

2017 Annual Assessment Report- Chemistry

I. Assessment Meetings.

The BCS Faculty (Professors Bailey, Blake, Burwell, Schmidt & Schnurr) met several times this academic year to discuss Assessment. At the December 6, 2016, meeting (1:30-2:30) we made sure that each of the respective major programs (Biology, Chemistry, Biochemistry & Molecular Biology, and Biological & Chemical Sciences) would have their own assessment and point person. At the May 2, 2017, meeting (12:20-1:00) we updated each other on the respective assessments and talked about common themes and formats. The Chemists (Bailey and Burwell) met separately on May 4th (12-12:50) to talk specifically about the Chemistry assessment. This was culminated by a May 11, 2017 meeting (11:00-12:10) which involved all five faculty members discussing each of the respective annual reports.

II. Closing the Loop.

In the 2016 chemistry assessment report the action plan for the 2016-2017 academic year included adjustments to Medicinal Chemistry (Chem303) and the Organic Chemistry sequence (Chem213L & Chem214L). Medicinal Chemistry was reorganized into a project based course that focused on the principles of pharmacology and drug development. New projects that were developed for this course included case studies focused on epidemiology, drug development and nutrition. Students also designed presentations on “Quack Drugs” and that led into discussions on drug development and regulation of drugs by the FDA. At the end of the course students wrote a mini-review, designed an information pamphlet, and gave an oral presentation on a specific drug. Rubrics were designed for each of these projects to assess student learning. The redesign of this course was considered successful based on the quality of student work as well as the positive student feedback provided in the course evaluations.

In Organic Chemistry, the textbook was switched to one authored by Marc Loudan and Jim Praise. The reason for this change was due to the cost of the previous textbook (\$170 vs \$70) as well as the content. The content in the new textbook was presented in a more applied approach, focused on real world problems, which made it easier for the students to read and use throughout the year. This change was considered successful based on student course evaluations. Many student commented they utilized the book frequently and found the example problems as well as the study guide great tools to review course content.

III. Examination of Assessment Data.

Last years' Chemistry assessment indicated that we would be focusing on specific courses rather than specific outcomes. Subsequent to the submission of the report we discovered that that was not the correct format for these reports and so for this current report we decided to focus on the single Program Goal 3, to “*Train students to communicate scientific work in a clear, coherent manner in both written and oral form.*”

In Inorganic Chemistry, Chem315L, students selected articles from the current primary literature and did two 10-15 minute oral presentations, one each at midterm and the end of the semester. Students were assessed on how well they conveyed the main points from the article to their peers, how well their Power Point presentations assisted in the understanding of the respective paper, and how well they fielded questions from their peers following the presentation. For both presentations, 100% of the students earned 80% or better.

Scientific writing and speaking was assessed in Chem213L, Chem214L, Chem323L, Chem326 and Chem303. Both the writing and presentation assignments were assessed using rubrics that students had access to while completing these tasks (see, for example, Appendix I). In Chem213L, Chem214L and Chem323L students wrote a formal lab report based on data that was collected in lab. In

Chem214L and Chem323L students presented the results of their research to their peers in an oral presentation. In Chem326 and Chem303 students wrote mini-review articles and presented their articles to the class at the end of the semester. For the oral presentations in Chem326 the average was 82% and 21/22 students scored above 70%; and in Chem303 the average was 87% and 100% of the students scored above 70%.

A big change this year in the Senior Capstone course (BCS403) was the switch from the composition of a “mini-thesis” to a “research propositional” as the major focus of the course. A research propositional does include a survey of the current state of the field in one particular area as a “mini-thesis” might do, but then asks the students to propose new investigations (individual experiments or broader studies) which might move the field forward. Thus, the students weren’t just reporting on something, they were taking ownership of an area. This exercise was assessed by the composition and submission of the propositional (the rubric is attached as Appendix II). Assessments were fairly high (for 26 students, the average grade was 88%, with the actual minimum grade being 70%), in large part because the students felt a strong connection to the work they were reporting on. A selection of quotes, taken from our BCS Senior Reflective Essays, regarding the propositional is attached as Appendix III. It should be noted that the students were not asked specifically about this course, so these responses were generated spontaneously.

