and presentation skills
Students will prepare and deliver presentations on recent chemical research from both their work and the literature in seminars open to faculty and students. Students will effectively communicate with the audience at an appropriate level, use visual aids (e.g., Power point slides) that are clear, professional-looking, and which support and supplement the oral presentation, and answer questions from the audience in a manner that demonstrates a thorough knowledge of the material presented.

C. Students will demonstrate competency in organizing complex information
Students will present data, information and ideas in a logical sequence to present a sound scholarly argument in both oral presentations and written papers.

D. Students will demonstrate competency in interpreting and critically evaluating experimental results
Students will present current state of knowledge of a topic including balanced descriptions of various and possibly conflicting opinions. The gaps in current knowledge are clearly identified and significant directions and approaches that fill these gaps are identified. The relationship to the students' own research is clearly explained (when appropriate).

E. Students will demonstrate competency in scientific writing skills
Students will write papers that meet the style and format of an appropriate peer-reviewed journal. The paper follows conventions for spelling and grammar and is essentially error free in terms of mechanics. Writing flows smoothly from one idea to another. Transitions effectively establish a sound scholarly argument and aid the reader in following the writer's logic.

F. Students will demonstrate competency in collecting scientific data
Students will design experiments and collect data in an appropriate way to answer key research questions. Data are collected with appropriate accuracy and precision, and possible errors/limitations are recognized.

III. Curriculum Map (Matrix of Courses X Learning Outcomes)

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Course	Objectives					
	A	B	C	D	E	F
CHEM 201		I				
CHEM 215-251	I	I	I,R		I	I
CHEM 260	R	R	R	I, R	R	I
CHEM 280	R	R, A	R			
CHEM 290	R, A		R, A	R, A	R, A	R
CHEM 295	A		A	A		A
CHEM 299	A	A	A	A	A	A

I = Introduced; R = Reinforced; A = Advanced

IV. Assessment Methods

A. Direct Measures (at least three)

1. Literature seminar (CHEM 280) evaluation by faculty using presentation rubric (Appendix A).
2. Thesis defense seminar evaluation by faculty using presentation rubric (Appendix B).
3. Graduate writing requirement (GWR) paper evaluation by faculty using writing rubric (Appendix C).
4. Thesis evaluation by faculty using writing rubric (Appendix C).

B. Indirect Measures *(Alumni Survey is required)*

1. Graduate student survey (Appendix D).
2. Alumni survey (Appendix E).

These assessment methods will be applied to measure student learning outcomes as specified below.

Student Learning Outcome A.
Direct Measure 1: Section 2. “Literature Review & Citation”.
Indirect Measures 1 and 2: Items 4 “Searching of Chemical Literature”and 5 “Reading of Chemical Literature”.

Student Learning Outcome B.
Direct Measures 1 and 2: Sections 5. “Speaking Ability”, 3. “Visual Aids”, and 6. “Question and Answer Session”.

Indirect Measures 1 and 2: Items 7 “Presenting (orally) of Chemistry Papers and Reports”, 8 “Communicating with faculties and fellow students” and 9” Working in team projects”.

Student Learning Outcome C.
Direct Measures 1 -4: Measures 1 and 2 Section 4. “Organization & Analysis of Material”; Measures 3 and 4 Section III “Section III. Content and Organization”.

Student Learning Outcome D.
Direct Measures 3 and 4: Section IV “Integration and Critical Analysis”.
Indirect Measures 1 and 2: Item 1 “Understanding Chemical Information”.

Student Learning Outcome E.
Direct Measures 3 and 4: Sections I. “Style and Format”, and II. “Mechanics”.
Indirect Measures 1 and 2: Item 6 “Writing of Chemistry Papers and Reports”.

Student Learning Outcome F.
Direct Measure 2: Section 2. “Scientific Data Collection”.
Indirect Measures 1 and 2: Item 3 “Conducting Chemical Research and Experiments”.

A mean score for all students of 2.0 (out of 3) demonstrates achievement of the learning outcome for direct measures A.1. and A.2. A mean score for all students of 3.5 (out of 5) demonstrates achievement of the learning outcome for direct measures A.3. and A.4 and indirect measures B.1. and B.2.

