Department of Chemistry
University of Colorado Denver
Outcomes Assessment Plan

Department Overview:

The Department of Chemistry offers both the B.S. and M.S. degrees in chemistry. Students at the B.S. level have the option of obtaining an American Chemical Society Certified degree. Normally this involves taking just one additional class beyond the basic degree requirements.

Undergraduate Program Outcomes:

1. Students possess an adequate knowledge base in several sub-disciplines of chemistry as defined by the American Chemical Society.
2. Students can rely on this knowledge base to link more than one chemical principle to solve problems, both qualitatively and quantitatively, individually and in groups.
3. Students can (a) recognize and define a general problem in any of several sub-disciplines of chemistry, (b) design and carry out at least one significant experiment which addresses the problem, and (c) competently analyze and report their experimental results in oral and written form, adhering to proper chemical conventions.
4. Students can (a) identify when information is needed to solve a problem, (b) identify and locate appropriate sources of information, and (c) effectively extract and construct scientific meaning from critical reading of written material, including primary, secondary, and instructional literature.
5. Students understand the concepts of safe laboratory practice, use ethical reasoning to evaluate their practices in performing experiments and communicating results, and conduct themselves responsibly according to the ethical and safety standards of the profession.

1. Outcomes Assessment Faculty Questionnaire

Answer the following questions as they apply to your class. Please be as thorough as possible, and feel free to provide answers to questions that we didn't explicitly ask.

Name of Course:

1. How were the projects designed and set up?
    a. What prerequisite knowledge and skills (laboratory, literature, literacy, etc.) do you assume your students possess upon entering your course?

    b. What activities (if any) did the students perform either through lecture or laboratory to prepare them for the projects?

    c. Who determined the actual experimental questions the project addressed? Was the design student-centered? Instructor-centered? Some combination?

    d. How many weeks of the semester were devoted to the project? (Also how often does the class/lab meet?)

    e. Do the students work individually or in groups? If they work individually, are they allowed to collaborate? Are they encouraged to collaborate? If they work in groups, who determines the group make-up and how the work will be distributed?

    f. How much and what kind of guidance do the students get as they work on their projects? What is your philosophy towards guiding the students?

2. Project Assessment
    a. How are the projects assessed? (Mechanics: proposal, notebooks, written report, oral presentation, poster session, other?) Are students assessed individually or in groups (or some combination)?

    b. What is the grading scheme associated with the project? (Overall percentage of student's grade, percentage for each of the items within the project, etc.)

    c. What criteria do you use for assessing student performance? (Level of understanding, experimental design, creativity, hard work, quality of writing, artwork, etc.)

    d. How do you provide feedback to the students on the success of the project? What kind of feedback to you provide?

3. Outcomes
    a. What do you hope this project will accomplish for your most motivated and best performing student?

    b. What is the bare minimum you hope this project will accomplish for your less motivated, poorest performing (but still passing) student?

    c. How do you see this project experience integrating with the lecture portion of the course (or correlated course)? Within our overall curriculum in Chemistry? Within your sub-discipline?

    d. Do you feel the course was successful? Do you feel the project was successful? What would you change?

4. What other comments, philosophical approaches, course details, etc. can you share that are not covered above?

2. Chemistry Undergraduate Outcomes Assessment Matrix

Outcome	Assessment(s)	Sampling	Data Collection Method	Assessment Scoring Method
Outcome 1: Students possess an adequate knowledge base in several sub-disciplines of chemistry as determined by the American Chemical Society	American Chemical Society (ACS) Standardized Examinations	Select courses from across the major	Administered as final exam	Percentage correct of 100 points and compared to nationally normed scores
Outcome 2: Students rely on this knowledge base to link more than one chemical principle to solve problems both qualitatively and quantitatively.	Percentage of points from each course exam	Select courses from across the major	At least 20% of points on every course exam assesses student performance	Rubrics developed by instructor for each exam and linked to exam/course grades.
Outcome 3: Students can recognize and define a general chemical problem in any of several sub-disciplines of chemistry and can design and carry out at least one significant experiment which addresses the problem, competently	Laboratory research project final report	All students in CHEM 3018 CHEM 3498 CHEM 4128 CHEM 4538 CHEM 4828	Final report collected by course instructors	Rubric based on research report sections and linked to course grades.
reporting their experimental results in oral and written form, adhering to proper chemical conventions.	Laboratory research project presentation	All students in CHEM 3498 CHEM 4538	Formal presentation of project results at semester end to class and members of Chemistry faculty	Rubric based on presentation of results in a scientific context

