**NATURAL SCIENCE:**

**Science and Engineering Program (CAPE and BEECh Departments)**

**Annual Program Review for 2017-2018 Academic Year**

**Part III: Assessment**

**PLO Assessment Project Plan for 2017-2018**

1. **PLOs assessed:** During Spring of 2018, our department developed a five-year assessment plan for our natural science PLOs (See Appendix A). For 2017-2018, we assessed the following PLOs:

*PLO 3: Communicate the primary principles and processes underlying at least one natural system*

*PLO 5: Demonstrate safe and proper use of scientific instrumentation, measuring devices, chemical reagents, media, and/or other tools of science in a laboratory or field setting relevant to specific disciplines of science*

1. **Description of assessment method:**

*PLO 3: The national HAPS exam is given at the end of BIOL& 242 each quarter to all sections. All sections of BIOL& 160 participate in a common final exam. All sections of CHEM& 163 and CHEM& 263 take the ACS national exams. All astronomy sections will take the same online final exam each quarter.*

*PLO 5: Biology lab technicians will collect and analyze data on proper microscope care and storage. Chemistry lab technicians will document all accidents/spills/etc of all chemistry reagents in all chemistry classes.*

1. **Results for PLO3:**
   1. **Overview:**  The BEECh Department uses nationally standardized exams in four of its courses: BIOL& 242 (Anatomy and Physiology 2), CHEM& 121 (Introduction to Inorganic Chemistry), CHEM& 163 (General Chemistry III), and CHEM& 263 (Organic Chemistry III). In all disciplines we are well-above the national average, indicating that our students compete well with their peers, including those in four-year institutions. We are additionally proud of the fact that we have managed to maintain excellence even as our FTEs and number of students has increased over time.
   2. **HAPS exam:** Our goal is to have a strong science program that prepares students well for success in future courses and careers. To assess our strengths in preparing students in the pre-Allied Health area we have been administering the Human Anatomy & Physiology national standardized exam since winter 2010. In that time more than 2500 students have completed the courses and taken the exam with a TCC cumulative average in that time of 57. This compares extremely favorably to the national average of 52.9. The big gap in this area is the difference in student learning between those taught by full time faculty where the average is 61.5 and the adjunct faculty average which is 51.4. This ten percent gap in student learning is due to the fact that it is extremely difficult to hire and retain qualified faculty in this area. We frequently must hire faculty with no teaching experience or who we know have low averages because we have fully enrolled classes with no qualified instructors to teach them.
   3. **National Exams for Chemistry**

Students in Chemistry also often take a cumulative national exam at the end of both year-long majors’ sequences in General Chemistry (CHEM& 163), Organic Chemistry (CHEM& 263), as well as after CHEM& 121 (Introduction to Inorganic Chemistry). The exams were written by the American Chemical Society (ACS) and were standardized prior to our students taking the exam. The results for the last five years are presented in the table below. The scores are reported as the average percentile (with the national average as 50th-percentile). While Not all Chemistry professors choose to use the ACS exam, the number of instructors giving it has increased recently.

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Intro to Inorganic Chemistry**  **(CHEM& 121)\*** | **General Chemistry (CHEM &163)\*** | **Organic Chemistry (CHEM &263)** |
| 2011-12 |  | 70 | 75 |
| 2012-13 |  | 71 | 67 |
| 2013-14 |  | 75 | 72 |
| 2014-15 | 69 (W15)  67 (Sp15) |  | 68 |
| 2015-16 | 60 (F15)  69 (W16)  74 (Sp16) |  | 69 (Sp16)  71 (Su16) |
| 2016-2017 | 72 (F16)  76 (W17)  79 (Sp17)  79(Su17) | 76 (F16) | 79 (Sp17)  71 (Su17) |
| 2017-2018 | 68 (F17)  72 (W 18)  60 (Sp 18)  52 (Su 18) | 58 (Sp 18)  54 (Su 18) | 68 (Sp 18)  54 (Su 18) |

\*Not all Chemistry professors choose to use the ACS exam.

* 1. **BIOL &160 Common Final:** Since Fall 2014, students in all sections of BIOL&160 have been taking a common final exam. The exam is given in Canvas, and the questions are pulled from test banks that we established for each of the outcomes for the course. Each quarter, we summarize the data generated from the quiz statistics. This information is used to help determine weaknesses and strengths in our curriculum. We have been attempting to address inconsistencies in course grade and content mastery. In the graph below, we expected to see a linear relationship between course grade and final exam score. In general, we saw a good relationship between the two. This shows that overall our students’ grades are good reflections of how well they know the material.

