

Biotechnology

New Program Performance Item

Program/Unit:

Biotechnology

Data Trend Summary:

Enrollment in the biotechnology program peaked in 2017-2018. Although there was a decline from 2017-18 to 2018-19, enrollments in lower division have been increasing over the past three years. After falling from 53 in 2017-18, FTES rebounded and increased from 50 to 59 over the three-year time span. Efficiency over this period also increased from 259 to 305. These increases were a result of higher fill rates (growing from 77% to 84%) since the department has offered the same number of sections for the past four years. Despite the pandemic, the biotechnology program continued to see robust enrollments with wait lists of 12-19 students for various online courses (BTEC 120, BTEC 180, BTEC 210, and BTEC 211) in 2020-21.

In upper division, the department has seen fluctuating enrollments. For Cohort 2 in Fall 2018, we welcomed 23 students to the program. We then hit the maximum enrollment of 30 students for Cohort 3 in Fall 2019. Following disruptions in learning and work due to the pandemic, we welcomed 22 students for Cohort 4 in Fall 2020. We have seen that upper division enrollments have been impacted in two ways:

1. Students struggling with pandemic-related stressors are not able to complete the program pre-requisites in time to start the program. Students have dropped key courses after conditional acceptance that makes them ineligible to enter the cohort on time.
2. Students are benefiting from a strong labor market with many well-paying entry-level opportunities available in the local industry. The department sees this as a win for our students although we have lost students between the acceptance period and their program start date.

Student demographics have remained relatively stable in lower division with an average age between 27-28. Our participation by female students has ranged from 55-61%. The LatinX/Hispanic population has ranged from 34-40%. The percentage of students in lower division that already have a bachelor's degree continues to hover around 15% with about a quarter of our lower division population being first-generation college students. About half of our lower division students are enrolled full-time and the same proportion are economically disadvantaged. In Fall 2020, 14% indicated that they were food insecure, and 18% reported being housing insecure. By contrast, 19% of the upper division students in Fall 2020 reported food insecurity and 25% indicated that they faced housing insecurity. This correlates with the much higher rate of economically disadvantaged students in the upper division program, ranging from 57-82% over the three year period. The % of first-generation college students in the bachelor's degree program is also higher than in lower division, increasing from 17% to 36% over the three years. Finally, it is notable that the participation by female and LatinX/Hispanic students in the bachelor's program has grown significantly over the three year period. The % female students grew from 39% to 73%, and the rate of participation of LatinX/Hispanic students increased from 35% to 46% over the same period. It appears that efforts to recruit diverse

students have been particularly successful with Latina students, who are extremely underrepresented in the life sciences industry.

The biotechnology programs consistently exhibit higher than average rates for success and retention. In lower division, retention rates have hovered around the 80-84% over the past three years with rates lowest during the pandemic. One of courses hardest hit by the pandemic was BTEC 110, which is our foundational lab skills course. Before the pandemic, retention rates were around 84%, while the rate dropped to 65% in 2020-21. Success rates in this course were also impacted dropping from around 75% pre-pandemic to 55% in 2020-21. Faculty for this course have observed a higher number of students dropping the course due to time conflicts with family and work obligations. This course takes significant time and effort, and many students have struggled to complete the extensive at-home lab activities. Biostatistics (BTEC 180) is another course that was negatively impacted by the pandemic. Retention rates went from 73% pre-pandemic to 60% in 2020-21. Although course success rates were always lower than average for this course (~65%), they dropped further to 47% in 2020-21. This lecture for this course was previously taught fully on-ground, but has been offered in live Zoom and asynchronous formats during the pandemic. Faculty are examining how these modalities may be impacting student learning. We have not observed significant changes to success and retention rates in other courses due to the pandemic.

Overall for lower division, success rates overall range from 74-77% (compared to the college average of 72%). When examining disproportionate impact by ethnicity, there was a slight impact on success for LatinX/Hispanic students in 2017-18, which has not been observed in the last three years. Unfortunately, we saw a large gap for success rates of Black/African-American students in 2019-20 of 41 percentage points that has been reduced to 24 percentage points in 2020-2021. The department will take time to examine how we can better serve Black/African-American students and empower them to succeed in the STEM workforce. Retention and success data disaggregated by all other metrics do not display any disproportionate impacts. In upper division, we have 100% retention in the program although a few students have taken a short break and then returned to continue their studies with a subsequent cohort. Our upper division course success rates range from 96-99% across the three-year period. No disproportionate impacts are observed in upper division per any metric tracked by the college.

