2017-2018 Annual Program Assessment Report

Please submit report to your department chair or program coordinator, the Associate Dean of your College, and to james.solomon@csun.edu, director of assessment and program review, by September 30, 2017. You may, but are not required to, submit a separate report for each program, including graduate degree programs, which conducted assessment activities, or you may combine programs in a single report. Please identify your department/program in the file name for your report.

College: Science and Mathematics

Department: Chemistry and Biochemistry

Program: BA/BS/MS

Assessment liaison: Thomas Minehan

1. Please check off whichever is applicable:
   A. √ Measured student work.
   B. √ Analyzed results of measurement.
   C. ______ Applied results of analysis to program review/curriculum/review/revision.

2. Overview of Annual Assessment Project(s). On a separate sheet, provide a brief overview of this year’s assessment activities, including:
   • an explanation for why your department chose the assessment activities (measurement, analysis, and/or application) that it enacted
   • if your department implemented assessment option A, identify which program SLOs were assessed (please identify the SLOs in full), in which classes and/or contexts, what assessment instruments were used and the methodology employed, the resulting scores, and the relation between this year’s measure of student work and that of past years: (include as an appendix any and all relevant materials that you wish to include)
   • if your department implemented assessment option B, identify what conclusions were drawn from the analysis of measured results, what changes to the program were planned in response, and the relation between this year’s analyses and past and future assessment activities
   • if your department implemented option C, identify the program modifications that were adopted, and the relation between program modifications and past and future assessment activities
   • in what way(s) your assessment activities may reflect the university’s commitment to diversity in all its dimensions but especially with respect to underrepresented groups
   • any other assessment-related information you wish to include, including SLO revision (especially to ensure continuing alignment between program course offerings and both program and university student learning outcomes), and/or the creation and modification of new assessment instruments

3. Preview of planned assessment activities for next year. Include a brief description and explanation of how next year’s assessment will contribute to a continuous program of ongoing assessment.
2. **Overview of Annual Assessment Project(s).** Provide a brief overview of this year’s assessment activities.

The following major assessment activities took place this year:

• **Measure Student Work**

  A. General Education Assessment in Chem 100, 101, and 102 was performed. Faculty teaching the relevant courses assembled a set of 10 multiple-choice questions addressing GE SLO’s for natural sciences 1, 2, and 5, see appendices A1 and A2. These questions were then administered as part of the final exams in the respective courses and the results were tabulated by SLO.

  B. Assess basic knowledge in general chemistry, organic chemistry, and biochemistry (SLO1) using standardized exam questions in course finals.

  C. Assess students’ ability to keep a laboratory notebook in Chem 334L using our departmental notebook rubric

  D. Assess graduate students’ scientific oral communication abilities in literature and thesis seminars, relevant to SLO2m: Organize and communicate scientific information clearly and concisely, both verbally and in writing

• **Analyze Results of Measurement**

  E. An analysis of the results of GE assessment in Chem 100, Chem 101, and Chem 102 by SLO was undertaken

  F. An analysis of student performance trends in general chemistry, organic chemistry, and biochemistry was undertaken.

  G. Current student lab notebook performance was compared to a previous assessment from last year

  H. Review evidence pertaining to SLO2m: Organize and communicate scientific information clearly and concisely, both verbally and in writing.

The department chose these activities so as to 1.) participate in campus-wide GE assessment, as well as encourage more instructors in our GE courses to engage in assessment activities regularly, and 2.) encourage all faculty to continue doing assessment in their courses each year so as to identify trends over multiple semesters and weaknesses in student comprehension that need to be addressed at the individual course level and in the program as a whole.
A: Measure Student Work: GE assessment

SLO’s addressed:
GE SLO 1: Students will be able to demonstrate an understanding of basic knowledge, principles, and laws in natural sciences; GE SLO 2: Students will be able to explain how the scientific method is used to obtain new data and advance knowledge; GE SLO 5: Students will be able to demonstrate competence in applying the methods of scientific inquiry.

