

UNIVERSITY OF SAN FRANCISCO
College of Arts and Sciences

MS in Chemistry—Program Assessment Plan

This worksheet helps us refine department learning goals and to develop corresponding learning outcomes. An outcome is a measurable, specific, behavior that the student should demonstrate in the context of achieving the goal.

Program Goals

Goals for an MS degree in chemistry are broad learning outcomes and concepts. They describe what we want a typical graduate to learn by the end of our program.

1. Students demonstrate broad knowledge in areas of chemistry relevant to their research interests
2. Students will become safe and proficient in laboratory practice and instrumental techniques necessary for their research area
3. Students will be able to communicate the subject of chemistry, especially their own research project, in written and oral forms including: correspondence, reports and short presentations that may utilize multi-media tools that support effective communication
4. Students will become critical thinkers who are able to judge scientific arguments and make their own arguments based on experiments conducted during their research project
5. Students who graduate with a MS degree in chemistry from USF will be well prepared to pursue further graduate studies or employment in chemistry or related scientific fields.

Learning Outcomes

The specific skills, values and attributes of a graduate in the program. The outcomes must be measurable using **direct** (preferred) or **indirect** methods.

Goal 1

- Students will demonstrate knowledge on American Chemical Society (ACS) subject exams and/or selected final exam questions by the end of their second semester on campus
- Students will organize and summarize relevant resources in the chemical literature pertaining to their research area via progress reports and/or a research thesis

Goal 2

- Students can safely operate and analyze results from research quality instruments necessary for their research project.
- Students practice and/or enforce safe laboratory techniques, including waste disposal procedures, during their teaching and research projects

Goal 3

- Students will exhibit and employ good communication and teaching practice as assistants in undergraduate laboratories

- Written/visual communication: Students will exhibit the ability to prepare professional reports and/or multi-media presentations in formal (seminars, courses, professional meetings) and informal (group meetings) settings. This includes effective use of visual aids and may include the use of output from laboratory instruments or computer programs.
- Oral communication: Students will exhibit the skills and competencies necessary for professional and effective oral presentations. These skills would include clear organization, appearance, diction and ability to respond well to questions.

Goal 4

- Students will be able to discuss, in a written research thesis or scientific publication, a clear understanding of their research problem, other perspectives, key assumptions, data collection/analysis and conclusions.

Goal 5

- Students will formulate and execute a plan to identify and secure a position in industry or academics
- Students will obtain appropriate entry-level scientific jobs with reasonable chance for advancement or will be accepted into PhD programs in chemistry related fields.

Assessment Methods for the outcomes:

Direct methods include embedded test questions, graded presentation, graded written reports (drafts versus final rubric, for example), graded thesis, and standard exams from the ACS (American Chemical Society). The grading rubrics are generated by members of the department and evaluated by several faculty members (or readers in the case of a thesis rubric).

Indirect methods include: surveys, job and graduate school placement, retention/graduation statistics, course or TA evaluations.

When? The assessment plan will be submitted by October 1st, 2008. It will include a 3-year schedule of outcomes to measure starting with first semester MS students in the 2008-09 academic year.

Curriculum Mapping

Key:

I = Introduced with minimal coverage

M = Moderate Coverage

C = Comprehensive Coverage

Year 1 Goals/outcomes for assessment: ABOUT 1/3 OF PROGRAM	Elective (Chem 60x or 4xxx)	Chem 698 (Research Methods)	Chem 699 (Thesis writing)	Placement exams OR Teaching
Year 2 Goals/outcomes				
Year 3 Goals/outcomes				
1. Students demonstrate broad knowledge in areas of chemistry relevant to their research interests				
a. 1a. Students will demonstrate knowledge on American Chemical Society (ACS) subject exams and/or selected final exam questions by the end of their second semester on campus				C
b. Students will organize and summarize relevant resources in the chemical literature pertaining to their research area via progress reports and/or a research thesis	I	M	C	
2. Students will become safe and proficient in laboratory practice and instrumental techniques necessary for their research area				
a. Students can safely operate and analyze results from research quality instruments necessary for their research project.	M	C		
b. Students practice and/or enforce safe laboratory techniques, including waste disposal procedures, during their teaching and research projects	M	C		C
3. Students will be able to communicate the subject of chemistry, especially their own research project, in oral and written forms including: correspondence, reports and short presentations that may utilize multi-media tools that support effective communication				
a. Students will exhibit and employ good communication and teaching practice as assistants in undergraduate laboratories				C
b. Written/visual communication: Students will exhibit the ability to prepare professional reports and/or multi-media presentations in formal (seminars, courses, professional meetings) and informal (group meetings) settings. This includes effective use of visual aids and may include the use of output from laboratory instruments or computer programs.	M	C	C	I
c. Oral communication: Students will exhibit the skills and competencies necessary for professional and effective oral presentations. These skills would include clear organization, appearance, diction and ability to respond well to questions.	M	C		M
4. Students will become critical thinkers who are able to judge scientific arguments and make their own arguments based on experiments conducted during their research project				
a. Students will be able to discuss, in a written research thesis or scientific publication, a clear understanding of their research problem, other perspectives, key assumptions, data collection/analysis and conclusions.			C	
5. Students who graduate with a MS degree in chemistry from USF will be well prepared to pursue further graduate studies or employment in chemistry or related scientific fields.				
a. Students will formulate and execute a plan to identify and secure a position in industry or academics		C		
b. Students will obtain appropriate entry-level scientific jobs with reasonable chance for advancement or will be accepted into PhD programs in chemistry related fields.				