In terms of certificate and degree completions, we saw an increase from 62 to 79 graduates followed by a decline to 72 graduates over the three-year time period. Before the pandemic, faculty reminded students in the classroom to apply for degrees and certificates. Since the pandemic began, it has been more difficult to stay on top of these reminders. We observed a drop in associate degrees awarded from a high of 26 in 2019-20 to only 9 awards in 2020-21. Certificate completions also decreased from 118 in 2019-20 to 70 awards in 2020-21. We will continue to work with counseling to help students identify and apply for certificates and degrees.

Data Analysis and Use for Improvement:

The biotechnology department regularly evaluates data as part of our annual program review process. Following the review of data dashboards, the faculty discuss any emerging trends and needed program improvements. In addition, the faculty are in regular contact with industry advisors to learn about workforce needs. These conversations are used to inform curriculum modifications. Finally, faculty use SLO assessments to identify gaps in student achievement and how to better support students in their learning.

Improving Student Success:

The lower division program needs additional work to help support student learning, particularly when viewed from an equity lens. As classes return to campus, we hope to offer more in-class support and open lab periods. This will require personnel to supervise the laboratory space and answer questions. We will need to continue experimenting with avenues to provide more support for math learning, such as embedded tutors. We can also use in-class time to distribute graduation petitions to encourage students to apply for their certificates and degrees. In the past, this has been a fruitful practice for completions. Finally, the department will be helping to pilot credit for prior learning procedures that could help students earn more credit for their work-based experiences and reduce the time to completion.

Closing the Equity Gap:

As discussed above, we see equity gaps in the lower division curriculum. Faculty continue to discuss opportunities to provide more scaffolded learning and in-class support. Many of our students work and are unable to go to the STEM Center during their open hours. One avenue of exploration is competency-based assessment. Faculty are actively researching this approach and brainstorming how it could be applied to the program to promote equitable assessment practices.

Start:

7/1/2021

End:

6/30/2022

New Course and Program Learning Outcomes Item

Program/Unit:

Biotechnology

Summary of Course Student Learning Outcome Results:

Student Learning Outcomes for all courses are listed on the course outlines and class syllabi. The SLOs are assessed according to the 6-year calendar. The departmental standard is 65% of the students are expected to score 70% or higher in order for the SLO to have been met. Starting in Spring 2021, a full-time faculty member was designated as the SLO coordinator for the department to ensure that all faculty understood the SLO assessment process and that SLO assessments were completed on schedule.

SLOs have been met for all upper division courses assessed during this period. In some cases, 100% of students met SLOs (as shown in linked CSLO 1 for BTEC 470). However, in other cases SLOs were only narrowly met, such as for BTEC 340. This course was previously taught by an industry professional, who failed to submit formal results of SLO assessment. When a second industry professional gave notice at the start of the Spring 2020 semester that he was no longer able to teach the course, the department chair stepped in to redesign and teach BTEC 340 as an asynchronous online course. SLO assessment from Spring 2020 showed slightly lower success rates than expected (as shown in linked CSLO 2 for BTEC 340). This is most likely due to the quick changeover in instructors as well as the timing of the global pandemic. Many students reported dramatic life changes resulting from the pandemic, and their ability to study and focus on coursework was negatively impacted. We expect that this would have been particularly detrimental to their participation in an online asynchronous course, leading to fewer students meeting SLOs than expected. In Fall 2021 a reliable associate faculty member was assigned to teach BTEC 340 and has been working to increase teamwork amongst students with the goal of improving student success.

SLOs have been met for all lower division courses assessed during this period, with the exception of one SLO for BTEC 110 in Fall 2019. BTEC 110 is a fast-paced, hands-on introductory biotechnology laboratory course. Only 61% of students were able to produce an acceptable outcome by employing the appropriate equipment or tools effectively and safely when performing a technical laboratory task (as shown in linked CSLO 3 for BTEC 110). Interestingly, the number of students meeting this standard increased from 40% in Spring 2019 to 61% in Fall 2019. In Fall 2019, students were given an extra day of cell culture practice, which helped the students gain more experience and provided instructors with more time to go over calculations. Plans to provide students with even more cell culture practice were thwarted by the start of the pandemic in Spring 2020. As courses transition back to campus, BTEC 110 instructors will focus on providing students with as much cell culture practice as possible.