1. Instrument: 10 multiple choice questions embedded in the final exam of department courses Chem 100, Chem 101, and Chem 102

Instructors and course coordinators from our general chemistry courses (Chem 100, Chem 101, and Chem 102) as well as assessment committee members met to create a common assignment for GE assessment across all three courses that could be embedded in the final exams. GE SLO’s 1, 2, and 5 were selected for the assignment and appropriate multiple-choice questions were formulated and circulated to the relevant faculty for approval. A different set of assessment questions were crafted for the fall 2017 semester as well as the spring 2018 semester (see appendices A1 and A2). As is typical of GE courses in the college of science and mathematics, Chem 100, Chem 101, and Chem 102 are populated by both science (primarily chemistry/biochemistry and biology students) and non-science majors.

In Chem 100, in fall 2017, the assessment was administered in 11 sections totaling 627 students. In Spring 2018, the assessment was administered in 8 sections of Chem 100 totaling 554 students.

In Chem 101, in Fall 2017, the assessment was administered in 2 sections totaling 151 students. In Spring 2018, the assessment was administered in 4 sections of Chem 101 totaling 270 students.

In Chem 102, in spring 2018 the assessment was administered in one section totaling 66 students.

An acceptable benchmark for success would be 60% of the questions for each SLO answered correctly.

2. Results:
Chem 100: For fall 2017, the average percent correct for questions relating to SLO1 was 57%; the average percent correct for questions relating to SLO2 was 70%; the average percent correct for questions relating to SLO5 was 53%. For spring 2018, the average percentage correct for questions relating to SLO1 was 71%; the average percentage correct for questions relating to SLO2 was 49%; the average percentage correct for questions relating to SLO5 was 67%.

Thus in Spring 2018, student did significantly better on SLO’s 1 and 5 than students in fall 2017, but slightly worse on SLO2.
Chem 101: For fall 2017, the average percent correct for questions relating to SLO1 was 75%; the average percent correct for questions relating to SLO2 was 62%; the average percent correct for questions relating to SLO5 was 59%. For Spring 2018, the average percent correct for questions relating to SLO1 was 71%; the average percent correct for questions relating to SLO2 was 64%; the average percent correct for questions relating to SLO5 was 67%.

Chem 102: For spring 2018, the average percent correct for questions relating to SLO1 was 62%; the average percent correct for questions relating to SLO2 was 68%; the average percent correct for questions relating to SLO5 was 50%.

A summary of the results, representing average % correctly answered questions for each SLO:
E. Analysis of the Results

Though there was much instructor-to-instructor variability in the results for each SLO, some trends are apparent from the data present above. Other than for the Fall 2017 semester of Chem 100, all other aggregated sections of Chem 100,
Chem 101 and Chem 102 achieved the average benchmark score (60% questions answered correctly) for SLO1 (Students will be able to demonstrate an understanding of basic knowledge, principles, and laws in natural sciences). Interestingly, for SLO1 we observed an increase in performance on going from Chem 100 to Chem 101, and then a slight decrease in performance on going to Chem 102, perhaps indicative of students forgetting some of the basic laws and scientific principles learned in Chem 100. The dramatic difference in performance on SLO2 (Students will be able to explain how the scientific method is used to obtain new data and advance knowledge) for students in the fall and spring semesters of Chem 100 (70% correct vs. 49% correct) may be due to the fact that different assessment questions were used in these semesters, and perhaps the spring 2018 SLO2 questions were more challenging for the students. Nonetheless, the results for Spring 2018 Chem 101 and Chem 102 showed an improvement in performance on this SLO, with % correct averages above the benchmark score. SLO5 was clearly the weakest category for our students, with only two aggregate sections (spring 2018 Chem 100 and spring 2018 Chem 101) managing to get above the benchmark score (although it should be noted that an individual section of Fall 2017 Chem 101 cleared the benchmark score at 62%). This is not surprising, since SLO5 deals with critical thinking in “applying the methods of scientific inquiry” to specific problems and often our students struggle in this area, even in 200-400-level courses. It is suggested that our Chem 100, Chem 101, and Chem 102 instructors incorporate more problem-solving activities and/or active learning exercises in their lectures to help develop our students’ critical thinking skills.

B.1.1: Measure Student Work: Assess basic knowledge in general chemistry using standardized exam questions in course finals. Alignment with core competencies: critical thinking, quantitative literacy (SLO1).