3. Graduate Outcomes Assessment Matrix

Outcome	Assessment(s)	Sampling	Data Collection Method	Assessment Scoring Method
Outcome 1: Students possess an understanding of the basic concepts of the fundamental areas of chemistry (physical, analytical, inorganic, and organic) significantly beyond their baseline knowledge* and possess an extended understanding of one or more of these subdisciplines.	*Baseline Assessment: American Chemical Society Standardized exams in Organic, Physical, and Analytical Chemistry	All entering graduate students	Qualifying Exams administered before students begin coursework	Percentage correct of 100 points and compared to nationally normed scores to establish proficiency. Students who are not deemed proficient are required to take specific undergraduate or graduate courses to demonstrate mastery.
	Seminar presentation	All first-year graduate students	Formal presentation of literature article to Chemistry Department	Rubric based on presentation of results in a scientific context
	Course Completion or re-taking of ACS standardized exams	All students not passing proficiency exams (see above)	Examination of grades or repeating and successfully passing proficiency exams	Successful completion of designated coursework with grade of B or better. Percentage correct of 100 points and compared to nationally normed scores to establish proficiency.
Outcome 2: Students can effectively carry out a research project assimilating knowledge along the way, effectively report their experimental results in oral and written form, adhering to proper chemical conventions and develop the ability to use this knowledge to address new scientific questions	Seminar presentation	All graduate students	Formal presentation of research project to Chemistry Department	Rubric based on presentation of results in a scientific context
	Research Project Report or Thesis	All graduate students	Final report or thesis to committee consisting of research director and at least two other faculty members	Project/thesis rubrics and oral defense presentation

4. Rubric for Undergraduate Presentations:

1. Presentation	Highly Proficient	Proficient	Minimally Proficient	Not Proficient
a. Organization	Presentation is very well organized. Thorough outline of content is presented at the beginning, adhered to through the talk, and used to summarize at the end. There is an orderly progression from the statement of the problem, through the experimental design, description of experiments, gathering and analysis of data, conclusions drawn, to final summary and ideas for future experiments.	Presentation is well organized. Outline of content is provided at outset but not adhered to or has some elements missing. Progression through content is orderly but has occasional gaps or disconnects. Summary misses one or more key points and/or ideas for future experimentation. Student doesn't trim data to fit into talk length.	Presentation is organized but very minimal outline of content is provided at outset. Progression through content has gaps and/or disconnects. Presentation of experimental results is not explicitly linked to the problem or the conclusions. Summary is minimal.	No outline is provided at outset and/or outline is not adhered to. Numerous gaps and disconnects through presentation of content. No clear connection between problem, proposed experimental route to address problem, data gathered/analyzed, and possible conclusions from data. Summary is minimal or absent.
b. Time frame	Presentation makes best use of time allotted. Clear evidence that speaker has practiced beforehand. All the prepared material is covered and there is no necessity to rush through latter part of presentation.	Presentation makes good use of time allotted. Speaker appears to have practiced beforehand. Occasional need to rush or skip things, but most of the prepared material is covered.	Presentation makes fair use of time allotted. Speaker has practiced but not enough. Significant prepared material either not covered or rushed through because time is not managed well. Presenter speaks too slowly or too rapidly.	No evidence that speaker has practiced beforehand. Presentation is either rushed because time has not been managed properly or significant information is omitted and presentation is too short.
c. Delivery	Student consistently speaks clearly, is loud enough to be heard throughout room, and makes good eye contact and interacts positively with audience, appearing comfortable and confident. Presentation not read or memorized from a script.	Student usually speaks clearly, is loud enough to be heard, and makes good eye contact and interacts positively with audience. Parts of presentation read or memorized from a script or student infrequently gets flustered. Student occasionally blocks audience view.	Student speaks clearly, is loud enough to be heard, and makes good eye contact with audience through at least half of the presentation. Parts of presentation are read or memorized from a script and student gets flustered on occasion. Student is immobile and/or appears uncomfortable	Student does not speak clearly, is often not loud enough, or doesn't make eye contact with audience through significant parts of the presentation. Significant parts of presentation are read or memorized from a script and/or student gets flustered on several occasions.