V. Student Learning Outcomes X Assessment Methods Matrix

HOLD CTRL THEN CLICK TO VIEW EXAMPLE

Assessment Measure	Objectives					
	A	B	C	D	E	F
A1	x	x	x			
A2		x	x			x
A3			x	x	x	
A4			x	x	x	
B1	x	x		x	x	x
B2	x	x		x	x	x

VI. Timeline for Implementation of Assessment Methods and Summary Evaluations

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Year 2023 to 2024
Measure A1, A2, A3, A4 and B2
Assess SLO B.
Year 2024 to 2025
Measure A1, A2, A3, A4 and B1
Assess SLO D and SLO E.
Year 2025 to 2026
Measure A1, A2, A3, A4 and B1
Assess SLO A and SLO C.
Year 2026 to 2027

Measure A1, A2, A3, A4 and B1
Assess SLO F.
Year 2027 to 2028
Measure A1, A2, A3, A4 and B1
Assess SLO B.

VII. Closing the Loop - Summary Evaluation, Curriculum Adjustment, and Reporting

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Our assessment data will be collected according to the timeline above. The data will be incorporated into an annual program review that will be presented to and discussed with the M.S. Chemistry program's external advisory board each Spring semester. Assessment outcomes and advisory board feedback is discussed with the department's graduate committee, which proposes curricular and/or program changes as appropriate. These will then be discussed and voted on in department faculty meetings, and are implemented by the graduate faculty if approved.

Appendix A: Direct Assessment Measure A.1.

CHEM 280 Seminar – Literature – Faculty Evaluation of Student Presentation
Student's Name: _____ Faculty's Name:_____ Date_____

Scoring Grid – Excellent (5 pt.), Very Good (4 pt.), Good (3 pt.), Fair (2 pt.), Unsatisfactory (1 pt.)
(See next page for detailed explanation of each category)

Category	Faculty Comments	Score
1. Introduction and Statement of Purpose		
2. Literature Review & Citations		
3. Visual Aids		
4. Organization & Analysis of Material		
5. Speaking Ability		
6. Question & Answer Session		
General Faculty Comments:		**Total Score /30 pts**

CATEGORY/RATING	Unsatisfactory (1)	Fair (2)	Good (3)	Very Good (4)	Excellent (5)
1. Introduction & Statement of Purpose (Professional, Waits for Audience to Settle, Introduces themselves, Rationale and wider context of research given & connected to talk)	Opening is not engaging at all with no clear focus.	Intro & SOP meets all but 3 criteria.	Intro & SOP meets all but 2 criteria.	Intro & SOP meets all but 1 criterion.	Intro & SOP meets all criteria.
2. Literature Review & Citations (Relevant scientific journals, comprehensive literature, salient features noted, in-slide citations including year of publication)	No scientific journals.	Literature meets all but 3 criteria.	Literature meets all but 2 criteria.	Literature meets all but 1 criterion.	Literature meets all criteria.
4. Visual Aids (Readable by all, professional looking, not cluttered, relevant to talk, includes adequate citations)	Visual aids do not meet most criteria.	Visual aids meet all but 3 criteria.	Visual aids meet all but 2 criteria.	Visual aids meet all but 1 criterion.	Visual aids meet all criteria.
4. Organization & Analysis of Material (Consistent, logical, coherent transitions. Clear connection of ideas, both broad and specific. Strong sense of closure. No unnecessary info.)	No clear organization and analysis.	Organization & analysis meets all but 3 criteria.	Organization & analysis meets all but 2 criteria.	Organization & analysis meets all but 1 criterion.	Organization & analysis meets all criteria.
5. Speaking Ability (Speaker commands audience politely, consistently uses eye contact, speaks at appropriate volume and pace, does not use notes or keeps them to a minimum.)	Reads from notes or slides.	Speaking ability meets all but 3 criteria.	Speaking ability meets all but 2 criteria.	Speaking ability meets all but 1 criterion.	Speaking ability meets all criteria.
6. Question & Answer Section (Talk generates questions. Speaker understands questions, responds concisely, expands on previous statements, cites additional examples, and conveys knowledge)	Cannot answer questions or answers are irrelevant.	Answers meet all but 3 criteria.	Answers meet all but 2 criteria.	Answers meet all but 1 criterion.	Answers meet all criteria.

Appendix B: Direct Assessment Measure A.2.

