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Chemistry, Biological Chemistry concentration Learning Assessment Report

1. Assessment Plan

1.a Program Information	
Name of Program (Major)	Chemistry, Biological Chemistry concentration
School	Humanities and Sciences
Academic Years Covered by this Plan	2017-18
1.b Primary Faculty Contact	
Name	Christopher Chidsey
Position	Chair, Undergraduate Studies Committee, Chemistry.
E-Mail Address	chidsey@stanford.edu
1.c Other Contacts	
Name	*none*
Position	
E-Mail Address	

1.d Program Mission Statement

The mission of the undergraduate program in Chemistry is to provide students with foundational knowledge in the subdisciplines of chemistry as well as depth in one or more advanced areas, including cutting-edge research. Introductory course work allows students to gain hands-on experience with chemical phenomena, gather data, and propose models and explanations for their observations, thus participating in the scientific process from the start. In advanced labs and lectures, students build an in-depth knowledge of the molecular principles of chemistry empowering them to become molecular engineers comfortable with the methodologies necessary to solve complex problems and effectively articulate their ideas to the scientific community. Ultimately the analytical thinking and problem solving skills developed within the chemistry major make students successful candidates for a wide range of careers in chemistry and beyond, including engineering, teaching, consulting, medicine, law, science writing, and science policy.

1.e Undergraduate Program Learning Outcomes

The department expects undergraduate majors in the program to be able to demonstrate the following learning outcomes. These learning outcomes are used in evaluating students and the department's undergraduate program. Students are expected to:

1. demonstrate the knowledge and skills required to solve problems in the synthesis, measurement, and modeling of chemical systems.
2. apply this set of chemical knowledge and skills to analyze scientific data, evaluate and interpret its significance, and articulate conclusions supportable by the data.
3. be able to construct a scientific hypothesis and devise appropriate experiments to test and evaluate this hypothesis.
4. Communicate scientific research effectively in written and spoken form.

1.f Assessment Design	
Assessment Question	To what extent have our students achieved the learning outcomes of the major?
Nature of Student Work or Performance	Performance relative to specific learning outcomes in **CHEM 185: Biochemistry III** This course uses the primary literature in the context of the entire prior chemistry curriculum to develop critical reading, presentation and analytical skills. Each week, 3 or 4 students present papers that have been read by the entire class. Students must upload questions on each paper prior to the first day of discussion. At the end of the course, each student prepares a 10-15 page paper on a topic of current interest in biophysical chemistry, with the last two pages devoted to suggestions for future work, *i.e.* a mini-proposal. This paper is then critically and anonymously reviewed by another member of the class. **Learning Outcomes for Chem 185:** 1. Integrate existing chemical knowledge and skills to understand a broad range of complex systems in biochemistry. 2. Critically assess and integrate the reasoning process used in biochemical research and communicate it effectively in spoken and written form. 3. Apply understanding to evaluate experiments and propose new biochemical research projects.
How Student Work will be Analyzed	Score student work using the following learning outcomes rubric.
Other Notes on the Assessment Design	*none*

1.g Learning Outcomes Rubric				
	Unacceptable	**Marginal**	**Proficient**	**Exemplary**
Oral communication and critical assessment of chemical research: Each student presents twice with a different group selected at random. Because of the range of topics, this requires the integration of all previous coursework to understand novel, complex studies.	Student is not careful in reviewing the paper, is not clear in his/her explanations, or simply presents a "book report" rather than leading discussion of critical hypotheses and observations.	Student is able to explain most of the content of the paper. Attempts a discussion of the conclusions and limitations of the paper but is superficial in his/her analysis.	Student understands the paper, leads a critical discussion rather than just summarizing content, and provides context as needed to understand the paper.	Student demonstrates a strong grasp of the paper's strengths and weaknesses, smoothly guides discussion of complicated topics, and consistently incorporates other literature or connections with prior lab or lecture courses to help explain material.
Integration of chemical knowledge and critical discussion: Students demonstrate a conceptual understanding of experiments and chemical reasoning by questions posed during discussion and online prior to class.	No participation, or questions show only superficial understanding of the material.	Modest participation; limited understanding even of familiar topics; accepts literature as true rather than challenge dogma.	Active participation in most discussions; successfully uses experience in previous courses to understand concepts; questions recognize limitations in paper's reasoning and experimental design.	Consistent active participation; questions show thorough and insightful understanding of experiments and reasoning; strives to figure things out rather than accept dogma or reputation of author.
Written communication and experimental design: Students select a paper from a field at the frontier of biophysical chemistry, applying their knowledge to critically evaluate the content of the paper, and propose follow-up research.	Superficial summary, basically a book report, little in the way of novelty in the proposal.	Summarizes work accurately, but not critically; proposed work a minor extension.	Summarizes work accurately and critically on a topic that is not particularly challenging; proposals interesting but not far reaching.	Challenging topic with a high level of critical analysis; carefully summarizes strengths and weaknesses of the work; proposes potentially doable, insightful experiments; very well written.

