**DEPARTMENT OF BIOLOGY**

**ANNUAL ASSESSMENT REPORT, 2016-17 ACADEMIC YEAR**

**Assessment activities in the Biology B.S. Program during AY 2016-17**

During the 2016-17 academic year, the Department of Biology continued its cycle of assessment activities based on feedback from the recent full Program Review (AY 2012-13) and feedback from the previous year.

The Department of Biology restarted its 7-year Program Review cycle following the Program Review during the 2012-13 academic year. The Department as a whole responded to the external committee’s reviews of our undergraduate and graduate programs, with the Assessment Committee focusing on feedback about learning outcomes and assessment. **Table 1** shows the assessment calendar for our undergraduate program. During this academic year, the departmental assessment activities were Pre/Post Test, Evolution Term Paper and Student Research Tabulation. Research Experience (Post-Test) was not performed due to the permanent departure of the responsible faculty member. Finally, we developed a new SOAP effective May 2017, so these are the last departmental assessment activities based on the old SOAP.

**Table 1. Assessment calendar**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Method** | **2013-14** | **2014-15** | **2015-16** | **2016-17** | **2017-18** | **2018-19** | **2019-20** |
| 1. Pre and Post Test | **×** | **×** | **×** | **×** | **×** | **×** | **×** |
| 1. Ecology Lab Reports |  | **×** |  |  |  | **×** |  |
| 1. Research Experience (Post-Test) |  |  |  | **×** | **×** | **×** | **×** |
| 1. Research Experience (Evolution Term Paper) |  |  |  | **×** |  | **×** |  |
| 1. Student Research Tabulation | **×** | **×** | **×** | **×** | **×** | **×** | **×** |
| 1. Pipeline Analysis |  |  |  |  |  |  | **×** |
| 1. Alumni Survey |  |  |  |  |  |  | **×** |

**1. What learning outcome(s) did you assess this year?**

*List all program outcomes you assessed (if you assessed an outcome not listed on your department SOAP please indicate explain). Do not describe the measures or benchmarks in this section Also please only describe major assessment activities in this report. No GE assessment was required for the 2016-2017 academic year.*

The SOAP learning outcomes 1, 2 and 3 are stated below. The learning outcomes we assessed are highlighted in bold. Pre/post tests assessed learning outcomes 1A, 1B, 1C, 1E, 1F, 1G, 2.2 and 3.1. The Evolution term paper was used to evaluate learning outcome 3.2. Student research tabulation was used for learning outcomes 2.1 and 3.3; however, we note that the tabulation only compiles research productivity, so our assessment is indirect.

**Learning outcome 1:** Biology Majors will be able to integrate and apply biological knowledge into the following unifying themes:

**1A evolutionary patterns and processes**

**1B energy transformations and flow**

**1C nutrient cycles**

1D homeostasis and equilibria

**1E molecular information flow**

**1F structure-function relationships**

**1G hierarchy of biological organization**

1H developmental patterns and processes

1I complexity of interactions in biological systems

**Learning outcome 2:**

**2.1 Scientific Method: Biology Majors will be able to**

2.1A apply the scientific method to biological questions

2.1B generate testable hypotheses

2.1C design experiments to test hypotheses

**2.2 Analytical and quantitative skills: Biology Majors will be able to**

2.2A make appropriate measurements and create data sets

2.2B graph and display data

2.2C objectively analyze data

2.2D interpret results of experiments

2.3 Lab and field skills: Biology Majors will be able to

2.3A use appropriate equipment and instrumentation

2.3B understand and follow safety procedures

2.4 Teamwork skills: Biology Majors will be able to

2.4A work cooperatively in a group

2.4B solve problems in a group

**Learning outcome 3:**

**3.1 Critical thinking and problem solving: Biology Majors will be able to**

3.1A develop an argument and support it

3.1B recognize and use deductive and inductive reasoning

3.1C integrate concepts within and among disciplines

3.1D synthesize knowledge and apply concepts to solve problems

3.1E distinguish between data and inferences based on data

**3.2 Biological information skills: Biology Majors will be able to**

3.2A understand and evaluate primary biological literature

3.2B integrate published information in oral and written communication

3.2C use biological databases

**3.3 Communication: Biology Majors will be able to communicate science effectively to their peers and to the broader scientific community using:**

3.3A oral presentations

3.3B written scientific papers and reports

**2. What assignment or survey did you use to assess the outcomes and what method (criteria or rubric) did you use to evaluate the assignment?**

*If the assignment (activity, survey, etc.) does not correspond to the activities indicated in the timeline on the SOAP, please indicate why. Please clearly indicate how the assignment/survey is able to measure a specific outcome. If after evaluating the assessment you concluded that the measure was not clearly aligned or did not adequately measure the outcome, please discuss this in your report. Please include the benchmark or standard for student performance in your assessment report (if it is stated in your SOAP then this information can just be copied into the report). An example of an expectation or standard would be “On outcome 2.3 we expected at least 80% of students to achieve a score of 3 or above on the rubric.”*

For AY 2016-17, we employed (i) Pre/Post Test (BIOL 1A, BIOL 1B, and BIOL 102), (ii) Evolution (BIOL 105) Term Paper and (iii) Student Research Tabulation. However, Research Experience (Post-Test) was not performed due to the permanent departure of the responsible faculty member, which was also mentioned in the last year (AY 2015-16) report. In addition, we developed a new SOAP (posted on the University website in May 2017) and the mechanism to assess students’ research experience was fundamentally changed.

**2.1. Pre/Post Test for BIOL 1A, BIOL 1B and BIOL 102**

**Table 2** summarizes assessed courses and assessment instruments used for pre/post tests. All of the instruments are published standard ones (references are found below the table).

**Table 2. Assessment courses and instruments used for pre/post tests**

|  |  |  |  |
| --- | --- | --- | --- |
| **Surveyed Course** | **Semester (Instructor)** | **Instrument** | **Number of Items** |
| BIOL 1A | Fall 2016  (Calderon-Urrea) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| B. Energy and Matter in Dynamic Systems Survey | 5 |
| BIOL 1A | Spring 2017  (Schreiber) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| B. Energy and Matter in Dynamic Systems Survey | 5 |
| BIOL 1B | Fall 2016  (Constable) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| C. Conceptual Inventory of Natural Selection (CINS) | 20 |
| BIOL 1B | Spring 2017  (Constable) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| C. Conceptual Inventory of Natural Selection (CINS) | 20 |
| BIOL 102 | Fall 2016  (Schreiber) | D. Genetics Concept Assessment (GCA) | 25 |

A. Semsar, K., Knight, J. K., Birol, G., & Smith, M. K. (2011) The Colorado Learning Attitudes about Science Survey (CLASS) for use in biology. *CBE - Life Sciences Education*, 10, 268-278. doi: 10.1187/cbe.10-10-0133.

B. Wilson, C. D., Anderson, C. W., Heidemann, M., Merrill, J. E., Merritt, B. W., Richmond, G., & Parker, J. M. (2006) Assessing students’ ability to trace matter in dynamic systems in cell biology. *CBE - Life Sciences Education*, 5, 323-331. doi: 10.1187/cbe.06–02–0142.

C. Anderson, D. L., Fisher, K. M., & Norman, G. J. (2002) Development and evaluation of the Conceptual Inventory of Natural Selection (CINS). *Journal of Research in Science Teaching*, 39, 952-978. doi: 10.1002/tea.10053.