Thesis Presentation Seminar – Thesis – Faculty Evaluation of Student Presentation
Student's Name: _____ Faculty's Name:_____ Date_____

Scoring Grid – Excellent (5 pt.), Very Good (4 pt.), Good (3 pt.), Fair (2 pt.), Unsatisfactory (1 pt.)
(See next page for detailed explanation of each category)

Category	Faculty Comments	Score
1. Introduction and Statement of Purpose		
2. Scientific Data Collection		
3. Visual Aids		
4. Organization & Analysis of Material		
5. Speaking Ability		
6. Question & Answer Session		
General Faculty Comments:		**Total Score /30 pts**

CATEGORY/RATING	Unsatisfactory (1)	Fair (2)	Good (3)	Very Good (4)	Excellent (5)
1. Introduction & Statement of Purpose (Professional, Waits for Audience to Settle, Introduces themselves, Rationale and wider context of research given & connected to talk)	Opening is not engaging at all with no clear focus.	Intro & SOP meets all but 3 criteria.	Intro & SOP meets all but 2 criteria.	Intro & SOP meets all but 1 criterion.	Intro & SOP meets all criteria.
2. Scientific Data Collection (Techniques used are appropriate for addressing the research questions. Measurements are accurate and precise. Observations are thorough and possible errors/limitations are recognized)	No scientific data.	Scientific data meets all but 3 criteria.	Scientific data meets all but 2 criteria.	Scientific data meets all but 1 criterion.	Scientific data meets all criteria.
4. Visual Aids (Readable by all, professional looking, not cluttered, relevant to talk, includes adequate citations)	Visual aids do not meet most criteria.	Visual aids meet all but 3 criteria.	Visual aids meet all but 2 criteria.	Visual aids meet all but 1 criterion.	Visual aids meet all criteria.
4. Organization & Analysis of Material (Consistent, logical, coherent transitions. Clear connection of ideas, both broad and specific. Strong sense of closure. No unnecessary info.)	No clear organization and analysis.	Organization & analysis meets all but 3 criteria.	Organization & analysis meets all but 2 criteria.	Organization & analysis meets all but 1 criterion.	Organization & analysis meets all criteria.
5. Speaking Ability (Speaker commands audience politely, consistently uses eye contact, speaks at appropriate volume and pace, does not use notes or keeps them to a minimum.)	Reads from notes or slides.	Speaking ability meets all but 3 criteria.	Speaking ability meets all but 2 criteria.	Speaking ability meets all but 1 criterion.	Speaking ability meets all criteria.
6. Question & Answer Section (Talk generates questions. Speaker understands questions, responds concisely, expands on previous statements, cites additional examples, and conveys knowledge)	Cannot answer questions or answers are irrelevant.	Answers meet all but 3 criteria.	Answers meet all but 2 criteria.	Answers meet all but 1 criterion.	Answers meet all criteria.

Appendix C: Direct Assessment Measure A.3. and A.4.

Graduate Writing Requirement and Thesis Rubric

Research proposals submitted for fulfillment or partial fulfillment of the graduate writing requirement are evaluated using the following scoring rubric. Students are scored on a basis of 1 (beginning) to 5 (exemplary) in four areas: style and format, mechanics, content and organization, and integration and critical analysis. A score of 12 or higher on the rubric with a score of 2 or greater for each section is considered passing.

	Beginning	Developing	Satisfactory	Accomplished	Exemplary
Style and Format	1	2	3	4	5
Mechanics	1	2	3	4	5
Content and Organization	1	2	3	4	5
Integration and Critical Analysis	1	2	3	4	5
Total Score	/ 20				

I. Style and Format:

5-Exemplary: In addition to meeting the requirement for a "4," the paper consistently models the language and conventions used in the scholarly/ professional literature appropriate to the student's discipline. The manuscript would meet the guidelines for submission for publication in a peer reviewed American Chemical Society (ACS) journal in the student's field of study.

4-Accomplished: While there may be minor errors, conventions for style and format are used consistently throughout the paper. Demonstrates thoroughness and competence in documenting sources; the reader would have little difficulty referring back to cited sources. Style and format contribute to the comprehensibility of the paper. Suitably models the discipline's overall journalistic style.

3-Satistfactory: The style and format are broadly followed, but inconsistencies are apparent. There is selection of less suitable scientific sources (non-peer reviewed literature, web information). Weak transitions and apparent logic gaps occur between topics being addressed. The style may be difficult to follow so as to detract from the comprehensibility of the manuscript.

2-Developing: While some ACS conventions are followed, others are not. Paper lacks consistency of style and/or format. It may be unclear which references are direct quotes and which are paraphrased. Based on the information provided, the reader would have some difficulty referring back to cited sources. Significant revisions would contribute to the comprehensibility of the paper.