Instructors in Chem 101 also utilized 12 questions from an ACS standardized exam in general chemistry to assess their classes with a series of pre- and post tests. For one instructor, the same 12 ACS exam questions were given as a pre (first week of class) and post (final week of class) test to 77 students in fall 2017 Chem 101. For the pretest only 4 students achieved the benchmark score of 7 or more questions correct out of 12; however, for the post-test 29 students achieved the benchmark score or higher. For the same instructor, 77 students in spring 2018 Chem 101 were given the 12 ACS questions in pre- and post-test format. For the pretest only 7 students achieved the benchmark score of 7 or more questions correct out of 12; however, for the post-test 34 students achieved the benchmark score or higher. In another section of Chem 101, an instructor utilized 12 questions from the ACS standardized exam in General Chemistry for assessment pre (first week of class) and post (final week of class) tests in his fall 2017 (78 students) and spring 2018 (76 students) sections. In fall 2017, the average student score on the pretest was 4.2/12, and the average student score on the post-test was 6.7/12. Indeed, 86% of the students received a score in the final week that was
higher than the first week. In spring 2018, the average student score on the pretest was 4.7/12, and the average student score on the post-test was 6.4/12, with 74% of students receiving a score in the final week that was higher than the first week.

F.1.1 Analysis of the results for General Chemistry
Clearly a dramatic improvement in student understanding of core concepts is being demonstrated in all the cases above, indicative of value-added learning throughout the course. It appears that for the post-test, approximately 50% of a given class in Chem 101 performs at or above benchmark. While there is still much work to be done to improve the overall number of students achieving the benchmark, the course instructors are doing a good job of improving our students' comprehension of the fundamental concepts of general chemistry.

B.1.2 Qualitative Assessment in General Chemistry Courses: Self-Efficacy
To understand students’ affective judgment about themselves in chemistry and how chemistry courses help improve students’ affective domain, a pre- and post-survey to measure students’ self-efficacy in chemistry in introductory chemistry courses was administered by faculty in Chem 110 (16 students, a course for non-majors), Chem 100 (160 students, a preparatory chemistry course), Chem 101 (30 students, General Chemistry I), and Chem 102 (49 students, General Chemistry II) in Spring 2018. Self-efficacy in chemistry is defined as one's belief in one's ability to accomplish a task in chemistry such as explaining chemical laws and theories, describing the structure of an atom, and interpreting chemical equations. The survey was taken from the chemical education literature and contains 8 items (see Appendix A.3); each item has five-point Likert-type scale, ranging from 1’ (‘very poorly’) to 5 (“very well”). The survey was administered twice for selected classes of each course, at the first week (pre-survey) and at the last week of the semester (post-survey). The mean self-efficacy scores of the 8 items from pre and post surveys are presented in Table 1 and Figure 1.
Table 1: Pre- and Post Mean Self-Efficacy (SE) Scores in Introductory Chemistry Courses

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<th>Pre Mean SE</th>
<th>Post Mean SE</th>
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<td>CHEM 100 (N=160)</td>
<td>2.57</td>
<td>3.74</td>
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<td>CHEM 101 (N=30)</td>
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<tr>
<td>CHEM 102 (N=49)</td>
<td>3.58</td>
<td>3.85</td>
</tr>
</tbody>
</table>

Figure 1: Pre- and Post Mean Self-Efficacy Scores in Introductory Chemistry Courses
F.1.2 Analysis of the Results of Qualitative Assessment in General Chemistry Courses

Students’ mean self-efficacy scores increased in post-surveys compared to pre-surveys within all the introductory chemistry courses. This means that the instruction in all the introductory courses improved students’ self-efficacy in chemistry. Furthermore, the increment became smaller from CHEM 110 to CHEM 102. This is most likely due to the fact that students who have already completed more advanced chemistry courses and have had more experiences in learning chemistry believe they are more capable in chemistry than those who haven’t taken a chemistry course before or who have less experience in chemistry.