Student oral presentations were assessed twice during the Senior Capstone Course (BCS403). For the first presentation, students selected one article from the primary literature that they were using for the background section of their propositional paper. For the second, students presented an overview of their propositional paper. For both presentations, students were assessed both on their own presentation and also on the feedback that they provide their peers; the feedback was collected and shared anonymously through Google Forms. A sheet describing the assessment for the Literature Presentation Evaluation is attached as Appendix IV; the Propositional Presentation Evaluation had a similar format. These forms were also used by the faculty in their assessment of each student presentation. For the Literature Presentation, the average was 84%, and all students achieved at least the 70% standard. For the Propositional Presentation the average grade was 88%, with two students failing to meet the 70% goal; both of these students scored in the 60-69% range.

We interpret these results as indicating that as a major we are successfully meeting the goal to “*Train students to communicate scientific work in a clear, coherent manner in both written and oral form.*” Students get the opportunity to practice scientific writing and oral communication in numerous courses, culminating with the Senior Capstone course.

IV. Program Changes for the Upcoming Year.

Based on the results reported above, we do not see that any major adjustments are necessary at this time in regards to written and oral communication.

V. Action Plan for the Upcoming Year.

We have been concerned for many years about the use (or lack thereof) of the textbook by students in the Introductory Chemistry sequence (Chem107 and Chem108). The textbook itself is quite large and often finds its primary use that of being a doorstop. For the past two years students have had access to a digital copy of their textbook in addition to a printed version, but that alone does not appear to have gotten them to utilize it more efficiently. This coming year we are having students purchase a loose-leaf version of the text, which should allow them to bring individual chapters with them to class. We thus plan to develop exercises which will require them to utilize the textbook in class. The goal of this is to help address objective 1a, “*Has a working knowledge of the concepts and principles presented in class.*” We will use exams, quizzes, problem sets, and specifically designed exercises to assess whether students are better gaining this knowledge.

Appendix I. Oral Presentation Rubric used in Chem 213, 214, 323, 326, and 303.

Category	20 points	15 points	10 points	5 points	0 points
Preparedness	<ul style="list-style-type: none"> -Well Organized (presented in a logical order). -15min presentation. -Fields Answers well and promotes discussion - Presentation shared on Google drive. 	3 out of 4	2 out of 4	1 out of 4	No criteria met
Content	<ul style="list-style-type: none"> -Contains an introduction and provides adequate background. -Discusses why this topic is exciting to spark interest. -Discusses at least one future direction for the project. -Minimal typos/ Grammatical Errors. Cites references. 	3 out of 4	2 out of 4	1 out of 4	No criteria met
Engagement	<ul style="list-style-type: none"> -Makes good eye contact -Speaks clearly and loudly -Slides are not cluttered and do not confuse the audience -The class is engaged with the presentation. 	3 out of 4	2 out of 4	1 out of 4	No criteria met
Group Involvement	<ul style="list-style-type: none"> -Everyone in the group participates in the presentation -Everyone in the group participates in answering the questions. -Apparent the group worked together while putting the presentation together (nothing is repeated or forgotten) 	2 out of 3	1 out of 3		No criteria met
Your participation and feedback	<ul style="list-style-type: none"> -Self reflects on your own presentation. What worked well and what could have been improved? -Provides comments or ideas on how your project can be improved -Asks one question to another group. -Provides constructive feedback on other groups' presentation. 	3 out of 4	2 out of 4	1 out of 4	No criteria met

Appendix II. 2016 Propositional Rubric 150 pts (BCS304)