1-Beginning: The stylistic conventions of scientific writing are not followed. Fails to demonstrate thoroughness and competence in documentation. Inappropriate style and format make reading and comprehensibility problematic.

II. Mechanics:

5-Exemplary: In addition to meeting the requirements for a "4," the paper is essentially error free in terms of mechanics. Writing flows smoothly from one idea to another. Transitions effectively establish a sound scholarly argument and aid the reader in following the writer's logic.

4-Accomplished: While there may be minor errors, the paper follows normal conventions of spelling and grammar throughout. Errors do not significantly interfere with topic comprehensibility. Transitions

and organizational structures such as subheadings are effectively used which help the reader move from one point to another.

3-Satisfactory: Grammatical conventions are generally used, but inconsistency and/or errors in their use result in weak, but still apparent, connections between topics in the formulation of the argument. There is poor or improper use of headings and related features to keep the reader on track within the topic. Effective scientific vocabulary is used.

2-Developing: Frequent errors in spelling, grammar (such as subject/verb agreements and tense), sentence structure and/or other writing conventions make reading difficult and interfere with comprehensibility. There is some confusion in the proper use of scientific terms. Writing does not flow smoothly from point to point; appropriate transitions are lacking.

1-Beginning: Paper contains numerous errors in spelling, grammar, and/or sentence structure, which make following the logic of the paper extremely difficult. Scientific terms are misused.

III. Content and Organization:

5-Exemplary: In addition to meeting the requirements for a "4," excels in the organization and representation of ideas related to the topic. Raises important issues or ideas, which may not have been represented in the literature cited. Would serve as a good basis for further research on the topic.

4-Accomplished: Follows all requirements for the paper. Topic is carefully focused. Clearly outlines the major points related to the topic; ideas are logically arranged to present a sound scholarly argument. Paper is interesting and holds the reader's attention. Does a credible job summarizing related literature. General ideas are expanded upon in a logical manner thereby extending the significance of the work presented beyond a re-statement of known ideas.

3-Satisfactory: Ideas presented closely follow conventional concepts with little expansion and development of new directions. Certain logical connections or inclusion of specific topics related to the student's area of study may be omitted. Ideas and concepts are generally satisfactorily presented although lapses in logic and organization are apparent. The reader is suitably introduced to the topic being presented such that the relationship to the student's area of study is obvious.

2-Developing: The paper is logically and thematically coherent, but is lacking in substantial ways. The content may be poorly focused or the scholarly argument weak or poorly conceived. Major ideas related to the content may be ignored or inadequately explored. Overall, the content and organization needs significant revision to represent a critical analysis of the topic.

1-Beginning: Analysis of existing scholarly / professional literature on the topic is inadequate. Content is poorly focused and lacks organization. The reader is left with little information about or little understanding of the paper's topic.

IV. Integration and Critical Analysis

5 - Exemplary: The document presents the current state of knowledge for the topic being addressed utilizing a diversity of scientific opinions. These various, and possibly conflicting, opinions are presented in a balanced manner and seamlessly woven together to illustrate a complete grasp of the scientific literature across multiple research approaches utilizing appropriate national and international peer-reviewed journals. Essential findings of multiple sources are accurately and concisely paraphrased, analyzed, and integrated. Original sources are clearly identified and correctly cited in both the body of the text and the reference section. Organizationally, smooth and effective transitions between topics lead the reader through an orderly discussion of the topic being addressed. The gaps in current knowledge are clearly identified and significant directions and approaches that fill these gaps are identified.

4 - Accomplished: There are inconsistencies in the organization and logic of the presentation, but still clear analysis of the presented materials. While synthesis of all aspects of the topic may show varying degrees of development, the overall consistency, thoroughness, and analysis result in a well-

crafted document.

3 - Satisfactory: Identification of key topics or uncertainties in the field may be incomplete. New concepts resulting from a synthetic presentation of ideas is poorly developed or lacking. Complex topics and related concepts are awkwardly presented and linkages among topics may be unclear.

2 - Developing: Weakness is evident in the coverage of the field and analysis resulting in incorrect or poorly developed synthesis of results. Analysis is limited to categorizing and summarizing scientific topics. The resulting manuscript significantly degrades the comprehensibility of the document and the identification of knowledge gaps.