D. Smith, M. K., Wood, W. B., & Knight, J. K. (2008) The Genetics Concept Assessment: a new concept inventory for gauging student understanding of genetics. *CBE Life Sci Educ.* 7, 422-430. doi: 10.1187/cbe.08-08-0045.

**2.2. Evolution (BIOL 105) Term Paper**

A total of 40 papers were randomly chosen from the two sections of BIOL 105 during Fall 2016 (20 papers/section). Each term paper was evaluated once by one of the two class instructors (Crosbie, Waselkov) according to the attached scoring rubric (see Appendix 1 below).

**2.3. Undergraduate student research tabulation**

Data of undergraduate student involvement in research are taken from the Department’s Annual Report. We considered number of publications and number of conference presentations as important data inputs.

**3. What did you discover from the data?**

*Discuss the student performance in relation to your standards or expectations. Be sure to clearly indicate how many students did (or did not) meet the standard for each outcome measured. Where possible, indicate the relative strengths and weaknesses in student performance on the outcome(s).*

**3.1. Pre/Post Tests for BIOL 1A, BIOL 1B and BIOL 102**

**3.1.1. Overall Patterns**

Students in core biology classes have positive attitude scores between 65-80%, and these attitudes often have significant decreases after instruction (**Figure 1**). Positive attitudes generally return to the original level of positivity (or exceed those of the previous course) by the next course. Of particular concern in these data are the significant decreases in attitudes about memorization after BIOL 1A and 1B (dark blue), and the significantly lower scores for synthesis and application (purple) in problem solving in comparison to other attitude scores.

Note **Figure 1** depicts different populations of students, including 3 different populations to create the overall populations of BIOL 1A and 1B students (spring 2016, fall 2016, and spring 2017). That is, the students in the 102 population are not the same students that were in BIOL 1A. We cannot infer that we are improving attitudes over time, but we plan to continue longitudinal analysis of this nature in the department.

**Figure 1.** **Changes pre- to post-instruction for the Colorado Learning Attitudes about Science Survey (CLASS; Semsar et al., 2011) scores.** Target courses were BIOL 1A, 1B, and 102 from Spring 2016 through Spring 2017, wherein 50% = neutral attitude. We chose a non-standard y-axis scale used to better illustrate the patterns.

**3.1.2. Course Specific Assessment Reports**

3.1.2a. BIOL 1A Overall Report

In Fall 2016 (n=87) and Spring 2017 (n=186), we surveyed BIOL 1A students with the energy and matter survey from Wilson et al. (2006) and the Colorado Learning Attitudes about Science Survey (CLASS; Semsar et al., 2011). The Energy and Matter in Dynamic Systems Survey (Wilson et al., 2006) is a 5-item multiple-choice instrument that measures students’ knowledge of energy and matter as related to photosynthesis and cellular respiration. The CLASS is a 31-item Likert scale instrument that generates seven category scores related to students’ attitudes about learning biology.

We saw significant overall gains in energy and matter knowledge after instruction (*p=*8.12E-09), but these are not as consistent by semester or instructor (**Figure 2**). We cannot state at this time if these are a product of the instructor or the population of students who took BIOL 1A in Fall 2016.

As is the case across the core courses in the department, we see significant decreases in several key attitudes about learning biology (**Figure 2**). These are not consistent by instructor or semester, but are true of the population overall. Significant decreases pre- to post-instruction in attitudes include Real World Connections (*p*=4.29E-06), Problem Solving: Reasoning (*p*=0.001), Problem Solving: Effort (*p*=0.05), and Memorization/Connections (*p*=1.29E-42). We do not have overall significant differences in Enjoyment, Problem Solving: Synthesis and Application or Problem Solving: Strategies.

Many of the attitudes scores significantly correlate with students’ knowledge of energy and matter, therefore indicating a relationship between attitudes about learning biology and success in learning the content (**Table 3**).

**Table 3. Pearson’s Correlations between Attitudes about Learning Biology (Semsar et al., 2011) and Knowledge of Energy and Matter (Wilson et al., 2006)**



**Figure 2. Changes pre- to post-instruction for the energy and matter survey from Wilson et al. (2006) and Colorado Learning Attitudes about Science Survey (CLASS; Semsar et al., 2011) scores.** Target courses were BIOL 1A from Spring 2016 through Spring 2017. 50% = neutral attitude score.

3.1.2b. Demographic Results in BIOL 1A

*Biology Majors vs. Non-Biology Majors*

*Real World Connections Scores*. Post-instruction real world connections scores were significantly higher for Biology majors (*p* = 0.010; n = 100) than other majors (n = 82). These differences did not exist pre-instruction (*p* = 0.171).

*Enjoyment/Personal Interest Scores.* Post-instructional enjoyment/personal interest scores were significantly higher for Biology majors (*p* = 9.74E-07; n = 100) than other majors (n = 82). These differences did exist pre-instruction (*p* = 1.54E-04). Post-instructional Biology major enjoyment/personal interest (*p* = 0.025; n = 100) scores were significantly higher than scores for animal science majors (n = 13). These differences did not exist pre-instruction (*p* = 0.094).

*Problem-Solving: Reasoning Scores*. Post-instruction Problem Solving: Reasoning scores were significantly higher for Biology majors (*p* = 0.029; n = 100) than other majors (n = 82). These differences did not exist pre-instruction (*p* = 0.435).

*Problem-Solving: Synthesis & Application Scores.* Post-instruction Problem Solving: Synthesis and Application scores were significantly higher for Biology majors (*p* = .022; n = 100) than other majors (n = 82). These differences did exist pre-instruction (*p* = .007). Pre-instruction Problem Solving: Synthesis scores were significantly different by major (*p* = 0.030; n = 119). Post-instruction Problem Solving: Synthesis scores remained significantly different (*p* = 0.009). *Note.* There were no significant differences in the post hoc test.

*Problem-Solving: Effort Scores.* Post-instruction Problem Solving: Effort scores were significantly higher for Biology majors (*p* = .003; n = 100) than other majors (n = 82). These differences did exist pre-instruction (*p* = .034). Post-instruction Problem Solving: Effort scores for biology majors were significantly higher (*p* = 0.039; n = 100) than animal science majors (n = 13). These differences did not exist pre-instruction (*p* = 0.226).

*Ethnicity*

*Energy and Matter Score*.Post-instructional energy and matter scores were significantly higher for white students (*p* = 0.003; n = 26) than students of color (n = 157). These differences did not exist pre-instruction (*p* = 0.804). Specifically, post-instructional energy and matter scores were significantly higher for white students(*p* = .003; n = 26) than Hispanic or Latino students (n = 91). These differences did not exist pre-instruction (*p* = 0.454).

*Problem-Solving: Synthesis & Application Score*. Post-instructional synthesis and application were significant higher for white students (*p* = 0.036; n = 26) than students of color (n = 157). These differences did exist pre-instruction (*p* = 0.089).

*First Generation*

After instruction, there were no significant differences between first generation students and non-first generation students. These differences did not exist pre-instruction.

*Gender*

After instruction, there were no significant differences by gender. These differences did not exist pre-instruction.

*Transfer*

After instruction, there were no significant differences between Transfer students and Non-Transfer Students. These differences did not exist pre-instruction.

