**Continuous Improvement Plan Report to be Completed in Years 2/4 of Program Review Cycle**

**Date:** February 11th, 2025  **Name of Program:** Biotechnology

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**Table 1: CIP Student/Program Level Learning Outcomes Targeted for Improvement, Description of Assessment Measure(s) and Targets Levels of Success Table (focus on at least one student/program level outcome for the next two years)**

**Description of Fields in CIP Table 1:**

**A. Student Learning Outcome(s)** -Results expected in this program (e.g., students will be able to compare/contrast conflict and structural functional theories). Outcomes must be quantifiable and measurable.

**B. Assessment Measure(s)** –Assessmentinstrument(s)/process(es) used to measure results (e.g., embedded test questions 6 & 7 from final exam)

**C. Targeted Level(s) of Success** -Level of success expected (e.g., X% of students will score at least Y on the indicated assessment)

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| 1. **Student/Program Level Learning Outcome(s)**   **Targeted for Improvement**  (e.g., “Students will be able to…”) | **B. Description of Assessment Measure(s)**  (Assessment instrument(s)/process(es) used to measure results - Include course in which assessment will be given) | **C. Targeted Level(s) of Success**  (e.g., X% of students will score at least Y on the indicated assessment.) |
| **Program Learning Outcome 1:** Students will apply laboratory math techniques to calculate dilutions and plan multicomponent solutions. | In BIOL 1414, students will be given a quiz that assesses their ability to make perform calculations and describe the making of solutions of varying concentrations | 70% of students will score 100% on test |
| **Program Learning Outcome 4**: Students will demonstrate their ability to run and interpret an agarose electrophoresis gel | In BIOL 1414, students will prepare and load a gel with DNA samples of unknown size and will complete a report and analysis of the gel. | 70% of students will score 90% or better on the report and analysis |
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**Add additional rows if necessary.**

**Table 2. CIP Student Learning Outcomes 1–3 (focus on at least one for the next two years)**

**Description of Fields in CIP Table 2:**

**A. Student/Program Level Learning Outcome(s) Targeted for Improvement** -Results expected in this program (e.g., Students will be able to compare/contrast conflict and structural functional theories). Outcomes must be quantifiable and measurable.

**B. Assessment Measure(s)** – **Assessment** Instrument(s)/process(es) used to measure results (e.g., embedded test questions 6 & 7 from final exam)

**C. Targeted Level(s) of Success** -Level of success expected (e.g., X% of students will earn a score of Y or greater on the embedded test questions)

**D. Description of Action Plan to Improve Learning** -Describe action(s) to be taken to improve student attainment of the indicated student/program level outcome. What will you do?

**E. Summary of Results/Data** - Summarize the information and data collected in year 1/3 when action plan was implemented.

**F. Findings** - Explain how the information and data has impacted the expected student learning outcome.

**G. Implementation of Findings** – Describe how you have used or will use your findings and analysis of the data to make improvements.