Outcome Rubrics

First year assessment plan in yellow

Outcome	Very Poor Achievement of Outcome	Poor Achievement of Outcome	Average Achievement of Outcome [Benchmark Standard]	Good Achievement of Outcome	Very Good Achievement of Outcome
1a. Students will demonstrate knowledge on American Chemical Society (ACS) subject exams and/or selected final exam questions by the end of their second semester on campus	Student passes one or none of the ACS subject exams at or above the 60th percentile AND/OR is below 70% on final exam questions.		Student passes two ACS subject exams at the 60 th percentile or above AND/OR correctly answers at more than 70% on selected final exam questions.		Student passes two ACS subject exams at or above the 80th percentile AND/OR correctly answers above 80% on selected final exam questions.
1b. Students will organize and summarize relevant resources in the chemical literature pertaining to their research area via reports and/or a research thesis	Needs significant help finding, organizing and presenting scientific information. With some repeated instructor input, can improve these skills yet makes errors, particularly in written work. Does not always use disciplinary databases and other peerreviewed library resources. Has an unclear understanding of the literature pertaining to the research project they are presenting.		Can consistently find scientific information using disciplinary databases and peer reviewed library resources. Is able to reasonably organize collected information but has average writing and organizational skills. Shows marked improvement with instructor input on a particular project, but is slow to translate input into new contexts. Can answer most scientific questions that are directly related to their presented material.		After initial training needs minimal instructor input to prepare a well researched, organized and written scientific report/paper or oral presentation. Anticipates and can answer the majority of scientific questions related to their presented material. Understands the larger scientific context of what they are presenting.
2a. Students can safely operate and analyze results from research quality instruments necessary for their research project.	Given the appropriate experimental, instrumental or computational context and/or training, cannot acquire or analyze data without significant input from an instructor.		Can use many resources to determine correct operation and theory behind a research quality instrument. Can use prior training to acquire and analyze data using familiar methods with minimal input from an instructor. Most often needs some help when faced with new experimental, computational or instrumental methods.		Can readily use resources and extrapolate prior training into new experimental, computational and instrumental contexts. Can correctly analyze data gleaned via a variety of methods with minimal input from an instructor.

<p>2b. Students practice and/or enforce safe laboratory techniques, including waste disposal procedures, during their teaching and research projects</p>	<p>Student needs to be reminded two or more times to use and enforce the use of appropriate safety equipment. Does not fill out waste disposal forms correctly and does not pass or complete all safety training in a timely manner.</p>		<p>Student needs to be reminded more than one time to use and enforce the use of appropriate safety equipment. Fills out waste disposal forms and passes all safety training in a timely manner.</p>		<p>Student always uses and enforces the use of appropriate safety equipment, reviews experimental designs for safety. Fills out waste disposal forms and passes all required safety training in a timely manner.</p>
<p>3a. Students will exhibit and employ good communication and teaching practice as assistants in undergraduate laboratories</p>	<p>Student score mostly a 3 or below on a significant number of scaled teaching evaluation questions (see attached example)</p>		<p>Student will average above 3 out of 5 on a scaled teaching evaluation questions.</p>		<p>Student will average above 4 out of 5 on a scaled teaching evaluation questions.</p>
<p>3b. Written/visual communication: Students will exhibit the ability to prepare professional reports and/or multimedia presentations informal seminars, courses, professional meetings) and informal (group meetings) settings. This includes effective use of visual aids and may include the use of output from laboratory instruments or computer programs.</p>	<p>Needs significant help finding, organizing and presenting scientific information. With repeated instructor input shows some improvement in these skills. Makes repeated errors in written work or in oral presentations. Has an unclear understanding of the science they are presenting.</p>		<p>Can consistently find scientific information using disciplinary databases and library resources. Is able to reasonably organize collected information but has average writing and/or oral presentation skills. Shows marked improvement with instructor input on a particular project. Can answer most scientific questions directly related to their presented material.</p>		<p>After initial training needs minimal instructor input to prepare a well researched, organized and written scientific report/paper or oral presentation. Anticipates and can answer the majority of scientific questions related to their presented material. Understands the larger scientific context of what they are presenting.</p>
<p>3c) Oral communication: Students will exhibit the skills and competencies necessary for professional and effective oral presentations. These skills would include clear organization, appearance, diction and ability to respond well to questions.</p>	<p>See attached Oral communication rubric</p>				