3.1.2c. BIOL 1B Overall Report

In Fall 2016 (n=100) and Spring 2017 (n=51), we surveyed BIOL 1B students with the Conceptual Inventory of Natural Selection (Anderson et al., 2002) and the Colorado Learning Attitudes about Science Survey (CLASS; Semsar et al., 2011). The Conceptual Inventory of Natural Selection (CINS; Anderson et al., 2002) is a 20-item multiple-choice instrument that measures students’ knowledge of natural selection. The CLASS is a 31-item Likert scale instrument that generates seven category scores related to students’ attitudes about learning biology.

We saw significant overall gains in natural selection knowledge after instruction (*p=*0.003), but these are not consistent by semester. The gains were significant overall and significant in spring 2017 (*p=*0.006), but not significant in fall 2016 (*p=*0.198). We cannot state at this time why these differences exist, since Julie Constable taught both populations of students.

As is the case across the core courses in the department, we see significant decreases in several key attitudes about learning biology. These are not consistent by instructor or semester, but are true of the population overall. Significant decreases pre- to post-instruction in attitudes include Real World Connections (*p*=6.70E-06), Problem Solving: Synthesis (*p*=0.041), Problem Solving: Strategies (*p*=0.004), and Memorization/ Connections (*p*=4.13E-20). We do not have overall significant differences in Enjoyment, Problem Solving: Reasoning, or Problem Solving: Effort.

Many of attitudes scores significantly correlate with students’ knowledge of natural selection (CINS scores), therefore indicating a relationship between attitudes about learning biology and success in learning the content (**Table 3**).

**Table 3. Pearson’s Correlations between Attitudes about Learning Biology (Semsar et al., 2011) and Knowledge of Natural Selection (Anderson et al., 2002).**



3.1.2d. Demographic Results in BIOL 1B (Overall)

*Biology Majors vs. Non-Biology Majors*

*Real World Connections Scores.* Post-instructional real world connections score were significantly higher for Biology majors (*p* = 0.015; n = 182) than other majors (n = 175). These differences did exist pre-instruction (*p* = 0.001).

*Enjoyment/Personal Interest Scores.* Post-instructional enjoyment/personal interest score were significantly higher for Biology majors (*p* =6.47E-08; n = 182) than other majors (n = 175). These differences did exist pre-instruction (*p* = 3.49E-08).

*Problem-Solving: Reasoning Scores.* Post-instructional reasoning score were significantly higher for Biology majors (*p* = 0.015; n = 182) than other majors (n = 175). These differences did exist pre-instruction (*p* = 0.006).

*Problem-Solving: Synthesis & Application Score.* Post-instructional synthesis and application score were significantly higher for Biology majors (*p* = 0.030; n = 182) than other majors (n = 175). These differences did not exist pre-instruction (*p* = 0.077).

*Problem-Solving: Effort Score.* Post-instructional effort score were significantly higher for Biology majors (*p* = 0.001; n =182) than other majors (n = 175). These differences did exist pre-instruction (*p* = 0.004).

*Ethnicity*

*CINS Score.* Post-instructional CINS score were significantly higher for white students (*p* = 7.42E-05; n = 23) than students of color (n = 185). These differences did exist pre-instruction (*p* = 1.50E-04).

*Conceptual Connections/Memorization Score.* Post-instructional conceptual connections/memorization were significantly higher for students of color (*p* = 8.64E-07; n = 185) than white students (n = 23). These differences did not exist pre-instruction (*p* = 0.497).

*First Generation*

*CINS Score.* Post-instructional CINS score were significantly higher for non-first generation college students (*p* = 0.025; n = 54) than first generation college students (n = 74). These differences did not exist pre-instruction (*p* = 0.268).

*Gender*

*Real World Connections Scores.* Pre-instructional real world connections score were significantly higher for men (*p* = 0.009; n = 133) than women (n = 223). These differences did not exist post-instruction (*p* = 0.222).

*Problem-Solving: Enjoyment/Personal Interest Scores.* Post-instructional enjoyment/personal interest score were significantly higher for men (*p* = 0.004; n = 133) than women (n = 223). These differences did exist pre-instruction (*p* = 0.016).

*Problem-Solving: Reasoning Scores.* Post-instructional reasoning score were significantly higher for men (*p* = 0.008; n = 133) than women (n = 223). These differences did exist pre-instruction (*p* = 0.041).

*Problem-Solving: Effort Scores.* Post-instructional effort score were significantly higher for men (*p* = 0.009; n = 133) than women (n = 223). These differences did not exist pre-instruction (*p* = 0.232).

*Transfer*

*Problem-Solving: Strategies Scores.* Post-instructional strategies score were significantly higher for transfer (*p* = 0.023; n = 41) than non-transfer (n = 260). These differences did not exist pre-instruction (*p* = 0.212).

*Conceptual Connections/Memorization Scores.* Post-instructional conceptual connections/memorization score were significantly higher for transfer (*p* = 2.93E-06; n = 41) than non-transfer (n = 260). These differences did not exist pre-instruction (*p* = 0.052).

3.1.2e. BIOL 102 Assessment Report 2016-2017

In Fall 2016, we used the Genetics Concept Assessment (GCA, Smith, Wood, & Knight, 2008) to survey BIOL 102 students (n = 37). The Genetics Concept Assessment (GCA) comprehensively measures students’ knowledge of genetics. This 25-item dichotomous multiple-choice instrument measures 9 different genetics learning goals, including:

1. Analyze phenotypic data and deduce patterns of inheritance from family histories;

2. Describe the molecular anatomy of genes and genomes;

3. Describe the mechanisms by which an organism’s genome is passed on to the next generation;

4. Describe the phenomenon of linkage and how it affects assortment of alleles during meiosis; 5. Extract information about genes, alleles, and gene functions by analyzing the progeny from genetic crosses;

6. Describe the processes that can affect the frequency of phenotypes in a population over time; 7. Compare different types of mutations and describe how each can affect genes and the corresponding mRNAs and proteins;

8. Apply the results of molecular genetic studies in model organisms to understanding aspects of human genetics and genetic diseases; and

9. Interpret results from molecular analyses to determine the inheritance patterns and identities of human genes that can mutate to cause disease.

Before instruction, students averaged 38 ± 16% correct with scores of 9.5 ± 4.0 (out of 25) on the genetics concept assessment. After instruction, students averaged 42.4 ± 20.8% correct with scores of 10.6 ± 5.2 (out of 25); the maximum score post-instruction was a 22 out of 25. Although the pre- to post-instruction difference seems small, it indicates a significant increase in students’ genetics understanding (*p* =.014).

These results did not differ by gender, future plans (biology grad school, health professional school, other), year in school (junior vs. senior), biology majors vs. non-biology majors, nor transfer vs. non-transfer students.

As summarized in **Table 4**, GCA pre-instruction scores had significant positive correlations with CLASS category scores for Enjoyment (r = .332; *p* < .05), Synthesis & Application (r = .509; *p* < .05), Effort (r = .354; *p* < .05), and Conceptual Connections/ Memorization (r = .341; *p* < .05). However, post-instruction scores only had significant positive correlations with CLASS category scores for Synthesis & Application (r = .448; *p* < .05), Effort (r = .341; *p* < .05), and Conceptual Connections/ Memorization (r = .457; *p* < .05). Post-instruction GCA scores did not remain significantly correlated with Enjoyment (*p* > .05).