A mixed between-within subjects’ analysis of variance was conducted to assess the impact of the four introductory chemistry courses on students’ self-efficacy scores across two time periods (first week and last week of the semester). There was a substantial main effect for time, Wilks’ Lambda = 0.69, F (1, 253)=111.41, p<0.001, partial eta squared=0.31, with all the four introductory chemistry courses showing a increment in mean self-efficacy scores across time. The main effect comparing courses was also statistically significant, F (3, 253) = 13.91, p<0.001, partial eta squared=0.14, suggesting there was a difference in self-efficacy scores among the four introductory chemistry courses. The interaction effects between course and time was statistically significant, F (3, 253) = 14.84, p<0.001, partial eta squared=0.15, which means the impact of the instruction on self-efficacy in chemistry across time depends on the course.

B.2: Measure Student Work: Assess basic knowledge in organic chemistry using standardized exam questions in course finals. Alignment with core competencies: critical thinking, quantitative literacy (SLO1).

The organic chemistry I course Chem 333 is taken in sequence by all Chemistry BS, Chemistry BA and Biochemistry BS majors. In addition, a large number of non-majors (especially from Biology) take this course as required in their program. Ten multiple-choice questions from an ACS standardized exam in organic chemistry were incorporated in the course final exams for Fall 2017 (69 students) and Spring 2018 (63 students) Chem 333. In Fall Chem 333, of the 69 students who took the final exam, 39 students (57%) achieved the benchmark score of 6 or more questions out of 10 answered correctly. In Spring 2018 Chem 333, of the 63 students who took the final exam, 40 students (64%) got 6 or more questions correct.
F.2. Analysis of the Results for Organic Chemistry

In both sections it is gratifying to see that over half the class is achieving the benchmark score of 6/10 on the ACS standardized exam questions. Students in Chem 333 benefit from mandatory recitation sessions where they are required to engage in group problem-solving activities on a weekly basis. The lack of a mandatory discussion session for the subsequent course Chem 334 (Organic Chemistry II) results in significantly poorer student performance on the ACS exam questions administered at the end of Chem 334, and emphasizes the importance of the problem-solving sessions to student success. Although faculty have advocated for mandatory discussion sessions for Chem 334, for several reasons this requirement has not been implemented. As a result, it is advisable for Chem 334 instructors to include more problem-solving activities in their lecture courses for the time being.

B.3.a: Measure Student Work: Assess basic knowledge in biochemistry using standardized exam questions in course finals. Alignment with core competencies: critical thinking, quantitative literacy (SLO1).

Chem 464 is a one-semester course in biochemistry taken primarily by non-majors. In Fall 2017, 10 questions taken from the ACS standardized exam in Biochemistry were administered in two sections of Chem 464 (38 students in Section 1 and 34 students in Section 2) in a pre-test on the first day of class and in a post test on their course final exam. The benchmark for success in this assessment was 6 or more questions correct out of 10. For the pre-assessment, only 10 students (14% of the students) achieved the benchmark level or higher; however, for the post assessment, 41 students (57% of the class) achieved the benchmark level or higher.

Chem 465 is a one-semester course (Topics in Biochemistry) that biochemistry majors typically take at the end of the program, so in some sense this course is a capstone for the biochemistry major. Topics in the course typically emanate from recently published research, in an effort to encourage students to become more familiar with the biochemical literature. The instructor crafted a pre- and post-assessment questionnaire with questions that addressed course content and that asked the students to self-report their achievement, confidence, or comfort level with certain skills pertinent to the course. Twenty-six students were enrolled in this course in the spring semester of 2018. While the results on objective course content weren’t as clear, the self-reported achievement and confidence questions showed gains, but not gains uniformly across the board. See the graphs below.
Number of Biochemistry Journal Articles Read Either Prior to Taking CHEM 465 (Pre) or at End of Course (Post)

5 = More than 20 papers
4 = 10-20
3 = 5-10
2 = 1-5
1 = Zero
Chem 462L is a laboratory course that accompanies Chem 462, the second semester of a year-long course in biochemistry (Chem 461/Chem 462) typically taken by biochemistry majors. For many students this is the last laboratory course they will take in the major. A significant component of the evaluation of students in this course is
the laboratory reports that they submit to the instructor, so assessment in this course was in the form of a lab report question. Twenty-three students total were enrolled in two sections of Chem 462L during the spring semester of 2018. The benchmark score for this assessment was 40/50 points total. For spring 2018, 18 students (78%) performed at the benchmark level or above. The same question on the same lab report was used for assessment in this course in Spring 2013, at which time 5 out of 15 students (33.3%) achieved the same benchmark. Thus the spring 2018 results represent a huge improvement.