Critical evaluation of writing and proposed research: Students effectively summarize the content of a paper written by a peer on a topic they are not familiar with; clearly evaluate the writing and proposal.		Minor comments, mostly obvious, not particularly critical.		Takes seriously the role of critic and reviewer, providing comments that would lead to improvement of the original paper.

2. Collect and Assess Student Work

2.a Timeline of Assessment Activities		
Academic Year	**Planned Activities** (Fill in all rows of this column at the time the Assessment Plan is created, saying what you plan to do each year for the next three years going forward.)	**Actual Assessment Activities Completed** (Fill in one row of this column at the conclusion of each academic year, saying what activities were in fact completed.)
2016-17	Not planned	Not collected
2017-18	Performance in Chem 185 to be evaluated	Assessed each student's work in Chem 185 on the four outcomes above based on their performance on the oral presentation of papers in biochemistry, The questions they pose before and during discussion of the papers presented by others, their written report of a paper of their own choosing and proposed follow-up research, and their critical evaluation of other students' reports.
2018-19	Possibly revise assessment plan	To be determined.

3. Results and Assessment Report

3.a Learning Outcomes Data Table					
	Unacceptable	**Marginal**	**Proficient**	**Exemplary**	**Total Number of Students Assessed on Each Dimension**
Oral Communication	2 (18%)	2 (18%)	4 (36%)	3 (27%)	11 (100%)
Integration of Knowledge	2 (18%)	2 (18%)	4 (36%)	3 (27%)	11 (100%)
Written Communication	0 (0%)	0 (0%)	5 (45%)	6 (55%)	11 (100%)
Critical Evaluation	3 (27%)	2 (18%)	0 (0%)	6 (55%)	11 (100%)

Notes: "Count" is the raw number and "%" the percentage of students evaluated who fall into each category (e.g. the number scored exemplary on learning outcome #1 divided by the total number of students assessed on learning outcome #1). **Please enter "0" when no students fall in a category; please do NOT leave any cells blank. Please check that percentages across each row sum to 100%, or note rounding error.** The table can be adapted to display trends over time or compare subgroups. Please contact learning_assessment@lists.stanford.edu for assistance.

3.b Assessment Report	
Written Summary of Assessment Results	Students performed best on the written work (all proficient or exemplary), and less well in the other dimensions. Prof. Boxer reported that qualitatively the class was overall less strong than recent groups, which may simply be a fluctuation of small numbers. On the other hand, this year's strong written performance (previously an area of weakness) can be attributed to a specific change in the course: the publication to the class of a detailed rubric for the written work. It is possible that this group was able to better focus their effort with the very detailed target that the rubric provided.
Limitations of the Assessment Results	None other than the limitations of small numbers.
What mechanisms will you use to share these results with program faculty?	These results will inform the ongoing discussion in the Curriculum Committee about curricular revisions to take to the full faculty.

What changes in the program do these findings suggest?	It may be helpful to begin preparing students for the work of Chem 185 earlier in their careers. One topic for discussion among faculty teaching prior courses may be establishing coordinated expectations for how to critically read and critique both the published literature and other students' work, as well as more explicit, shared understanding of what critical writing should contain so that less explicit rubrics are needed at the end of the major.

3.c Notes for the Next Assessment Cycle

To be determined in light of on-going committee and full faculty deliberations.