Although CLASS category scores did not significantly increase after instruction, we suggest that the correlations support emphasis on students’ ability to persevere through problem solving difficulties and find usefulness in the study of a topic (Problem Solving: Synthesis & Application; Problem Solving: Effort) and on the connections of concepts across biological curriculum (Real World Connections). Emphasis on these elements could potentially help to yield higher GCA scores for students in future sections of the course.

**Table 4. Pearson’s Correlations between Attitudes about Learning Biology (Semsar et al., 2011) and Genetics Concept Assessment scores (Smith, Wood, & Knight, 2008).**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Correlations for BIOL 102** | | | | | | | | | | |
|  | | | **GENETICS\_PRE** | **REAL\_WORLD\_PRE** | **ENJOYMENT\_PRE** | **REASONING\_PRE** | **SYNTHESIS\_PRE** | **STRATEGIES\_PRE** | **EFFORT\_PRE** | **CONNECTIONS\_PRE** |
| **GENETICS\_PRE** | **Pearson Correlation** | 1 | | -0.023 | .332\* | 0.133 | .509\*\* | 0.275 | .354\* | .341\* |
| **Sig. (2-tailed)** |  | | 0.891 | 0.044 | 0.432 | 0.001 | 0.100 | 0.032 | 0.039 |
| **N** | 37 | | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
|  |  |  | |  |  |  |  |  |  |  |
| **GENETICS\_POST** |  | **GENETICS\_POST** | | **REAL\_WORLD\_POST** | **ENJOYMENT\_POST** | **REASONING\_POST** | **SYNTHESIS\_POST** | **STRATEGIES\_POST** | **EFFORT\_POST** | **CONNECTIONS\_POST** |
| **Pearson Correlation** | 1 | | 0.240 | 0.299 | 0.204 | .448\*\* | 0.269 | .341\* | .457\*\* |
| **Sig. (2-tailed)** |  | | 0.152 | 0.072 | 0.226 | 0.005 | 0.108 | 0.039 | 0.004 |
|  | **N** | 37 | | 37 | 37 | 37 | 37 | 37 | 37 | 37 |

**3.2. Evolution (BIOL 105) Term Paper**

A total of 40 papers were randomly chosen from the two sections of BIOL 105 during Fall 2016 (20 papers/section). Each term paper was evaluated once by one of the two class instructors (Crosbie, Waselkov) according to the attached scoring rubric (see Appendix 1 below).

**Table 5 & 6** shows scores of the BIOL 105 term papers from Crosbie and Waselkov’s sections, respectively. Results from both sections show that students are more than “satisfactory” overall in writing on topics in evolutionary biology. Scores are also very comparable between the two classes in terms of overall class average score (3.42 for Crosbie vs. 3.37 for Waselkov). Nevertheless, there are some differences as well. For example, in Crosbie’s class, students scored the best overall in Content and worst in Integration and Critical Analysis. In Waselkov’s class, students scored the best overall in Organization and worst in Content. This may reflect difference in rubric interpretation between the two instructors.

Also, all the individual scores are 2 or higher, meaning there was not a single beginning score (1) from any student in any category. This is a good indication that our program is working, on the other hand it is also expected given the fact that BIOL 105 is our culminating core course. There were only a few Exemplary scores (5) with none for “Integration and Critical Analysis.” While our program is successful in providing quality education, it may need to incorporate a mechanism for talented students to excel in the future.

**Table 5. Scores of the BIOL 105 student term papers (N=20) randomly selected from Fall 2016 Crosbie’s section.** Scoring rubric is found in Appendix 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Paper #** | **Content** | **Organization** | **Integration and Critical Analysis** | **Mean** |
| 1 | 4 | 3 | 4 | **3.67** |
| 2 | 3 | 3 | 3 | **3.00** |
| 3 | 4 | 4 | 4 | **4.00** |
| 4 | 4 | 5 | 4 | **4.33** |
| 5 | 3 | 3 | 3 | **3.00** |
| 6 | 3 | 4 | 4 | **3.67** |
| 7 | 4 | 4 | 3 | **3.67** |
| 8 | 3 | 3 | 3 | **3.00** |
| 9 | 4 | 3 | 3 | **3.33** |
| 10 | 3 | 2 | 2 | **2.33** |
| 11 | 4 | 4 | 3 | **3.67** |
| 12 | 4 | 4 | 3 | **3.67** |
| 13 | 3 | 3 | 2 | **2.67** |
| 14 | 4 | 5 | 4 | **4.33** |
| 15 | 2 | 2 | 2 | **2.00** |
| 16 | 3 | 4 | 3 | **3.33** |
| 17 | 4 | 4 | 4 | **4.00** |
| 18 | 3 | 3 | 3 | **3.00** |
| 19 | 5 | 4 | 4 | **4.33** |
| 20 | 4 | 3 | 3 | **3.33** |
| **Mean** | **3.55** | **3.5** | **3.2** | **3.42** |
| **SD** | **0.69** | **0.83** | **0.69** | **0.69** |

**Table 6. Scores of the BIOL 105 student term papers (N=20) randomly selected from Fall 2016 Waselkov’s section.** Scoring rubric is found in Appendix 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Paper #** | **Content** | **Organization** | **Integration and Critical Analysis** | **Mean** |
| 1 | 2 | 3 | 2 | **2.33** |
| 2 | 2 | 4 | 3 | **3.00** |
| 3 | 4 | 5 | 4 | **4.33** |
| 4 | 3 | 3 | 3 | **3.00** |
| 5 | 3 | 4 | 3 | **3.33** |
| 6 | 3 | 2 | 3 | **3.67** |
| 7 | 3 | 3 | 3 | **3.00** |
| 8 | 3 | 4 | 3 | **2.33** |
| 9 | 3 | 3 | 3 | **3.00** |
| 10 | 3 | 4 | 4 | **3.67** |
| 11 | 3 | 5 | 4 | **4.00** |
| 12 | 4 | 4 | 3 | **3.67** |
| 13 | 4 | 4 | 3 | **3.67** |
| 14 | 4 | 3 | 4 | **3.67** |
| 15 | 2 | 3 | 2 | **2.33** |
| 16 | 4 | 4 | 4 | **4.00** |
| 17 | 4 | 3 | 4 | **3.67** |
| 18 | 4 | 5 | 4 | **4.33** |
| 19 | 2 | 2 | 3 | **2.33** |
| 20 | 4 | 4 | 4 | **4.00** |
| **Mean** | **3.20** | **3.60** | **3.30** | **3.37** |
| **SD** | **0.77** | **0.77** | **0.77** | **0.77** |

**3.3. Undergraduate student research tabulation.**

**Publications.** Undergraduate students were involved in four peer-reviewed publications out of a total of 20 peer-reviewed publications by Biology faculty during 2016-17 The number of student-involved publications also increased from three during AY 2015-16 to four during AY 2016-17. This means that our undergraduates are meaningfully and consistently contributing to research in the Biology Department and direction is positive. Two papers were published in Genome Announcements (impact factor, 1.18), one in Integrative and Comparative Biology (impact factor, 2.149), and one in the Journal of Crustacean Biology (impact factor, 1.064).