B.3.b: Measure Student Work: Effectively utilize the scientific literature, including the use of modern electronic search and retrieval methods, to research a chemistry topic or to conduct chemical research (SLO3).

The laboratory courses CHEM 461L (Biochemistry I Laboratory) and CHEM 464L (Principles of Biochemistry Laboratory) have a Library Assignment that students need to turn in as the first lab report. The students select a general Biochemistry topic of interest to them either from the accompanying lecture courses (CHEM 461 and CHEM 464 respectively) or from another source.

First, they identify a general reference text or popular science magazine (a Class A general reference) that covers their topic of interest. Next, the students use electronic literature search methods like PubMed and Web of Science to research four references each in two additional classes of scientific literature to zero in on a very specific research area in the general Biochemistry topic they had selected. These reference classes are:

Class B (intermediate level knowledge) – This reference class includes review articles, reference texts, and compilations of methods and procedures around their Biochemistry topic.

Class C (current or state-of-the art knowledge) – This reference class includes reports of current research, where the primary sources are the professional peer-reviewed journals.

As students move through the reference classes from A to C, their references reflect that their chosen topic is becoming more focused and specific. In other words, while the Class A references may cite general aspects of the topic, by the time they get to Class C, the four references must have some reasonable connection between them (and not just a random assortment of references with a vague connection to a very broadly defined topic). The reference format for classes A through C is based on the American Chemical Society’s journal Biochemistry.

In addition, the students find two web-only references, which we call Class D (research knowledgebases, databases, and webservers). This reference class includes online content (like a database) related to their biochemistry topic that
may not take the form of a written article, but instead, may include content in tabular or list form. It may also possess a calculation or search tool that would generate useful information, like the calculation of a protein’s molecular weight after a user inputs its amino acid sequence.

In Chem 461L, the library assignment for 29 students was assessed, and the average score was 73.7%. In Chem 464L, the library assignment for 53 students was assessed and the average score was 87.6%. For the whole group of 82 students assessed, the average was 82.7%

F.3.a: Analysis of the Results for Biochemistry (SLO1)

In Chem 464, the percentage of students who improved their score (by >1) between pre-and post-assessment was 78%. Furthermore, the percentage of students who improved their score significantly (by >3) between pre- and post-assessment was 50%. This result is indicative of value-added learning through the course and suggests solid gains in student understanding in Chem 464.

In Chem 465, the results of the self-assessment and confidence questions show that the student's comfort and confidence in handling the biochemical literature grew over the course of the semester. The “numbers of papers read” and “confidence in reading the scientific literature” categories showed the greatest gains, while the “confidence in giving oral presentations” category showed the most limited gain. These results affirm the value of Chem 465 in getting students more comfortable with reading the chemical/biochemical literature, a skill which is crucial for their success in graduate school and in their future scientific careers. One of the objective questions in the pre vs. post assessment questionnaire (on the biochemistry of circadian rhythm, the topic of one of the papers read in the class) showed a significant increase in the numbers of students answering correctly. This shows that the reading improved the students’ knowledge of the field. Others of the questions showed increases in the numbers of students answering correctly, but not statistically significant increases. Since this was a pilot year in assessment efforts in this course, it is likely some of the questions were poorly chosen (either asking things the students already knew prior to reading the corresponding papers, or asking questions referring to information too detailed to be appropriate for assessment). Future iterations of this pilot will attempt to refine these objective assessment questions.
In Chem 462L, the results suggest that the instructional methods have improved significantly since 2013; however, an alternative explanation may be that students have had increasing access to lab reports from previous years. In Spring 2013, the department had only been running the corresponding lab for about 3 years (so fewer students from prior years had old, graded lab reports to communicate to newer students). By Spring 2018, the questions had been in existence for an additional five years, which meant there were many more old lab reports circulating. Quite interestingly, for the first few years the lab was run, the lab report scores went up every year, which may indicate that students were perusing the old graded lab reports prior to the assessment. In the future, an alternative assessment question may be given on the report to assess if student understanding of the course material is indeed improving relative to prior years.