CSLO 1

As the result of this course students will be able to evaluate the effectiveness of the laws and regulations governing biopharmaceutical manufacturing and demonstrate an understanding about how these regulations are crafted and approved.

Academic Year 2019-2020: BTEC 470

Term: Spring 2020

CSLO 2

At the end of this course, students will be able to apply the methodologies used in lean manufacturing to analyze the design of a biomanufacturing process and create a strategy for improvement of the process economics.

Academic Year 2019-2020: BTEC 340

Term: Overview

CSLO 3

When performing a technical laboratory task, the students will produce an acceptable outcome by employing the appropriate equipment or tools effectively and safely.

Academic Year 2019-2020: BTEC 110

Term: Overview

Action Plan Progress:

As has been discussed in this program review as well as prior reviews, students struggle with mathematical computations, particularly in BTEC 110. Since the start of the pandemic, instructors transitioned to a batch-record approach for documenting this lab activities, which included sample calculations. Faculty also created course-specific videos for BTEC 110 to provide students with 24/7 online access to support materials tailored to the course content. The instructors now emphasize the difference between the mass of a chemical or the number of molecules/cells, and the concentration of the chemical or the concentration of molecules/cells.

Instructors of other BTEC courses have also been making modifications to provide students with more mathematical support. BTEC 180 (biostatistics) instructors recently created a math review module that is completed at the start of the course. This extra help has improved student performance surrounding basic calculations.

From the previous program review, faculty found that students in the advanced cell culture class did not meet the outcome for aseptic technique when last assessed. Since then, the instructor created a detailed video showing aseptic technique and provides it to students prior to the first day of class. The instructor's long term goal is to be able to have a technology set up that will allow for simultaneous monitoring of all 20 students to ensure proper aseptic technique. The department has recently purchased iPads, with the goal of using them to monitor students in the lab.

Areas for Improvement:

All recent CSLO data collected after the previous comprehensive program review was examined, and a summary of findings is shown below:

- Laboratory math continues to be a challenge for students. This was noted for both hands-on labs (such as those in BTEC 110) and asynchronous online labs (such as those in BTEC 180). Providing additional math preparation at the start of courses and/or programs could help to address this equity gap.
- In some instances, students struggle to complete laboratory activities (particularly those involving calculations) in the time given. A key example of this was given in the summary above: students in BTEC 110 did not meet the standard for "producing an acceptable outcome by employing the appropriate equipment or tools effectively and safely when performing a technical laboratory task." Revising laboratory curriculum to provide extra sessions for challenging laboratory activities might help improve student success.
- Faculty have suggested revising some assignments and projects to more accurately evaluate CSLOs. Pandemic-induced changes to the modality in which courses were offered led to a disconnect between a few CSLOs and their method of assessment, especially in lab-based courses. The return to on-campus instruction should address this issue.

Program Student Learning Outcomes:

Students in all departmental certificate and degree programs are largely meeting SLOs based on the departmental standard: 65% of the students are expected to score 70% or higher in order for the SLO to have been met. In one instance, an SLO was not met and for a few classes it was narrowly met due to students struggling with mathematical calculations. Faculty are addressing the gap in mathematical preparedness by providing students with extra support in the form of videos, example calculations, practice problems, and math review modules. Early results of these interventions are promising and indicate that more students are meeting SLOs as a result of the extra support.

Start:

7/1/2021

End:

6/30/2022

New Program Resources Item**Program/Unit:**

Biotechnology

Facilities Improvements:

For the BTEC400 class, we worked with the Academic Information Services (AIS) department to enable a network that allows the student to remotely access the process data generated during the on-campus labs. For this network, AIS prepared a set of computers to access virtual computers that students can use to work on data analysis. This was an improvement required due to COVID and remote instruction requirements. We would like to maintain this setup for future cohorts.

In addition, the department is in need of more laboratory space and an office for our Science Laboratory Technician. These needs will be remedied by the new biotechnology/chemistry building coming soon.