**Conference presentations.** Biology undergraduate students contributed to a total of 55 presentations (3 local, 37 regional, 9 national and 6 international) in 12 different conferences or meetings. The number increased from 41 for AY 2015-16 to 55 for AY 2016-17. The conferences included the Central California Research Symposium, CSUPERB Annual Symposium, Society for Neuroscience, Society for the Study of Evolution Meetings, Botanical Society of America Meetings, Society for Integrative and Comparative Biology, American Educational Research Association, National Association for Research in Science Teaching, National Association of Biology Teachers Conference, CSM Celebration of Research, American Society for Microbiology, The Crustacean Society Summer Meeting, Society for Developmental Biology - West Coast Region, and the San Joaquin River Restoration Science Meeting. These diverse conferences or meetings are indicative of the breadth of research biology students are exposed to by biology faculty.

**4. What changes did you make as a result of the data?**

*Describe how the information from the assessment activity was reviewed and what action was taken based on the analysis of the assessment data.*

**4.1. Adjustments to BIOL 1A, BIOL 1B and BIOL 102 instruction.**

Based on the AY 2016-17 pre/post test results, the Biology Department recommends the following to adjust their course practices.

BIOL 1A, 1B, and 102 course instructors need to consider how to improve perceptions of the necessity of memorization and to engage students in more synthesis and application when problem solving. They also need to consider how to engage non-biology majors in course content, especially in BIOL 1A and 1B, as we see significant demographic differences across non-biology majors. In particular, we need to make better efforts to engage animal science majors in these courses. These students consistently perform below biology majors on our core course assessments. These patterns have persisted for more than one semester and with different instructors.

In addition, the BIOL 102 course could consider focusing on (a) synthesis and application and (b) effort related to problem solving. In doing so, students’ attitudes about Genetics could improve, as these attitudes were significantly positively correlated with Genetics Concept Assessment scores.

**4.2. Expanding Evolution (BIOL 105) Term Paper assessment into a paired pre (BIOL 1A)/post (BIOL 105) assessment**

Current term paper assessment evaluates a single data point, so while it is useful for evaluating the preparedness of students leaving the program, it is less informative in terms of assessing the effectiveness of our program. To resolve this, we will expand our current single term paper assessment to a paired one. Introductory Biology (BIOL 1A) is the first biology core course and each student in the course will write a term paper on a topic on biological disease. Evolution (BIOL 105) is the Department’s culminating core course. As noted above, each student in the course will write a term paper on a topic in evolutionary biology. In each term paper, each student selects a topic that is researched through the primary scientific literature, and discussed. Students papers will be scored by faculty according to the rubric published by Timmerman *et al.* (see Appendix 2). This new assessment mechanism has been already incorporated in our new SOAP. We anticipate this modification will allow us to better evaluate the effectiveness of our program.

**4.3. Implementing new BIOL 190 Pre/Post Survey**

As revealed in the student research tabulation, the Department of Biology is getting more and more successful in research productivity which involves undergraduate students. However, assessing Research Experience (Post-Test) had been stopped due to the permanent departure of the responsible faculty member. Given these changes, we have decided to evaluate students’ research experience more rigorously by implementing a pre/post BIOL 190 survey. This assessment method is incorporated into our new SOAP. Briefly, this pre/post-research experience survey will be performed by each student enrolled in BIOL 190. Not every Biology major takes BIOL 190, however this survey is expected to provide insights into student experiences in the departmental BIOL 190 course. The Survey of Undergraduate Research Experiences (SURE) survey will be administered online and analyzed according to the procedures outlined by Lopatto (Appendix 3).

**4.4. Adopting a BIOL 190 policy which reflects realistically the faculty workload**

Meaningful research activities by Biology undergraduate students cannot be achieved without extensive mentoring efforts by Biology faculty. Traditionally, the mentoring Biology faculty were not fully credited for BIOL 190 (i.e. the WTU associated with supervision of independent studies may have been only partially counted as part of the instructors teaching load. In fact, the faculty’s role in this matter is pivotal, and therefore the Biology Department has adopted a new BIOL 190 policy which realistically reflects the faculty workload. This change is expected to significantly increase research activities and productivity in the Department of Biology.

**4.5. More use of supplemental instruction**

Through the activities of the NSF-FLOCK and newly started Biology Honors Program below, we found that supplemental instruction may have a noticeable effect on student success: students that attended supplemental instruction sessions for BIOL 1A demonstrated better knowledge and understanding than students who did not. Based on this example of student success, the Biology Department expanded the use of supplemental instruction into 67A and 67B in addition to BIOL 1A and 1B.

**5. What assessment activities will you be conducting in the 2017-2018 AY?**

*List the outcomes and measures or assessment activities you will use to evaluate them. These activities should be the same as those indicated on your current SOAP timeline; if they are not please explain.*

In the AY 2017-18 we will begin to use new SOAP to assess the Biology undergraduate program. As indicated in **Table 7**, three assessment methods (Pre/Post Instruction Survey, Student Research Tabulation, Pre/Post research experience) will be used. The Pre/Post Instruction Survey is essentially identical to the Pre/Post Test of the old SOAP, and will be continuously administered and analyzed by Emily Walter. The Biology Department appreciates her efforts very much. Student Research Tabulation will be compiled and analyzed similarly as in AY 2016-17. Pre/Post Research Experience assessment also involves BIOL 190 pre-post survey, which is fundamentally different from the Research Experience (Post-Test) of old SOAP.

**Table 7. Assessment calendar for assessment methods.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Assessment Method | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| 1. Pre/Post Instruction Survey | × | × | × | × | × | × | × |
| 2. Student Writing (Term Paper) |  | × |  |  | × |  |  |
| 3. Student Writing (Experimental Data Analysis) |  |  | × |  |  | × |  |
| 4. Exam questions |  |  |  | × |  |  | × |
| 5. Class Observation |  | × |  |  | × |  |  |
| 6. Student Research Tabulation | × | × | × | × | × | × | × |
| 7. Pre/Post Research Experience | × | × | × | × | × | × | × |
| 8. Pipeline Analysis |  |  |  |  |  | × |  |
| 9. Alumni Survey |  |  |  |  |  | × |  |

**6. What progress have you made on items from your last program review action plan?** *Please provide a brief description of progress made on each item listed in the action plan. If no progress has been made on an action item, simply state “no progress.”*

* The department held an all faculty and full time lecturer retreat in August 2016, where the main agenda item was curriculum mapping and redesign of the undergraduate SOAP. The faculty then worked to effect these changes during the academic year, culminating in the submission and acceptance of a completely redesigned SOAP in May 2017. The department expects that the new SOAP guides Biology majors more effectively in learning Biology core concepts and competencies, and also better prepares them for their career opportunities.
* We continued to engage in course redesign efforts, notably in BIOL 10, and BIOL 1A, 1B and 1BL. The Department implemented the redesigned anatomy and physiology lower division courses (BIOL 67A and 67 B), with both courses now 4 units. We also continued/expanded the practice of incorporating research projects into courses, e.g. BIOL 160 (Microbial Physiology), BIOL 153 (Microbial Genetics) and BIOL 143 (Comparative Vertebrate Morphology).
* We worked with Student Success to develop more Supplemental Instruction for introductory classes and bottleneck courses (BIOL 1A and 1B/1BL, BIOL 67A and B).
* The pilot Biology Honors program entered its second year, and the four 1 unit courses created for it were approved by the University undergraduate curriculum committee.
* To better increase research productivity, several moves took place. Joe Ross has been planning (with others in the college) to move part of his research program to the Jordan Agricultural Research Center. That effort is now underway. Steve Blumenshine moved his research lab from its previous location in McLane Hall to a completely remodeled space (Rm 211) in the Science 1 building. Remodeling (> $5,000) was funded by the department. Dr. Lent partially moved into a completely refurbished space in the animal facility in Science 1, and completed that move in Summer 2017. His former lab in Science 1 will become the lab of the department’s 2017-18 beginning faculty member (Rory Telemeco).
* The major re-model of McLane 226 to accommodate 30 student laboratories in BIOL 1A was completed in Summer 2017.
* Biology improved their website with frequent and relevant updates of current events, such as seminars, student and faculty awards. This permits current and perspective students and community members to see the exciting things the department does.
* Increased cooperation amongst introductory courses to allow Biology and Chemistry majors into respective introductory courses. We increased seats for Chemistry majors in both BIOL 1A and 1B.
* We continued discussion of impacts and consequences of declaring impaction as a department – we chose to wait to review the overall effect of campus-wide impaction.