**Student/Program Level Learning Outcome Targeted for Improvement #1**

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| 1. **Student/Program Level Learning Outcome Targeted for Improvement #1:** PLO #1 Students will be able to use laboratory math techniques to calculate dilutions and plan multicomponent solutions. | |
| 1. **Assessment Measure(s):** Individual math test | 1. **Targeted Level(s) of Success:** 70% of students will score 100% on test |
| 1. **Description of Action Plan to Improve Learning:** Repeatedly expose students to math in all biotech classes, and administer a low-stakes assessment before the PLO assessment | |
| 1. **Summary of Results/Data:** 1414 students scored an average of 80.4 in fall of 2023, with 13 out of 19 (68%) students scoring better than 70. In spring 2023, the average stayed the same but the percentage of students that scored better than 60 decreased to 67% (14 out of 21). In fall of 2024, the average score dropped to 77, but 16/21 (76%) met our target score.   While students take individual quizzes that include math problems, we have also used the Applied Math portion of a third-party credentialing exam, BACE (Biotechnician Assistant Credentialing Exam), to assess how well students are doing on their lab math skills. Based on results of the exam: FA23 7/10 (70%), Sum24 1/3 (33%) and SP24 7/19 (37%) did master applied math with an 80% score or better. Not all students choose to sit for the BACE, but most who decide to take the exam consider themselves to be prepared. The exam is given near the end of the semester, so students should have mastered the material by that time. The applied math portion of the exam includes single-component solutions, dilutions and % solution problems. These are basic lab math skills but do not include planning multicomponent solutions. Based on the BACE results, we conclude that students did not meet our assessment goals, and the assessment strategy proposed did not provide a complete assessment of student ability since not all types of math problems are covered by the exam and not all students take the BACE. | |
| 1. **Findings:** Based on the results of the assessment for math skills, especially the percentage of students that do not meet the target for the PLO, the continuous improvement plan was not successful, and we need to incorporate more math skills into the curriculum. Students are not mastering the simpler skills; therefore, they are also not understanding the higher-level skills such as multi-component solutions. The math competency required to perform these calculations is at the algebra or pre-algebra level, so in theory, it should not be outside the abilities of college students. The real issues are lack of mastery of low-level math skills upon entering the classes and then not enough practice in the class. The contextualization of the skills is also a stumbling block for many students, namely, how to interpret word problems and insert the information into equations. | |
| 1. **Implementation of Findings:** Although data from math quizzes and the BACE exam will continue to inform faculty of student performance, for the next assessment period, instead of using either of the means to assess laboratory math competency, an individual test question will be administered in the second half of 1414. This question will cover molar and percent w/v solutions and dilutions of concentrated solutions, as a single multicomponent solution. These concepts are one of the main areas of focus at the beginning of the semester and students are expected to be able to apply this information by the time it is assessed. This change in assessment will be more comprehensive, covering all relevant math concepts and assessing all students in the class.   Students often enroll in their first biotech courses unprepared for the math we use in 1414 and 1415, especially in translating word problems to equations. We will share problem sets with the various math assistance services on campus, such as the math lab and the science den in order to increase the availability of help on campus. Utilizing these on-campus resources will help under-prepared students gain the lower-level math skills they are missing in order to be successful in their biotech courses and will allow the students to get more specialized support.  Students will be given more practice problems worded in multiple ways so they will be able to interpret the material regardless of the context in which it is presented. To help with this, students will be assigned newly available video content from the biotechnology textbook publisher that explains mathematical concepts in a laboratory context. Faculty will also assign daily math practice problems in both 1414 and 1415, which will keep the students’ math skills from waning.  Since many students take biotech 1 & 2 concurrently, strategic implementation of these math concepts is important. To do this, Faculty will review syllabi together and strategically incorporate math concepts in 1414 vs. 1415. For example, when one class covers a particular topic, the other will present a different one. For those topics covered in both courses, this staggered approach will lengthen the amount of time students will practice the concept and introduce repetition between the two classes sequentially, not simultaneously. Additionally, this approach will provide students with the same skills in varied applications. This will broaden their understanding of contextualized math, helping them understand how/when to apply the various equations used in lab math. | |

**Student/Program Level Learning Outcome Targeted for Improvement #2**

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| 1. **Student/Program Level Learning Outcome Targeted for Improvement #2:** PLO #4 Students will demonstrate their ability to run and interpret an agarose electrophoresis gel | |
| 1. **Assessment Measure(s):** Completion of report and analysis | 1. **Targeted Level(s) of Success:** 70% of students will receive at least 90%. |
| 1. **Description of Action Plan to Improve Learning:** Students will receive instruction in electrophoresis and will be familiarized with the concept of standard curves through other assays. The use of software programs such as Excel to create graphs will also be taught. | |
| 1. **Summary of Results/Data:** Students were asked to demonstrate their ability to run and interpret an agarose electrophoresis gel. Upon completion of the lab report the target was to ensure 70% of students received at least 90% on their electrophoresis analysis. During the review period between SP23 and FA24, this assessment was only carried out twice due to a change in the laboratory manual which altered the parameters of the electrophoresis lab and misaligned them from the proposed assessment measure. The lab manual change followed a knowledge and skills assessment with the industry advisory board in April 2023. The current assessment plan was revised so the Assessment Measures for Gel Electrophoresis PLO #4 are relevant to the current lab manual exercises. This will ensure more data are collected for this PLO. In 1414, the percentage of students that scored at least 90% was 100% of students with a small class of three students and 69% of students for the larger class of 13. The target goal is 70% of the students achieving 90% or higher, both 1414 semesters met or approached that goal. | |
| 1. **Findings:** The goal of 70% of students achieving 90% or higher on the report/analysis was met; 12/16 (75%) total students assessed met the assessment goal. In addition, subsequent student assessment on the 1414 practical exam demonstrated that this information was retained. Yes, the action plan worked; the emphasis on electrophoresis and the interpretation of unknowns using electrophoretic standards led to better outcomes than seen in previous periods of assessment. For example, in 2021, the percent error in determining size of electrophoretic unknowns was 35% on average. Involving students in all steps of the process, from manufacture of the gel to interpretation of data, demonstrated the importance of the program learning outcome. Also, introducing the concept of a standard curve using protein assays before electrophoresis helped students understand the concept in this different setting. Students created their graphs using Excel and were able to determine unknown size bands from the given equation of their trendline and to describe the significance of linearity in their data. | |
| 1. **Implementation of Findings:** This PLO will not be assessed next time, but data will continue to be collected. The current assessment plan will be revised so that the Assessment Measures for Gel Electrophoresis PLO #4 are relevant to the current lab manual exercises. This will ensure more data are collected for this PLO. | |