With so many of these sections offered per quarter, it is a difficult course to maintain consistency. We strive to maintain standards between the sections to ensure that their grade is reflective of their content mastery. The final exam gives us a tool to help address the consistency between sections, as we can compare score on the final exam with the grade in the course. We had pretty good correlation between exam scores and pass rates. The pass rate needs to be indicative of their content mastery for them to succeed in future courses. An example of the Spring 2018 data shows some of the differences we have between sections. Instructor #4 had a very small differential between their average score on the final, and their overall pass rate for the course (C or better). In contrast, Instructor #5 had a similar average score on the final, but a much higher pass rate. This suggests significant differences between the two sections in grading criteria. With this information, we can work to help standardize our sections better.

Summary results for Spring 2018 BIOL&160 Common Final

The table below summarizes our final exam scores to date. We’ve seen a plateau over recent years where scores have leveled off.

|  |  |  |
| --- | --- | --- |
| **quarter** | **Average Final Exam Score** | **Average Percent Completion** |
| Fall 2014 | 64.8 | 92 |
| Winter 2015 | 66.5 | 88 |
| Spring 2015 | 66.7 | 86 |
| Fall 2015 | 65.3 | 82 |
| Winter 2016 | 70.4 | 81 |
| Spring 2016 | 67.9 | 81 |
| Fall 2016 | 71.6 | 91 |
| Winter 2017 | 71.6 | 90 |
| Spring 2017 | 70.8 | 88 |
| Fall 2017 | 70.8 | 88 |
| Winter 2018 | 70.1 | 87 |
| Spring 2018 | 69.3 | 87 |

1. **Results for PLO5**

We collected data from both biology and chemistry labs during Winter Quarter 2018 to help evaluate this outcome. For biology, we assessed microscope care from lower (BIOL& 160, BIOL& 175), and upper level (BIOL& 223, 241, 242, 260) biology courses. In chemistry, we collected data on the cleanliness of hoods, sinks, and instrumentation upon completion of the lab. This was done in every chemistry lab winter quarter. As part of this assessment plan, we expected to see a decrease in “violations” as students progressed through the curriculum. We expected more violations in lower level classes and fewer violations in upper level courses. Having collected similar data in 2013-2014, we were also hoping to see a decrease in violations relative to the last assessment.

In biology, we assessed 22 sections. Half were 100-level labs, the other half were 200-level. Across all sections we averaged 11.1 violations per quarter (range 0-37). When we separated based on the level of the course, we saw no statistical difference (12.1 for 100-level, and 10.1 for 200-level). This suggests that there isn’t a significant improvement as students progress through the curriculum. Compared with the previous assessment of this PLO, we saw a slight decrease in overall violations (from 16.1 to 12.1 in 100-level courses and 12.1 to 10.1 for 200-level courses).

In chemistry labs, we assessed 31 lab sections for lab cleanliness infractions (18 were lower-level, and 13 were upper-level). Overall there was an average of 6.7 violations per section for the quarter (range 0-21). After separating based on level, the lower-level courses averaged 6.5 violations whereas the upper-level courses averaged 7.1. These were not significantly different. Similar to biology, we also didn’t see a significant difference when we looked at full-time vs. part time faculty. When comparing this data to 2013-14, we saw an increase in violations in this current assessment. 100-level classes increased from 3.76 to 6.5, and 200-level courses increased from 3.05 to 7.1.

Compared to our last assessment, we saw very similar data. There was not any noticeable improvement by our students in the 4 years since we last assessed this objective. We also saw the same patterns across our curriculum when comparing upper and lower-level courses.

In our previous assessment we noted that violations correlated highly with the instructor, regardless of the level they were teaching at. We see a similar trend here. It is not so much the experience of the student, but how much the instructor emphasizes proper care of equipment.

In looking at the biology data, there were too many variables. We need to focus the data collection in order to remove some confounding variables. Our plan is to focus on two courses (BIOL& 160, and BIOL& 241). In those courses, we will monitor specific labs that we know are microscope intensive. We will assess those labs every quarter and establish a much stronger dataset to analyze.

One action that has already been taken is a modification of the lab manual for BIOL& 160. The lab that introduces microscopy now requires students to have their instructors “sign off” on their microscopes to ensure that they were properly handled. This action should give every student feedback on proper microscope care at least once. We would really like to see students improve as they move through the curriculum. Since we’re not seeing a decrease, it suggests that we’re not reinforcing proper microscope usage as they enter upper-level courses. Now that we’re aware of this, we can take action to reinforce proper care and use with our 200-level courses.

There was a lot of inconsistency with the data, especially from Biology. To make sure we’re being consistent, future data collection is going to be focused on three high-use microscopy labs in BIOL& 160, and compare that with the histology labs done in BIOL& 241.