<p>4a. Students will be able to discuss, in a written research thesis or scientific publication, a clear understanding of their research problem, other perspectives, key assumptions, data collection/analysis and conclusions.</p>	<p>See attached research thesis/publication rubric (under construction)</p>				
<p>5a. Students will formulate and execute a plan to identify and secure a position in industry or academics</p>	<p>Needs much guidance and prompting to find oncampus and off-campus resources. Is not timely and independent on making and executing a plan.</p>		<p>Independently uses resources on-campus and off-campus to assemble materials and identify potential employers. May need instructor prompting and reminders for materials</p>		<p>Independently uses resources on-campus and off-campus to assemble materials and identify potential employers. Seeks out advice and mentors on the job search. Is timely and prompt with requests for letters of reference.</p>
<p>5b. Students will obtain appropriate entry-level scientific jobs with reasonable chance for advancement or will be accepted into PhD programs in chemistry related fields.</p>	<p>Is a poor candidate for almost any job related to chemistry even when the job market for scientists is "good". Have poor interpersonal and inadequate scientific skills and a bad work ethic. Would not be appropriate candidate for graduate level work.</p>	<p>Can get a low level scientific "tech" job with little probability for advancement. Has decent interpersonal, but only adequate scientific, skills. Student is a reliable worker. Would not be an appropriate candidate for graduate level work.</p>	<p>Can readily get an entry level scientific job with a reasonable chance for advancement. Has a strong work ethic. Should get accepted into some graduate programs in chemistry related disciplines.</p>		<p>Can readily get entry-level scientific job with a good chance for advancement. Would get into a number of top-tier graduate programs in chemistry-related disciplines.</p>

ORAL COMMUNICATION RUBRIC					
	1	2	3	4	Total
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow.	Student presents information in logical, interesting sequence which audience can follow.	
Subject Knowledge	Student does not have grasp of information; student cannot answer questions about subject.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student is at ease with expected answers to all questions, but fails to elaborate.	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration.	
Graphics	Student uses superfluous graphics or no graphics	Student occasionally uses graphics that rarely support text and presentation.	Student's graphics relate to text and presentation.	Student's graphics explain and reinforce screen text and presentation.	
Mechanics	Student's graphics explain and has four or more spelling errors and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has no misspellings or grammatical errors.	
Eye Contact	Student reads all of report with no eye contact.	Student occasionally uses eye contact, but still reads most of report.	Student maintains eye contact most of the time but frequently returns to notes.	Student maintains eye contact with audience, seldom returning to notes.	
Elocution	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	
Audience Response	Incoherent; audience lost interest and could not determine the point of the presentation	Some related facts but went off topic and lost the audience; mostly presented facts with little or no imagination	Presented facts with some interesting "twists"; held the audience's attention most of the time	Involved the audience in the presentation; points made in creative way; held the audience's attention throughout	
Length of Presentation	Too long or too short; ten or more minutes above or below the allotted time	Within six minutes of allotted time +/-	Within four minutes of allotted time +/-	Within two minutes of allotted time +/-	
Demonstrates understanding	Not able to answer questions	Hesitates and not able to answer many of the questions or does not expand well on answers.	Responds well to questions, but is average in generalizing or expanding upon the principles	Able to respond to questions and shows ability to generalize the principles to other problems or ideas.	

<u>Criterion</u>	<u>Excellent</u> (5)	<u>Very Good</u> (4)	<u>Average (benchmark)</u> (3)	<u>Poor</u> (2)	<u>Unsatisfactory</u> (1)
Demonstrates original thinking or project design.	Under Construction				
Articulates the research problem or question clearly.					
Places the problem or question in proper scientific, historical, and scholarly context.					
Formulates an original hypothesis.					
Designs and conducts relevant experiments to test hypothesis.					
Shows evidence of advanced technical achievement.					
Analyses findings in adequate depth.					
Draws appropriate, reasoned conclusions from findings.					
Reports findings clearly.					

Time Frame:

3-year plan starting Fall 2008, with ~1/3 of outcomes assessed each year

Who will do the assessment?

The MS program director and MS research active faculty (see table below)

How will data be used to revise the program?

to be determined in faculty meetings at end of each year.

Specific Assessment Methods for year 1 outcomes:

Outcome	Assessment Tool(s)	Person Responsible
1a	Two ACS subject exams upon entrance and at the end of 2 nd semester	MS program director, Chemistry Admin
	Final exam questions from elective courses (if taken).	Instructor from elective course grades by rubric and forwards answers to MS program director
1b	Chem 698 will require a written literature research and/or progress report summarizing the literature.	Graded by rubric Chem 698 Instructor
3a	End of semester TA evaluations filled out by students.	Chemistry Admin (compiled and summarized) forwards to MS program director
3b	Written research progress report (draft and final) required as part of second semester Chem 698. Graded by rubric (draft versus final).	Chem 698 instructor
3c	Oral presentations in elective or Chem 698 graded by rubric.	Instructor
3c	Practice teaching sessions recorded and graded by rubric from TA meetings	Faculty in charge of Chem 111/113/organic as needed

**Support and documentation of assessment (exams, copies of reports/presentations, graded rubrics, DVD) will be forwarded to the Chemistry Admin and placed in the MS program assessment file.