F.3.b: Analysis of the Results for Biochemistry (SLO3)

It appears that the students in both Chem 464L and 461L completed the library assignment with good average scores, showing their ability to successfully access the scientific literature to research a topic. Interestingly, students did better in Chem 464L (the class for non-majors) than in Chem 461L (the class for majors). It is suggested that the biochemistry faculty look into this difference in performance to discover possible reasons why non-majors appear to be more successful at utilizing electronic search and retrieval methods than majors.

C. Measure Student Work. SLO’s assessed: SLO 4, Work effectively and safely in a laboratory environment, including the ability to follow experimental chemical procedures and maintain a proper lab notebook.

Assess students’ ability to keep a laboratory notebook in Chem 334L using our departmental notebook rubric. Alignment with core competencies: written communication.

Chem 334L, Organic Chemistry II laboratory, is taken roughly midway through the BS/BA Chemistry and Biochemistry majors, and students in this lab have already taken three required laboratory courses as prerequisites: Chem 101L, Chem 102L, and Chem 333L. With this preparation, it is expected that students in this course should be able to properly maintain their laboratory notebook, an important skill for all practicing scientists. 29 Chem 334L lab notebooks from Chemistry and Biochemistry majors were assessed using the departmental lab notebook rubric (see Appendix B) by our lab TA’s. Out of a possible score of 20 points, the average score for one section of 18 students was 15/20 (75%); the average score for a second section of 9 students was 13/20 (65%). Interestingly, the highest scores
were obtained for categories in which students prepared their notebook outside of the lab: abstract, TOC entry, page #s, completed table of amounts and physical properties of all reactants and solvents, procedure flowchart, etc. Poorer performance was observed in the categories “record of in-lab observations/notation of changes to experimental procedures”, and “conclusions and comparison of results to literature values”. For these two categories (assigned 4 points each), the average scores were 4.4/8 (55%) and 4.7/8 (59%).

G. Comparison to data from previous years

In the 2016-2017 academic year laboratory notebooks were assessed in Chem 334L. For the 29 students assessed, the average score using the departmental lab notebook rubric was 16.3/20 (81.5%). Again it was noted that the weakest categories were “record of in-lab observations/notation of changes to experimental procedures”, and “conclusions and comparison of results to literature values”; however, for the 2016-2017 assessment, the average score for these categories was the average scores were 8.8/12, or 73%. Thus, there has clearly been a weakening of student lab-notebook keeping over the past year, and it is the duty of our laboratory coordinators to remind lab TA’s to continually communicate to students the importance of in-lab notebook record-keeping. Our rubric will be amended this year to place a greater emphasis on in-lab observations, deviations from protocol, conclusions, and post lab-reflection of the results obtained. Four categories (two for pre-lab preparation, one for in-lab data recording and observations, and one for calculations and post-lab reflection) with five points each will likely be contained in the new rubric.

D. Measure Student Work: Assess graduate students’ scientific oral communication abilities in literature and thesis seminars, relevant to SLO2m: Organize and communicate scientific information clearly and concisely, both verbally and in writing. Alignment with core competencies: oral communication, information literacy.

In Spring 2018 the oral presentation rubric (developed in the Department of Chemistry and Biochemistry and used to assess the literature and thesis seminars) was modified slightly to include one different category. The categories scored prior to Spring 2018 were organization, understanding of scientific content, style/delivery, use of visual aids, and ability to answer questions. The new set of categories, starting in Spring 2018, are now organization, quality of chemical / biochemical content, understanding of scientific material, delivery & use of visual aids, and ability to answer questions. The department wanted a larger portion of the score to be dedicated to content, and a smaller portion to style of presentation. As before, performance in each category could be rated with a score of 0-20. The rubric provided
descriptions for “A” range (17-20 points), “B” range (14-16 points), “C” range (12-13 points), and “D” range (10-11 points) performance. Faculty attending the seminar filled out the rubrics and forwarded them to the seminar coordinator. The seminar coordinator then tabulated the results for each category and an average score for literature and thesis seminars was obtained.