			with room/equipment.	
d. Vocabulary	Student always uses appropriate chemical terms correctly to describe background chemistry, laboratory equipment and experiments and data analysis.	Student usually uses appropriate chemical terms correctly to describe background chemistry, laboratory equipment and experiments and data analysis. Occasional lapses into non-chemical terminology.	Student uses appropriate chemical terms correctly to describe background chemistry, laboratory equipment and experiments and data analysis through half the presentation. Frequent lapses into non-chemical terminology.	Student rarely uses appropriate chemical terms correctly to describe background chemistry, laboratory equipment and experiments and data analysis.
e. Ability to handle questions	Student responds to questions confidently and enthusiastically. Student shows ability to think through and answer unexpected questions.	Student responds to questions s/he has prepared for confidently and enthusiastically, but occasionally gets flustered by unexpected questions.	Student responds to half of the questions confidently and enthusiastically. Gets flustered often.	Student unable to handle questions without demonstrating significant disconcertion.
2. Content	**Highly Proficient**	**Proficient**	**Minimally Proficient**	**Not Proficient**
a. Context of Problem	Problem is introduced with thorough and methodical explanation of how the problem fits into chemical sub-discipline and how experimental approach will address the problem.	Problem is introduced with logical explanation of how the problem fits into chemical sub-discipline and how experimental approach will address the problem. Occasional gaps or disconnects are evident.	Problem is introduced with minimal connection to chemical sub-discipline. Experimental approach is not well connected to problem.	No connection is established between problem and chemical sub-discipline. Experimental approach is either not correlated to problem or the correlation is incorrect or illogical.
b. Presentation and Evaluation of Data/Results	Data/results are presented and discussed in logical manner using tables, graphs, spectra, etc. effectively. Student demonstrates a clear understanding of how data/results were obtained, what they mean and how they fit into the problem's context.	Data/results are presented and covered in logical manner using tables, graphs, spectra, etc. effectively. Student does not always show a clear understanding of how data/results were obtained, what they mean or how they fit into the problem's context.	Data/results are presented but explanations are illogical or incomplete. Use of tables, graphs, spectra, etc. not always effective or student does not always demonstrate an understanding of how data/results were obtained, what they mean and how they fit into the problem's context.	Data/results are presented with minimal or incorrect explanations. Tables, graphs, or spectra are absent or used ineffectively. Student does not demonstrate an understanding of how data/results were obtained or what they mean. No connections to problem's context.
c. Assessment against Objectives	Student demonstrates a clear understanding of how experimental approach will address problem, how results	Some gaps evident in student understanding of how experimental approach will address problem, how results	Some gaps apparent in student's connection between experimental approach and problem. Explanation of	Student demonstrates only minimal understanding of how experimental approach will address problem. No or

	will contribute to better understanding, what control/background experiments will necessary, and how those control/background experiments will rule out certain possible conclusions/confusion. Student frames results within context of problem and other data (other students or literature)	will contribute to better understanding, what control/background experiments will necessary, and/or how those control/background experiments will rule out certain possible conclusions/confusion. Understanding is enhanced by questioning or explanation from faculty or other students.	control/background experiments does not fully explain their necessity or conclusions that can result from acquired data or results. Understanding only minimally enhanced by questioning or explanation from faculty or other students.	minimal discussion of control/background experiments. No connections made between experimental results and possible conclusions. No connections between student results and results of other classmates or in the literature.
d. Validity of Conclusions	All conclusions follow logically and correctly from data/results presented. Student makes no irrational claims or assumptions. Student demonstrates a clear and thorough understanding of what conclusions mean and how they fit into problem's context.	Most of the conclusions follow logically and correctly from data/results presented. Student makes a few claims or assumptions that do not directly follow from data/results. Student demonstrates a surface understanding of what conclusions mean and how they fit into problem's context, but misses some deeper connections.	Many of the conclusions follow logically and correctly from data/results presented. Student occasionally makes irrational claims or assumptions. Student demonstrates a partial understanding of what conclusions mean and how they fit into problem's context.	Several of the conclusions presented are not substantiated by data/results. Student makes several irrational claims or assumptions and has no clear understand of what the data/results mean and how they fit into the problem's context.
e. Response to Questions	Student always understands questions, and answers are always logical, thorough, and within the context of the chemical problem and experimental results obtained.	Student usually understands questions, and answers are usually logical, thorough, and within the context of the chemical problem and experimental results obtained.	Student does not understand all the questions, and answers reveal that student does not fully understand the chemical problem and/or what the experimental results mean.	Student is unable to answer questions or answers are illogical or incorrect.