Optimize Program Performance:

The network improvement for BTEC 400 allows students to be able to construct a process control chart that evaluates and demonstrates whether a process is in a state of control. This is one of the student learning outcomes for the class. During the pandemic, we found that students' ability to remotely access this data provided them with additional opportunities to learn how to work with the data. In the past, students were limited to their on-campus lab time, which constrained their learning. As we work to increase work-based learning activities in the upper

division program, it would be beneficial for students to be able to perform data analysis as part of their course homework at home.

Impacts on Processes and Procedures:

We will need to work with AIS to ensure that the network settings are configured to continue to allow for remote access by students. This may impact their processes and procedures.

Correlation to Program Efficiencies:

Providing students with additional learning resources that they can access from home will enhance their learning and achievement of student outcomes.

Supplies, Software and Equipment:

During the pandemic, we had to pivot our laboratory classes to a virtual environment. The biotechnology faculty used Labster software to provide students with virtual laboratory activities. The department had not previously used virtual labs, but found that they help to reinforce concepts for students. Based on the positive student feedback, we have identified Labster software to be a key learning tool for students. Although it cannot replace hands-on learning in the laboratory, Labster assignment help to solidify key knowledge and skills when used in combination with lab activities. In addition, the department recently piloted the use of Jakapa software for soft skills evaluation. This is also helpful for students as they assess their own workforce skills. We would request that subscriptions for these software platforms are renewed by the college.

Start:

7/1/2021

End:

6/30/2022

New Program Personnel Item

Program/Unit:

Biotechnology

Faculty/Staff Contributions:

The biotechnology faculty and staff work closely to support student success. During the pandemic, these collaborations enabled us to pivot from hands-on laboratory courses to fully online delivery in Spring 2020, and then hybrid classes in Fall 2020 and Spring 2021. When the pandemic lock-down began in Spring 2020, the faculty and staff came together to strategize the best approach to finish the semester. We decided to cancel an 8-week laboratory course that had not yet begun. Wally Perez used the time he would have taught that class to help his full-time faculty colleagues transition their on-ground courses to a virtual lab environment.

Over the summer of 2020, the faculty worked with the laboratory staff to design and build extensive at-home kits for students to use in BTEC 110 and BTEC 221. These kits have enabled lower division students to gain industry-relevant, hands-on skills from home. In upper division, faculty and staff worked closely to rearrange the equipment in the biotechnology building to allow students to come to campus for lab activities while adhering to social distancing protocols. Our Science Laboratory Technicians demonstrated great creativity and resolve in spearheading the equipment relocation and process for preparing and distributing kits to students in the parking lot. As a result, the biotechnology department has been able to offer hands-on training both at home and on campus throughout the course of the pandemic while other colleges temporarily halted their biotechnology programs.

The bachelor's program Student Success Specialist provided key support for students, particularly during the pandemic. She connected students to crucial financial resources, including the emergency grants and rental assistance. She also facilitated technology loans to students that suddenly found themselves in need of a computer for at-home learning. The Specialist and full-time faculty meet weekly to discuss student progress and address challenges from an equity lens.

Currency in Field:

All full-time faculty regularly engage in professional development. Given that the life sciences industry is constantly evolving, we are committed to growing our knowledge base to support program improvements. Barbara Juncosa and Dominique Ingato were co-PIs on a national project funded by NIIMBL to explore the emerging area of cell- and gene-based therapies. As part of this project, Dominique convened an industry listening session to learn about the process of manufacturing these types of products and the workforce needs of this sector. We have used the insights gathered to inform equipment purchases and future curricular additions and modifications.

To support the development of a new General Education course in biomanufacturing, Barbara participated in two conferences focused on cell-based food manufacturing. Wally Perez participated in various trainings on automation software and equipment to build the BTEC 400 coursework. Finally, Dominique Ingato attended trainings on biomanufacturing principles to update her currency in the field as she transitioned from teaching content focused on basic research to large-scale manufacturing. The faculty also regularly participate in Flex workshops at the college, including as participants in panel discussions on hands-on learning at home during

the pandemic and providing an active learning environment over Zoom. The collective passion for lifelong learning in the department has resulted in faculty engaged both in industry and pedagogical innovations.