Results for 2017-2018: Due to the change in rubric, the summary of scores has been divided into the Fall 2017 semester, and the Spring/Summer 2018 semesters. In Fall 2017, 4 MS Chemistry or Biochemistry students presented literature seminars, with average scores 18.0/20, 16.8/20, 17.3/20, 17.8/20 and 15.8/20 for the categories of organization, understanding of scientific content, style and delivery, use of visual aids and ability to answer questions, respectively. In Spring 2018, 4 MS Chemistry or Biochemistry students presented literature seminars, with average scores 17.5/20, 17.0/20, 16.5/20, 16.8/20 and 16.3/20 for the categories of organization, quality of chemical / biochemical content, understanding of scientific material, delivery & use of visual aids, and ability to answer questions. The average total score for all 8 literature seminars was 85.4/100.

In Fall 2017, 4 MS Chemistry or Biochemistry students presented thesis seminars, with average scores 18.3/20, 16.8/20, 17.3/20, 18.3/20 and 16.3/20 for the categories of organization, understanding of scientific content, style and delivery, use of visual aids and ability to answer questions, respectively. In Spring and Summer 2018, 3 MS Chemistry or Biochemistry students presented thesis seminars, with average scores 17.7/20, 17.7/20, 18.0/20, 16.7/20 and 17.3/20 for the categories of organization, quality of chemical / biochemical content, understanding of scientific material, delivery & use of visual aids, and ability to answer questions. The average total score for all 7 thesis seminars was 87.0/100.
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<th>Use of visual aids</th>
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<td>19.0/20</td>
<td>17.0/20</td>
<td>16.3/20</td>
<td>17.3/20</td>
<td>15.7/20</td>
<td>85.3 %</td>
</tr>
<tr>
<td>(n=7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2013-2014</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literature</td>
<td>16.8/20</td>
<td>15.6/20</td>
<td>16.6/20</td>
<td>16.9/20</td>
<td>14.4/20</td>
<td>80.3 %</td>
</tr>
<tr>
<td>(n=9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td>17.6/20</td>
<td>17.1/20</td>
<td>16.7/20</td>
<td>17.2/20</td>
<td>16.0/20</td>
<td>84.6 %</td>
</tr>
<tr>
<td>(n=7)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

h. Analysis of the Results of Measurement

As can be seen, the overall scores for both literature and thesis seminars increased year-over-year from 2013 - 2016, but decreased slightly in the past year. Each year, the thesis seminar grades have been slightly higher than the literature seminar grades. The results indicate that, on the whole, graduate students are doing well in their oral seminars, since the average scores in most categories are in the 17-18 range. The weakest category tends to be the ability to answer questions. One likely reason for the increase in scores from 2013 has been more rigorous pre-talk
preparation, particularly in the area of practice talks. It is now common to see students giving 3-4 practice talks in advance of their seminar date, and they invite both faculty and students from a variety of subdisciplines within the department. Up to a few years ago, students who attended the practice talks would not provide a lot of constructive feedback to their peers. However, in recent years, as they have become more familiar with critically evaluating presentations, they have participated more and the overall quality of the seminars has increased as a result. The students who continue to have low scores are those that tend not to involve their research mentors and tend to have significantly fewer practice runs in advance of their seminars. These practice sessions have clearly been extremely valuable to both the audience and the presenting student. The recent decrease in the average score is not a reflection on the quality of our students – in fact, it can be argued that the students now joining the program are better qualified on the whole than ever before. There are two likely reasons for the decrease in average seminar scores in 2017/2018: the first is that it might just be an anomaly. The more likely reason is that the faculty expect more from the students now and are grading them accordingly. Despite the rubric, it is still very possible to obtain this variation, especially since the newer faculty (hired in the past ~12 years), which constitute an increasing portion of the evaluators, tend to score more strictly than many of the older faculty.

3. **Preview of planned assessment activities for next year.** Include a brief description and explanation of how next year’s assessment will contribute to a continuous program of ongoing assessment.

In the next year we plan to continue to do assessment both in our GE courses and in our major courses. In addition we will re-boot our longitudinal program assessment in gateway (Chem 321) and capstone (Chem 401) courses using a revised instrument or the ACS DUCK exam.