	Exemplary	Above Average	Acceptable	Unacceptable	Pts
Introduction /Background (40)	Engaging and informative. Indicates what is known and not known in the field with support from the literature. Leads to propositional aims. Logically constructed.	Includes relevant information, with some support from the literature. Logically constructed.	Includes relevant information, with little support from the literature.	Includes information with an unclear relationship to the propositional topic. Minimal support from the literature.	
Propositional Aim(s) (20)	Well developed, interesting, novel, and extrapolates from current knowledge. Original thought is clear. Focused on a specific question(s).	Interesting and extrapolates from current knowledge. Original thought is present. Focused on a specific question(s).	Extrapolates from current knowledge. Original thought is unclear and aims are unfocused.	Original thought is unclear and aims are unfocused.	
Experimental (35)	Proposes well designed and feasible experiments; where appropriate includes details of control experiments. Relates experiments to propositional aims. Hypothesizes range of results, interprets predicted results, and knowledge gained. Occurs for each experiment proposed.	Proposes feasible experiments; where appropriate includes details of control experiments. Relates experiments to propositional aims. Hypothesizes range of results, interprets predicted results, and knowledge gained.	Proposes reasonable experiments; control experiments are unclear. Relates experiments to propositional aims. Hypothesizes some results.	Questionable relationship between experiments and propositional aims.	
Significance and Conclusions (15)	Clearly ties together all experiments proposed and their significance to the field. Relates results back to original propositional aims.	Ties together experiments proposed and their significance to the field. Relates results back to original propositional aims.	Included but does not clearly relate significance to field.	Conclusions missing and/or does not relate the significance of results to the field.	
Citation (15)	Consistent and correct.	A few errors.	Multiple errors.	Inconsistent and not correct.	
Overall Composition (25)	Well organized and reads logically. Sentences and paragraphs are well phrased and flow smoothly. The language is professional and appropriate. Almost no errors in punctuation, capitalization, and spelling.	Well organized and reads logically. Sentences and paragraphs flow smoothly. The language is professional and appropriate. A few errors in punctuation, capitalization, and spelling.	Problems with organization. Some problems on the sentence and paragraphs level. Some errors in punctuation, capitalization, and spelling	Not organized. Multiple problems on the sentence and paragraphs level. Multiple errors in punctuation, capitalization, and spelling.	

Appendix III. Quotes from BCS Senior Reflective Essays.

Writing my senior seminar proposal helped me practice the process of science –planning, executing, evaluating and communicating. Even though I didn't physically do the execution of the experiment, I was able to really take time to plan an experiment and communicate to my class how I would like to go about testing my hypothesis. I was able to learn about new experiment techniques and it was cool to be able to decide how I wanted to test my theory. The project helped me as a scientist because it allowed me freedom to explore different topics and allowed me to come up with different experiments and I was able to say what would happen if X happened or Y happened.

My favorite project was my propositional thesis. I myself had the choice to choose my own topic and explore anything about it. I loved it. I think it is important for any student to realize how to do this. It isn't easy, but I developed as a scientist, and that is important. I spent hours upon hours finding information and realized I chose a very hard topic. I had the choice to change the topic, but I liked the challenge. I had to present a very difficult subject to people who knew nothing about horses or the disease I studied. I ended up doing very well, but it was not easy and I worked very hard. Planning the whole thing, without performing it was important because that is how people write grants. It had to be perfect in order to convince others and I think that is the most important aspect I learned from this project.

I really enjoyed being able to create the proposal for senior seminar. It was the first time I was able to take what I had learned and apply it to a 'real life' situation. I had to think critically about the topic I was studying and how the experiment I was proposing would impact the scientific research that was currently being carried out. It also allowed me to investigate a field I was interested in, this case, renewable energy sources, and lithium ion batteries. The course truly made me consider the current LIB energy research and place myself within it, in order to plan a well thought out and critical proposal that would add to the field in real-time.

[For] my senior propositional I defiantly needed to practice the process of science, because I had to come up with a topic that I wanted to do write about, research it, come up with a solution, and design an experiment to attempt to achieve my solution.

In BCS Senior Seminar we had to analyze literature and come up with and design our own experiment. Although we never actually performed the experiment, this was the most life-like situation regarding finding research we are interested in and what other literature exists around that. This helped me grow as a scientist because it prepared me for what writing my own papers might be like in the future.