Professional Development Needed:

As indicated above, the biotechnology faculty and staff are active in maintaining currency in the field. The life science industry continues to rapidly evolve, however, with new technologies and techniques emerging each year. Through recent funding opportunities, we have been able to purchase equipment to modernize our curriculum and expand access to students. Rather than sharing one piece of equipment, students now have access to multiple sets of equipment. Furthermore, we have acquired equipment for cell- and gene-based therapy curricula to support one strategic program goal. With these new purchases comes the need to provide training for faculty and staff. We will pursue training opportunities with our vendors and ensure that faculty are cross-trained on the equipment.

In addition, we see the need to continue training on automation technologies, particularly to support the BTEC 400 curriculum. Our faculty lead Wally Perez has industry experience with automated systems, but requires additional professional development to ensure that our course is aligned with the workforce needs. He is looking to build more work-based learning activities, which is another strategic program goal. Finally, the department will continue to pursue opportunities to learn about best practices for STEM student equity to help address success gaps. We regularly have these conversations in our department and will continue to disseminate information learned through our individual professional development activities with departmental colleagues.

Changes in Staffing:

In Spring 2020, Andrew Relopez was hired as a permanent full-time, 10-month Science Laboratory Technician. Andy had previously been working in this role on a temporary basis. He has been a key support person during the pandemic helping faculty and our Senior Science Laboratory Technician Daniela Traykova to prepare on-campus activities, as well as at-home kits for hands-on learning.

Personnel Changes Needed:

We are currently in need of converting our part-time Student Success Specialist position to a permanent, full-time role. In October 2021, the bachelor's program pilot was granted permanency by the California legislature and Governor Newsom. With this exciting development, we see the need to have a permanent staff member to support student equity and

help ensure successful program functioning. We have now served five cohorts totaling over 100 students with an additional 24 students accepted to begin in Fall 2022. Over time, the efforts needed to track graduates, support current students, and perform outreach to prospective students have grown tremendously. As a small department with only three full-time faculty and no dedicated staff for the bachelor's program, we need more assistance to continue to provide the high level of support required to promote student equity and success. Our strong metrics, including 92% graduation rate and over 98% retention rate, are directly linked to the outstanding work of our Student Success Specialist. In the future, we are looking to expand our industry mentoring programs and provide more assistance for current students and graduates with job placement. This will all require more time and effort than is possible for our faculty team to continue without full-time staff support. We have requested that this position be converted to a full-time role for several years in the program review process. We are currently waiting to hear if the position was funded in the 2021-22 academic cycle.

In addition, the department would greatly benefit from increasing our 10-month Science Laboratory Technician to a 12-month position. Having two technicians working throughout the year will provide key support for faculty to continue to develop lab-based activities and for students who would like to practice hands-on skills in the laboratory on Fridays and during the summer period.

Start:

7/1/2021

End:

6/30/2022

New Program Curriculum Item

Program/Unit:

Biotechnology

Curriculum Currency:

Every year we meet with the industry advisory board to discuss workforce needs. The advisory board meeting is designed for advisors to provide curriculum feedback on different areas in the life sciences industry, such as Quality Control, Quality Assurance, Regulatory Affairs and Compliance, and Biomanufacturing technologies and equipment. In addition, we regularly invite guest speakers for different classes to talk about new trends in the biotechnology industry. Using the information from the guest speakers and our advisory board meeting, we identify curriculum needs and implement plans to improve the curriculum.

In the lower division program, new course outlines were written and approved over the last two years. BTEC 107 was approved as a CSU-GE Area E course examining the real world applications of biotechnology and exploring job-search skills, such as resumes and interviewing. BTEC 108 was approved as a CSU-GE natural science laboratory course introducing nonmajors to biomanufacturing. BTEC 231 was approved as an elective short

course focused on CRISPR DNA editing technology. Finally, honors versions of BTEC 108, BTEC 110, and BTEC 180 were created to support students looking to complete a Honors certificate using a biotechnology degree or certificate. This is the first time the department has offered honors curriculum.

The automation curriculum was modified to include new equipment that allows students to monitor and control process parameters, such as adding activities where students practice PID tuning for process variables. For these modifications, pumps and a serial communication module were added to the control panels as well as new scales for students to be able to work on monitoring and controlling bioprocess volume. Besides equipment purchases, new laboratory activities were designed for students to practice pH process control and PID tuning of process parameters. The quality curriculum was upgraded to include a work-based project where students work on a CAPA process for a bioprocess out of specification result.