**Other departmental activities**

**which may have impacts on Biology B.S. program**

**1. Developed New Biology SOAP**

The Assessment Committee and Department of Biology have completed a new SOAP which is posted on the University website. Our new SOAP is based on the AAAS Vision and Change report (http://visionandchange.org/files/2011/03/Revised-Vision-and-Change-Final-Report.pdf), and emphasizes core competencies as well as core concepts. We believe the new SOAP will guide Biology majors better in preparing career opportunities that use biology as a foundation. The assessment of the Biology undergraduate program will be performed according to the new SOAP starting AY 2017-18.

**2. Biology Honors Program**

The Department of Biology launched a Biology Honors Program and has graduated its first cohort in Spring 2017 and admitted its second cohort in Fall of 2016. The Honors Program provides students with the opportunity for advanced studies and interaction with a community of their intellectual peers, and to work closely with a faculty mentor of their choosing toward completion of a research project. The program consists of a three-course commitment (3 units total), beginning with an Honors Experimental Design & Writing course taken in the second semester of the junior year, followed by a course in Peer Instruction taken in the first semester of the senior year, and finally an Honors Colloquium taken in the second semester of the senior year. The Honors program will culminate with an honors thesis (3 units). In total, there are 6 units required for completion of the Department of Biology Honors Program.

In the first cohort, 5 of the 8 students completed their honors degree and graduated in spring of 2017. Two students are still completing their degree requirements and will graduate with Honors in Fall of 2017 and Spring of 2018. One of the students admitted to the first cohort was dismissed from the program due to poor academic performance (GPA fell below 3.5).

In the second cohort, a total of seven students applied to the upper division honors program. Six students were admitted. From the six students admitted, three students were part of the University Smittcamp Family Honors College. Candidates as a whole were strong; and all fulfilled the prerequisites (a problem in the first cohort). No students were given conditional admissions. The one student that was not offered a place in the honors program was denied because their GPA was below the minimum required 3.5. All other students were well above the minimum with an average of 3.9.

We are currently accepting applications for the third cohort and early feedback suggests that the enrollment in the honors program will nearly double. We are expecting that the third cohort will comprise at least 10 students.

The first honors cohort has been successful. All courses have been taught once as topics courses and are now being put through curriculum to convert to proper courses. As the Department progresses through the second cohort in the spring of Fall of 2017 and Spring of 2018, the program will have more data to assess its impact, and to provide a better assessment of its value to the enrolled students, the department and the university.

**3. Biology FLOCK (Faculty Learning for OutComes and Knowledge)**

FLOCK is an NSF-supported project with the goal to establish faculty learning communities that advance and spread evidence-based educational practices throughout the CSM. The participating Biology faculty are BIOL 1A or 1B instructors, content experts who help upgrading the course content, and faculty who teach courses that require BIOL 1A and 1B as prerequisites. As part of the FLOCK initiative, faculty continue to develop course content and course pedagogy and incorporate new changes. The following are Biology FLOCK activities for AY 2016-17.

**3.1. Course Reform**

BIOL 1A (1) Changes in course content. The focus on the core concepts ‘energy’ in just one lecture module in the first year was expanded by two more core concepts, ‘information’ and ‘structure/function’, so that in the second year the entire lecture is now brought in line with AAAS’ Vision and Change, and addresses three of the five core concepts that have been identified as underrepresented in the Biology core curriculum in a curriculum inventory in 2014. (2) Changes in course pedagogy. The course contains now more than 4 case studies, including case studies developed in previous years by FLOCK faculty; case studies are facilitated by student peer instructors who were trained in peer instruction through the Supplemental Instruction program at Fresno State and through peer mentoring courses for Biology Honor’s students, who are serving in introductory biology courses. (3) Assessment. We continued to administer (i) biology “pre-test/post-test” including graph interpretation and basics of cellular structure; and (ii) Colorado learning attitudes about science survey.

BIOL 1B (1) Changes in course content. The instructor refined the course material developed last year with the help of the student peer mentors serving in her course. (2) Changes in course pedagogy. The labs of this course were redesigned to be more inquiry-based. (3) Assessment. We continue to administer the assessments developed in year 1.

Emily Walter is overseeing and coordinating the implementation and analysis of these activities, enabling the department to make educational decisions based on scientific evidence gathered about our courses, students, and instructors.

In short, FLOCK continues to help reshape our BIOL 1A and 1B courses in terms of content, pedagogy, and assessment.

**3.2. Faculty Professional Development**

Through this project, Biology FLOCK members participated in the following professional development activities on campus: yearly FLOCK Summer Institute, monthly CSM Faculty Lounge and FLOCK meetings, bi-annual seminars and workshops given by off-campus speakers.

The project also enabled Emily Walter, a Biology faculty member, to explore off-campus professional development opportunities such as attending 2016 National Association of Biology Teachers; 2017 Society for the Advancement of Biology Education Research; 2017 National Association for Research in Science Teaching; 2017 American Educational Research Association.

**4. CSM FYE (College First Year Experience):**

The main components of CSM FYE are a 4-day summer experience and two GE courses (CSM 10 and CSM 15). We recognize there is no direct impact of CSM FYE on our Biology B.S. program. The Biology Department continued to participate in the CSM FYE program, by teaching or co-teaching CSM 10 and CSM 15 (Instructor: Dr. Amber Reece), with Biology Honors students serving as near-peer instructors in all three sections of CSM 10 (lead instructors: Dr. Mara Brady, Dr. Beth Weinman, Dr. Amber Reece). The impact of CSM FYE on the Biology program has not yet been evaluated. The lead instructors Dr. Brady and Weinman are working on an evaluation of the STEM FYE program and intend to share their findings within the next academic year.

**Additional Guidelines**

*If you have not fully described the assignment, then please attach a copy of the questions or assignment guidelines. If you are using a rubric and did not fully describe this rubric (or the criteria being used) then please attach a copy of the rubric. If you administered a survey, please consider attaching a copy of the survey so that the Learning Assessment Team (LAT) can review the questions.*

**Appendix 1: Evolution (BIOL 105) term paper scoring rubric**

**I. Content:**

**5-Exemplary:** In addition to meeting the requirements for a "4," content is adequate for publication of a review article. Would serve as a good basis for further research on the topic. Is formatted to peer-reviewed journal appropriate to the field or as a grant proposal to the appropriate funding agency.

**4-Accomplished:** Follows all requirements for the paper. Topic is carefully focused. Clearly outlines the major points related to the topic. Paper is interesting and holds the reader's attention. Does a credible job in summarizing related literature.