1 - Beginning: The manuscript contains numerous flaws in the essential components of a literature review. The manuscript lacks a successful synthesis of disparate works, and there is no logical flow to the presentation. These issues result in a manuscript with limited comprehensibility and utility in illustrating the author's effective grasp of the material."

Appendix D: Indirect Assessment Measure B.1.
Survey for Graduate Students of Chemistry Department,
California State University at Fresno

Your confidential survey will be seen by the departmental administrator only

Your Name: _____

Current Address: _____
Future Address (if Graduating): _____
E-mail: _____ Home Phone: _____
Work Phone (if applicable): _____ Cell Phone: _____

Area of specialization: _____
Thesis Mentor (if decided): _____
Number of Semester(s) since Joining the MS Program: _____
Date & the Semester of Taking this Survey: _____
Graduation Date (if determined): _____

QUESTIONS: ***Rating scale 1 - 5***
[excellent -5; very good -4; good-3; fair-2; poor-1; or not applicable -NA]

Assessing your learning

How do you rate yourself in the progress you made (compared to first joining the MS program) in

1. Understanding of Chemical Information _____
2. Solving of Chemical Problems _____
3. Conducting Chemical Research and Experiments _____
4. Searching of Chemical Literature _____
5. Reading of Chemical Literature _____
6. Writing of Chemistry Papers and Reports _____
7. Presenting (orally) of Chemistry Papers and Reports _____
8. Communicating with faculties and fellow students _____
9. Working in team projects _____

Assessing the quality of the MS program

10. The curriculum is _____
11. The availability of courses is _____
12. The quality of instruction is _____
13. The classroom facilities are _____
14. The availability of specialty areas is _____
15. The opportunities for interactions with the Chemistry Faculty is _____
16. The opportunity for research is _____
17. The research facilities are _____
18. The research laboratory space is _____
19. The overall quality of the program is _____
20. The career advising is _____
21. The quality of the education in preparing you for your career is _____

What is your plan after graduation?

Why did you pick (or plan to pick) your area of specialization?

Why did you pick (or plan to pick) your topic of thesis research?

When did you start (or plan to start) your thesis research?

What is the best educational experience you received in the department?

What is the worst educational experience you received in the department and how the department could have done to improve your departmental experience?

What are the strengths of the department, the staff, the program, the faculty, the courses, and the research facility?

What are the weaknesses of the department, the staff, the program, the faculty, the courses, and the research facility?

Are you satisfied with your overall educational experience in the MS program? Please elaborate.

Can you make suggestions for improvement to the department, the staff, the program, faculty, courses, and facility?

Appendix E: Indirect Assessment Measure B.2.
Survey for Graduate Alumni of Chemistry Department,
California State University at Fresno

Your confidential survey will be seen by the departmental administrator only

Your Name: _____Date _____

Current Address: _____
Work Address: _____
E-mail: _____Home Phone: _____
Work Phone:_____Cell Phone: _____

Area of specialization: _____
Thesis Mentor _____
Number of Residence Semesters in the MS Program _____
Date of Graduation: _____

QUESTIONS: ***Rating scale 1 - 5***
[excellent -5; very good -4; good-3; fair-2; poor-1; or not applicable -NA]

Assessing your learning

How well did your education at CSUF Chemistry prepare you in

1. Understanding of Chemical Information _____
2. Solving of Chemical Problems _____
3. Conducting Chemical Research and Experiments _____
4. Searching of Chemical Literature _____
5. Reading of Chemical Literature _____

6. Writing of Chemistry Papers and Reports _____
7. Presenting (orally) of Chemistry Papers and Reports _____
8. Communicating with supervisors and co-workers _____
9. Working in team projects _____

Assessing the quality of the MS program

10. The curriculum was _____
11. The availability of courses was _____
12. The quality of instruction was _____
13. The classroom facilities were _____
14. The availability of specialty areas was _____
15. The opportunities for interactions with the Chemistry Faculty was _____
16. The opportunity for research was _____
17. The research facilities were _____
18. The research laboratory space was _____
19. The overall quality of the program was _____
20. The career advising was _____
21. The quality of the education in preparing you for your career was _____

What is your current work, position, and industry?

Are you satisfied with your overall educational experience in the MS program? Please elaborate.

What are the perceptions from others, of your MS Chemistry Degree from CSU Fresno?

Can you make suggestions for improvement to the department, program, staff, faculty, courses, and facility?