[A] project ... that made me practice the process of science in both writing and orally would be our propositional in senior seminar. For [this] project we had to create our own experiment and write it out in a paper form as well as present to the class our ideas and/or results. This helped me develop as a scientist because this is something that scientist do all the time they have to find a way to convey their ideas and/or results both orally and in writing.

I think the propositional assignment in senior seminar was incredibly valuable for any sort of career in science. Because it was analogous to a qualifying exam for graduate school, I believe it gave me an edge for my applications to ... PhD programs. I was grateful that I could build off my past research, which helped me understand my work to a greater extent as well.

[Senior seminar] thoroughly helped me learn how to conduct a proper scholarly presentation. I had to find a question ... that has not been answered but has some information on it, enough to build a question off. Then I had to find scholar papers on this topic and formulate a concrete question then give background on that question. This project was extremely challenging, but was the one I learned the most from out of all the projects in my major. I then had to do two ten to twelve minute presentations

on this for my class. I had to perfect the image and text ratio on my slide show and then when presenting be sure to not use filler words and to speak loud and clearly.

My senior seminar research proposal was one project that really incorporated the process of science. My research proposal focused on the role of SNPs in people with rheumatoid arthritis. A lot of the planning involved reading plenty of primary sources and how I would use those to further research in the field. I would create drafts on how to conduct a research study and would have to evaluate how practical a method is and whether it has already been done before. I was required to write the research proposal but also give two oral presentations about my work. I think all of these skills were really valuable in developing me as a scientist because I was able to work on a project that I was interested in and understand the process of how research is started. The feedback was really helpful with each draft that I wrote and for improving my presentation skills. During the class we were able to learn about other fields of science since everyone had a different topic and evaluate their work which can be helpful for self-reflections as well. As a scientist you have to be willing to learn as much as you can and always stay curious on how you can learn more from what is already learned.

Appendix IV. Primary Literature Paper Presentation Evaluation

For the next few weeks, you'll be evaluating the primary literature paper presentations of your peers, on the basis of **both effective and engaging communication**.

As always, the burden lies with the communicator (not the audience) to make the presentation interesting and informative. This is accomplished through use of effective visual aids (good slides!), organization of material (storytelling), background information, inclusion/exclusion of certain data, and overall "likeability" (humor, mannerisms). Attend, listen carefully to, and evaluate (using the attached sheet) your fellow students presentations.

A list of questions for you to comment on is listed below. You will take notes by hand during the presentation and then submit your comments via google forms (links on moodle). Review your notes and think critically about the presentation when typing up your evaluation. Please use complete sentences, provide clarity, and be as detailed as possible in your comments. If you think some aspect of the presentation wasn't effective, state why. The point of this exercise is to **provide critical feedback** to the speaker as to how they can *improve* their presentation. **BE SPECIFIC IN YOUR COMMENTS.**

1. Did the presented clearly state the important question(s) being addressed by the author(s), and/or the hypothesis they were testing?
2. Did the speaker provide enough background information so that you were able to follow and understand how today's talk fits in with a larger body of work? Give an example of a) some background information that was helpful and b) some background information that you think would have been useful but was not given in the talk.
3. Presentation of data: Did the speaker clearly explain the research data they showed? Did they take the time to walk you through a figure (if necessary) so you could actually understand, interpret, and perhaps even believe the data presented?
4. Were the slides effectively designed and organized? Proper use of color, ratio of images/text, clearly labeled figures, etc?
5. Did the speaker communicate effectively with/ engage the audience? Why or why not – any particular techniques, mannerisms, speed of speech, volume of speech, etc.? Give examples that support your assessment here.
6. Overall order of presentation: Did the order of information presented make sense? Did the proper background material come at the correct time? Did the presentation tell a complete logical story of the data?
7. Was this talk "fun" to listen to? Did it capture and hold your attention? Explain – why or why not? Give one or more suggestions for how the speaker might have made improvements in this area, if you feel some were necessary.
8. What other comments do you have for the presenter that weren't addressed above?