**3-Satisfactory:** Ideas presented closely follow conventional concepts with little expansion and development of new directions. Certain logical connections or inclusion of specific topics related to the student’s area of study may be omitted. The reader is suitably introduced to the topic being presented such that the relationship to the student’s area of study is obvious.

**2-Developing:** The content may be poorly focused or the scholarly argument weak or poorly conceived. Major ideas related to the content may be ignored or inadequately explored. Overall, the content needs significant revision.

**1-Beginning:** Analysis of existing scholarly / professional literature on the topic is inadequate. Content is poorly focused or outdated. The reader is left with little information about or little understanding of the paper's topic.

**II. Organization:**

**5-Exemplary:** In addition to meeting the requirements for a "4," excels in the organization and representation of ideas related to the topic. Raises important issues or ideas, which may not have been represented in the literature cited.

**4-Accomplished:** Follows all requirements for the paper. Topic is carefully focused. Clearly outlines the major points related to the topic; ideas are logically arranged to present a sound scholarly argument. General ideas are expanded upon in a logical manner thereby extending the significance of the work presented beyond a re-statement of known ideas.

**3-Satisfactory:** Ideas presented closely follow conventional concepts with little expansion and development of new directions. Ideas and concepts are generally satisfactorily presented although lapses in logic and organization are apparent.

**2-Developing:** The paper is logically and thematically coherent, but is lacking in substantial ways. Overall, the organization needs significant revision to represent a critical analysis of the topic.

**1-Beginning:** The paper is an incoherent and disorganized list of unintegrated items.The reader is left with little information about or little understanding of the paper's topic.

**III. Integration and Critical Analysis:**

**5-Exemplary:** The document presents the current state of knowledge for the topic being addressed. Essential findings of multiple sources are accurately and concisely paraphrased, analyzed, and integrated. Original sources are clearly identified and correctly cited in both the body of the text and the reference section. Organizationally, smooth and effective transitions between topics lead the reader through an orderly discussion of the topic being addressed. The gaps in current knowledge are clearly identified and significant directions and approaches that fill these gaps are identified.

**4-Accomplished:** There are inconsistencies in the organization and logic of the presentation, but still clear analysis of the presented materials. While synthesis of all aspects of the topic may show varying degrees of development, the overall consistency, thoroughness, and analysis result in a well-crafted document.

**3-Satisfactory:** Identification of key topics or uncertainties in the field may be incomplete. New concepts resulting from a synthetic presentation of ideas are poorly developed or lacking. Complex topics and related concepts are awkwardly presented and linkages among topics may be unclear.

**2-Developing:** Weakness is evident in the coverage of the field and analysis resulting in incorrect or poorly developed synthesis of results. Analysis is limited to categorizing and summarizing scientific topics. The comprehensibility of the document is poor, and there is little identification of knowledge gaps.

**1-Beginning:** The manuscript contains numerous flaws in the essential components of a literature review. The manuscript lacks a successful synthesis of disparate works, and there is no logical flow to the presentation. The paper is almost incomprehensible and fails to show any grasp of the material.

**Appendix 2: Published rubric for evaluating student writing**

Timmerman, B. E. C., Strickland, D. C., Johnson, R. L., & Payne, J. R. (2011) Development of a ‘universal’ rubric for assessing undergraduates' scientific reasoning skills using scientific writing. *Assessment & Evaluation in Higher Education*, 36, 509-547.

**Appendix 3: Published method for BIOL 190 survey**

Lopatto, D. (2004) Survey of undergraduate research experiences (SURE): First findings. *Cell biology education*, 3, 270-277.

**DEPARTMENT OF BIOLOGY**

**ANNUAL ASSESSMENT REPORT, 2016-17 ACADEMIC YEAR**

**Assessment activities in the MS Biology Program during AY 2016-17**

**I. Background**

The Department of Biology offers graduate training with the opportunity to specialize in several areas of advanced biological study. One graduate degree is offered, the Master of Science in Biology. The department also offers a Master of Biotechnology degree in collaboration with other departments, and via the Moss Landing Marine Laboratories, a Master of Marine Science Degree. Neither of these latter programs are addressed in this SOAP. The M.S. in Biology degree requires a formal thesis following the completion of a field- and/or laboratory-based research project.

Three major emphases of the Department’s graduate program are 1) to provide training for those wishing to enter careers in the biological sciences that requires Master’s level training, 2) to prepare graduate students for teaching biological sciences in the primary and secondary schools, and junior college ranks and, 3) to provide a foundation for students seeking more advanced training at universities offering doctorate or professional degrees.

During the 2016-17 academic year, the Department of Biology continued refining its cycle of assessment activities based on feedback from the recent (2012-13) full Program Review and particularly the favorable feedback from the University Graduate Committee (UGC) received in April 2016. The UGC recommended approval of the MS in Biology as “***A program of quality and promise***”.

**II. Overview**

The Graduate Committee efforts during the 2016-17 academic year were focused more on program recruitment plan development, website enhancement, fee waiver implementation, and social activities to build our graduate student culture rather than on specific student learning outcomes assessment. And to get a better perspective on our graduate student population, the Graduate Committee sought data related to graduation rates and attrition as identified in **Table 1**.

**Table 1. MS Biology internal graduate data.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2012** | | **2013** | | **2014** | | **2015** | | **2016** | | **2017** | |
|  | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* |
| **Applicants** | 6 | 36 | 2 | 33 | 6 | 26 | 3 | 23 | 10 | 33 | 9 | 32 |
| **Admits** | 4 | 17 | 1 | 15 | 4 | 14 | 3 | 13 | 3 | 15 | 4 | 16 |
| **Enrolled** | 2 | 5 | 1 | 4 | 4 | 12 | 3 | 10 | 3 | 12 | 4 | 13 |
| **Grad/Enrolled^** | 2 | 3 | 1 | 2 | 2 | 8 | 0 | 1 | *IP* | *IP* | *IP* | *IP* |
| **Grad Rate (%)** | **100** | **75** | **100** | **100** | **67** | **73** | **0** | **10** | **-** | **-** | - | - |
| **Attrition** | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 4 | 0 | 1 | 0 | - |
| **Total Theses** | 14 | | 9 | | 14 | | 6 | | 10 | | *IP* | |
| **Total Program** |  |  |  |  |  |  |  |  |  |  |  | 54 |

\*Note – IP, In progress; ^, excludes attrition

Unlike undergraduate education, graduate education success and outcomes is a more nebulous concept and part of an ongoing national dialogue (e.g. see GEMS Report, 2014). As we struggle with these definitions and metrics, graduate programs in the biosciences may need to reassess their definition of graduate student success.

**1. What learning outcome(s) did you assess this year?**

Utilizing our scoring rubrics, we measured GWR/proposal, thesis, and exit seminar performance. Specific student learning outcome(s) were not assessed given other priorities identified from the program reviews (see item #6 below and Section III).

**2. What instruments did you use to assess them?**

Scoring rubrics and online exit interview survey instrument.

**3. What did you discover from these data?**

The data analyses are currently ongoing (see item #6 below and Section III).

**4. What changes did you make as a result of the findings?**

Not applicable

**5. What assessment activities will you be conducting in the 2017-18 academic year?**

As described above, we are in the process of comprehensive analyses of the scoring rubrics for improved student learning outcomes assessment. We have adopted the new scoring rubric instruments for the GWR/proposal, thesis, exit seminar, and online exit surveys. The Department is updating the curriculum in other areas to increase our graduate level course offerings. Additionally, as part of the action plan, the department has moved ahead with the development of a Biology Honors program that could be a partial pipeline for the MS Biology program in the future.