**Program Assessment Data Report**

**Program:**  Biotechnology **Terms Data Collected:** Fall 2023 - Fall 2024

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| Program-Level Learning Outcome- (From Assessment Plan) | Assessment Measure(s) and Where Implemented in Curriculum – (From Assessment Plan) | Target Outcome(s)- Level of Success Expected – (From Assessment Plan) | Assessment Results – (Provide data in a form related to targeted levels of success to left. Indicate if targeted level of success was met, partially met, or not met.) |
| PLO #1: Students will be able to use laboratory math techniques to calculate dilutions and plan multicomponent solutions. | In BIOL 1414, students will be given a quiz that assesses their ability to make calculations and describe the creation of solutions of varying concentrations. | 70% of students will receive 100% on test (new target outcome for Assessment Plan Revised 2/9/24: 75% of students score a 70% or better) | Percentages of students who met the target went from 68 to 67 percent from fall 2023 to spring 2024, but to 76% in fall of 2024. The targeted level of success was partially met. |
| PLO #2: Students will demonstrate accurate pipetting skills. | In BIOL 1415 students will test their accuracy and precision with a lab exercise in pipetting volumes of less than one milliliter | 70% of students will have an error rate of less than 5%. | In BIOL 2416, all fall 23 students had an acceptable error rate, but only 64% in fall 2024. Target was partially met. |
| PLO #3: Students will demonstrate proper sterile technique and use of a laminar flow hood. | In BITC 2431, one section on the practical exam will evaluate the student’s sterile technique and proper use of a laminar flow hood. | 80% of students will score 75% or better on this portion of the practical exam. | During this assessment period, this course met only once. 84.6% of students scored better than 75 on sterile technique. Targeted goal was met. |
| PLO #4: Students will prepare and run an electrophoresis gel and use graphs to interpret DNA sizes. | In BIOL 1414, students will prepare and load a gel with DNA samples of unknown size, and will complete a report and analysis | 70% of students will receive at least 90% on the report and analysis. (new target outcome for Assessment Plan Revised 2/9/24: 80% of students will estimate the sizes of the unknowns with an error rate of less than 10%.) | PLO was not assessed in fall 2023 due to a change in curriculum. An alternate assignment was administered in spring 2024 that assessed the same PLO, wherein 69% of students had an acceptable error rate. In Fall 2024, 69% of students met this goal.  The older goal of 70% was nearly met both times, but the newer goal of 80 was not. Targeted goal was not met. |
| PLO #5: Students will research and apply emerging regulatory information into a variety of regulated workplaces. | In BITC 1340, students will answer an essay question related to the rejection of the drug thalidomide from use in the United States. The question will be presented as a class discussion or as an exam question. | 80% of students will score 80% or better on this assignment. | No Data Collected |
| PLO #6: Students will evaluate and troubleshoot the results from a bacterial transformation. | In BIOL 2416, students will answer quiz questions that ask them to describe the expected results from a bacterial transformation, and questions that ask them to hypothesize reasons that a different result occurred. | 70% of students will score 90% or better on these questions. | In fall 2023, 71% of students scored better than 90. In fall 2024, 45% of students met the goal. Targeted goal partially met. |
| PLO #7: Students will analyze the ethical responsibilities of scientists as they relate to current laws, recordkeeping, documentation, research involving humans, animals and biomedical experimentation. | In BITC 1250, students will find and explain relevant codes, rules and regulations that guide the conduct of research in a biotechnology discipline or application. | 80% will score at least 80% on their assignment. | No Data Collected, BITC 1250 first offered at Collin in Spring 2025 |
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**Add additional rows if necessary.**