Due to COVID, we modified the laboratory component of all courses to offer at-home experiments and/or on-campus labs with small groups of students in which each student had the opportunity to work independently with the equipment. In collaboration with the AIS department, there were modifications to the curriculum for data analysis of bioprocesses. Through our collaboration with AIS, the department was able to configure a network that allows students to remotely access the data generated during the on-campus lab activities and use these to practice what learned in class. All courses in the department were modified to seek approval for 100% online offerings.

Curriculum and Equity Gaps:

We continue to seek opportunities to close equity gaps via curriculum design. One of the biggest hurdles for students has been laboratory math concepts in lower division. Just before the pandemic, large parts of BTEC 110 (our foundational lab course) were redesigned to better scaffold math concepts. This led to an improvement in SLO achievement between Spring 2019 and Fall 2019 when the changes were launched. Unfortunately, the pandemic presented great challenges for this on-ground course, but the faculty have generated a lot of support content available to students 24/7 on Canvas. To help with preparation for BTEC 110, faculty have created a new GE introductory course for biomanufacturing. This course will introduce students to key math concepts that will help them in BTEC 110 and beyond. This course has been approved and is currently under development. Finally, in BTEC 180 (biostatistics), faculty have launched a pre-course module to help students self-evaluate their math competencies and direct them to resources to review key concepts for the course. Faculty will continue to examine how AB 705 has impacted course success in BTEC 180 to identify opportunities for course improvement.

Start:

7/1/2021

End:

6/30/2022

New Dialogue and Collaboration Item

Program/Unit:

Biotechnology

Dialogue within Program/Unit:

The department (including full time faculty, associate faculty, and staff) meets at least once a semester to discuss program goals and share ideas for improving program effectiveness. Throughout the academic year, full time faculty and the department's student success specialist meet weekly. These meetings often include discussion around student learning outcomes, curriculum development, and collaboration with other departments and industry. Additionally, faculty teaching upper division bachelor's degree courses for the biomanufacturing program meet several times per semester to discuss program effectiveness and curriculum development.

Collaboration:

Several biotechnology department programs require students to take specific courses from other departments including biology, business and philosophy. Biotechnology faculty work with faculty teaching these courses to ensure that their learning outcomes meet and align with our program goals. These faculty members are invited to biomanufacturing faculty meetings several times a semester to facilitate collaboration. Additionally, biotech faculty have worked with business department faculty to co-host seminars focused on careers in the biotech industry that are relevant to both majors.

Start:

7/1/2021

End:

6/30/2022

New Reflection and Goal Development Item

Program/Unit:

Biotechnology

Overall Program Review Summary:

The biotechnology department is dedicated to student success and equity. This is demonstrated by the high success, retention, and graduation rates of the novel bachelor's program. The department was highlighted by the report from the Legislative Analyst's Office (LAO) as better preparing students for the workforce than traditional STEM degrees from four-year institutions. In addition, the program was recently selected as a Preferred Provider of Life Science Talent in San Diego. We are the only community college biotechnology program that

received this designation which provides our students with access to paid internships. In the future, we are looking to continue building our pipeline with partnership from local high schools, which has not been a focus in the past. We will also examine our upper division program to identify opportunities for work-based learning and curricular improvements based on industry trends.

Strategic Goals:

Over the next three years, we plan to:

1. Enhance program offerings by incorporating curriculum relevant to the emerging sector of gene- and cell-based therapies.
2. Explore new opportunities to build additional work-based learning activities into the bachelor's program.
3. Examine the upper division curriculum to identify gaps in content and explore the possibility to build pathways for students to specialize in particular topics.

Start:

7/1/2021

End:

6/30/2022

New Program/Unit Rating Item

Program/Unit:

Biotechnology

Program Rating By Chair:

1

Program Rating By Dean:

1

OPTIONAL: Comments on Program Rating:

The biotechnology department has demonstrated great collaboration, creativity, and innovation in their efforts to launch and build upon the bachelor's program. They continue to reevaluate all aspects of the departmental programs to ensure that students are well prepared for the regional workforce. The department models so many valued characteristics, including engagement, inclusivity, innovation, equity-mindedness, and student-centeredness.

Start:
7/1/2021

End:
6/30/2022