**6. What progress have you made on items from your last program review action plan?**

Since the last extensive program review in 2012-13 and as reported in the last annual assessment report, the graduate committee has made significant progress in restructuring the curricular roadmap for the MS Biology program

1. Curricular Roadmap - Our data suggested that getting students into a writing course early on (i.e. semester 1, see Appendix I) to make substantive progress towards the GWR requirement would accelerate the student’s pace through the graduate degree. Furthermore, offering this class in both semesters would allow the smaller number of spring semester admits to take advantage of a writing commitment as well. In keeping with the mission of offering flexibility in our program, the courses for each degree are individualized and are established by mutual agreement between the student and the adviser with input from the student’s thesis committee. The result creates a cohesive graduate program selected from among classes that are taught with regularity and topics or “T” classes that represent new offerings that may subsequently be transformed into regular offerings.
2. Core Course Admission Requirement - Historically, admission to the MS Biology program has relied upon the basic university requirements (2.5 GPA+, GREs, letters, Statement of purpose) for applicants as well as the scholarly completion of core courses within our biology core (Ecology, Genetics, Cell Biology, Genetics/Cell Biol lab, Evolution). This has at times limited incoming graduate students to Conditional standing until they have successfully passed with B or better these core courses. For some disciplines in the program, this requirement was deemed unnecessary and increasing the time to graduation. Over the past several years, these ‘core requirements’ have been waived such that all incoming students have Classified status, provided that they identify and are accepted into the lab of a specific PI i.e. admission is dependent upon a faculty member indicating that the student is accepted to their lab. We believe this will have two positive impacts: (i) improve recruiting by removing a barrier for some potential applicants to the program, and (ii) increase student success by decreasing the time to graduation standard. We think that this has minimal impact on the overall rigor of our program and puts more ownership of the graduate study plan/degree progress on the student and faculty mentor.
3. Rubric Development – The graduate committee has continued to develop strong assessment tools for program evaluation. Specifically, several rubrics have been improved with greater faculty participation including:
   1. GWR cover letter
   2. GWR scoring rubric – This scoring instrument is consistent with the MS Biotech program and provides summative assessment for the student in the areas of Style & format, Writing mechanics, Content & organization, Integration & critical analysis.
   3. Thesis scoring rubric – This scoring instrument also provides summative assessment for the student in the areas of Quality of Science (47% weighting), Quality of Writing (33% weighting), and Quality of Presentation (20% weighting). This important rubric is used in combination with other material to help determine student success/ranking towards scholarship and merit (i.e. Dean’s medalist and Best graduate student thesis, etc). This rubric also becomes the basis for assigning the final grade for the thesis units (BIOL 299) (see Appendix III).
   4. Exit seminar scoring rubric – This scoring instrument also provides summative assessment for the student in the areas of Quality of Science (64% weighting) and Quality of Presentation (36% weighting). This rubric is similar in structure to the thesis-scoring rubric, which improves the ease of use for faculty and thesis committee members (see Appendix IV).

**III. Program Priorities and Additional Progress**

Since the last annual report, the graduate coordinator and graduate committee have made significant progress in the following areas:

1. Continue to increase the number of graduate students in the program towards targeted enrollment - As you can see from **Table 1** (above) and **Figure 1** (below), since 2014, we have made substantial gains in the number of students enrolling in the Fall semesters. This has largely been accomplished through direct effort by the Grad Coordinator to communicate, meet, track, and recruit students towards specific faculty mentors.
2. Increase number of graduate assistantships – No progress as this depends on individual laboratory resources which is historically variable within the department.
3. Increase stipends for graduate assistantships – The CSM was recently awarded a NIH Bridges to Doctorate program with UC Merced focused on URM master’s students pursuing the biosciences. The students accepted into this program receive a generous 2-year stipend along with other benefits.
4. Provide fee waivers for teaching assistantships – With the new fee waiver funds approved and distributed to the respective colleges, we began allocating funds to eligible students based on APM rules. The Biology department received a significant proportion of available funds (~$9,000/semester) as we are one of the largest departments with the most TAs. The Graduate Committee developed a policy and a merit-based ranking system which we have implemented for a two-year trial period to best allocate the funds to the most deserving students

**Figure 1. MS Biology Admission & Enrollment Gains**

1. Increase recruitment activities – Through DGS, the Graduate Coordinator was awarded a $500 competitive mini recruitment award in 2015 to be used for various graduate recruitment strategies including marketing merchandise for the program including banners, brochures, and give-away items intended for use as career fairs.
2. Increase number of graduate course offerings – Several of our topics courses were converted to conventional numbers to enrich the course offerings. However, this is still limited by the number of full-time faculty available to teach in a department where significant research activity occurs.
3. Increase levels of graduate student support through external grants – see #2 & #3 above.
4. Build greater camaraderie among graduate students in the program through social activities and team-building exercises – For the past several years, we have organized social events at the beginning of each semester that includes faculty, MS Biology and other students of the MS Biotechnology program, and our Honors students to help us better cultivate a sense of graduate student life on our campus.
5. Tracking our graduates and program data – Two critical areas of our program to better understand is where our students go (**Figure 2**) and the terminal degrees (**Figure 3**) that they obtain. To get this data, we surveyed the department faculty to track graduated MS Biology students over the past 5 years. This was most informative on three fronts: (1) we learned about our recent student trajectories, (2) this provided a framework for a database to continue monitoring past, present, and future grad students, and (3) this information is now on the website for recruitment and marketing of the program. Furthermore, accessing institutional data (Tableau) about the program was informative to the graduate committee. This provided us with further benchmarks for retention rates and degree progress (**Figure 4**), and particularly the time-to-degree progress. We happily discovered that since implementing our program changes over the past several years the time-to-degree appears to be decreasing from ~4.4 yrs (2006-11) to ~3.4 yrs (2011-16)!

**Figure 2. Career fields after the MS biology.**

**Figure 3. Degrees obtained by our MS students.**



**Figure 4. Institutional data of retention and graduation rates.**

1. Alignment and refinement of SOAPs – The revision and alignment of our SOAPs has been an area under development to address. However, and despite university-level pressure to implement such changes, we think it is inconsistent to finalize program learning outcomes (Dvorakova and Matthews, 2017) and detailed assessment strategies without context. The context comes with alignment to the university’s strategic plan (which only became available earlier this year) and to the core competencies identified by the Division of Research and Graduate Studies (which are not yet available). For the interim, until that framework is clear, we intend to continue with our current SOAPs and guided by best-practices appropriate to STEM fields in California (CLSI Talent Report, 2016) with routine empirical assessment (Denecke et al, 2017).

**IV. Citations**

2016 Talent Integration: California Workforce Trends in the Life Science Industry. *San Francisco, CA: California Life Sciences Institute.*

Denecke, D, Feaster, K, & Stone, K. (2017) Professional development: Shaping effective programs for STEM graduate students. *Washington, DC: Council of Graduate Schools*.

Dvorakova, LS & Matthews, KE. (2017) Graduate learning outcomes in science: variation in perceptions of single- and dual-degree students. *Assessment & Evaluation in Higher Education* 42(6): 900-913.