SHORELINE COMMUNITY COLLEGE

Biotechnology
PROGRAM REVIEW

June 14, 2019

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Executive Summary and Priority Suggestions

Overall Observations

Shoreline Community College's Biotechnology program (Biotech) is nationally recognized with no peers in Washington State. It has a reputation of offering students a winning combination of deep content knowledge, diverse skills, unparalleled hands-on laboratory work, and extensive industry contacts. The program offers a Lab Specialist Certificate of Completion, marketed towards incumbent workers and others with a bachelor's degree in a science field seeking hands-on training, and an Associate of Applied Arts and Sciences (AAAS) degree.

The department is in its second year of administering a National Science Foundation grant. They are using this grant to revise existing courses, create new courses, replenish and update materials and equipment, and offer summer experiences to high school teachers and students.

In addition to the professional-technical program, Biotech offers a summer high school outreach program, one of two programs in the state and the only program with a laboratory component. While this summer program was not a part of the program review, it serves to build an important pipeline into the professional-technical program, otherwise serves both industry and community needs, and generally rounds out an impressive program.

Finally, busy Biotech faculty also host workshops for high school teachers. This includes a "kit loan" program to offer needed curriculum and supplies so the teachers can replicate lessons in their high school classrooms.

The Biotech program is well run, produces excellent results, and has some areas for improvement.

Priority Suggestion 1: Expand Market Share

Shoreline's Biotech program does not have direct competitors in Washington State. Some Puget Sound schools offer a biology degree or biology courses, but none offer professional technical training or an AAAS in Biotechnology. Biotech is mature, nationally recognized, and more advanced than any of its peers.

In order to meet industry needs, the program will need to grow. Shoreline's program currently operates at about 16 FTE per year. Industry demand is much higher than what any one college could fill and eventually other community colleges will build programs to help meet this demand. A recent report commission by Cascadia College recommended that Bellevue, Lake Washington, Edmonds, Everett, and Cascadia add Biotech courses and programs. Shoreline should be working hard at this point to grow its market share while it can. Some concrete steps that could be considered include:

Suggestions

1.1 Exploring opportunities to launch a Biotechnology manufacturing training program. Biotech manufacturing employment grew by 12 percent in King and Snohomish Counties between 2010 and 2017, to over 9,000 jobs. (pp. 23-24)

1.2 Consider pursuing Career Path funding allocated in the latest state appropriation. This funding will allow Shoreline to build its pipeline of high school students interested in the program. (p. 22)

1.3 Consider applying to become the Center of Excellence for Life Sciences. This designation by the State Board of Community and Technical Colleges allows an institution to serve as the hub between industry and colleges, helping other colleges achieve excellence in a particular industry. (p. 22)

1.4 To accomplish any of these objectives, Biotech faculty will need additional support. The demands of administering the NSF grant while also teaching and running a busy program has the lead faculty working at her limits. (p. 22)

Priority Suggestion 2: Update learning outcomes and conduct curriculum review

The program learning outcomes (PLOs) are almost completely skills-focused and provided limited descriptions of the type of learning occurring in the program. Because the PLOs are intended to guide curriculum development it's important that they reflect the learning expected of the program. Related, faculty note that a formal complete curriculum review has not occurred since 2016. Because of changes in industry and education, they plan to conduct a new review.

Suggestions

2.1 Review and update the PLOs using Bloom's Taxonomy to insure they meet industry requirements and adequately describe the type of learning occurring. (pp. 10-11)

2.2 Map courses to the new PLOs to ensure an understanding of where learning and assessment is occurring throughout the program and identify potential gaps. (p. 11)

2.3 Use the new PLOs and course maps to inform a curriculum review. (p. 11)

Program Review Findings

Program Level Findings

1. The process Biotech uses to engage their advisory committee in curriculum review is a best practice and should be documented and shared with other Shoreline programs. (pp. 8-9)

2. Former students indicated they learned the program outcomes at a much higher rate than normally seen for professional-technical programs. (pp. 9-10)

3. Course success rates and grades are comparable to Shoreline's professional-technical averages. Grade distributions show consistent and objective grading practices from year-to-year. Biotech faculty use grading rubrics that are normed and faculty have been trained on their use. (pp. 12-13)

Employment Findings

1. A high percentage of alumni and former student survey respondents indicated they were employed for pay (almost 75 percent). (p. 13)

2. The vast majority of these working alumni (13 out of 15 respondents) are working in an industry related to Biotech. (pp. 13-14)

Student/Course Level Findings

1. Enrollment in Biotech has remained stable since AY 2013, despite the increase in the economy and declining enrollments overall at Shoreline. (pp. 14-15)
2. Biotech students are more diverse on all accounts than the industry as a whole, and more diverse than Shoreline's Professional-Technical programs on average with the exception of age and Pell grant eligibility. (pp. 15-18)
3. To improve Pell Grant use, faculty should consider offering FAFSA presentation to summer camp students. (p. 19)
4. Biotech students complete certificate and degrees at a lower rate than Shoreline Professional-Technical students and about comparable to statewide averages. This is in part due to the intensiveness of the program and the working status of students. (p. 19)
5. There were no waitlist or fill rate issues for this program. (p. 20)

Faculty Findings

1. The faculty fully participated in this program review and were engaged, thoughtful, and had a good understanding of the needs of students and employers. (p. 20)
2. Biotech operates at a lower student-to-faculty ratio than the average Shoreline Professional-Technical program. This is due to the extensive laboratory work required in the program. (pp. 20)
3. Faculty would like additional opportunities to pursue professional development related to pedagogy. (pp. 20-21)

Resource Findings

1. Alumni and the advisory committee reported that students have extensive opportunities for laboratory work, more than most other colleges and universities. These opportunities prepare them to work in laboratories directly upon graduation. (p. 21)
2. Because of the extensive laboratory work offered, this is an equipment-intensive program. (p. 21)
3. Faculty used the NSF and Perkins grants to replenish the majority of needed equipment. (p. 21)
4. Faculty need a new overhead projector. The existing one is old and used every day, all day. (p. 21)
5. Faculty also report needing a new flow cytometer and incubators as the existing ones are unreliable. (p. 21)

Partnerships

1. Based on open-ended responses to the advisory committee survey, the majority of committee member respondents seemed engaged in the work of the committee and in Shoreline's program. (p. 21)

2. The Shoreline School District has a new CTE director, who is engaging program staff, but no results have yet been realized. (p. 21)

Program Updates

1. To improve program accessibility and persistence, faculty are considering adding an afternoon block for working students and updating the planning guides so that AAAS candidates get some Biotech curriculum in the first year. (p. 21)

Competition

1. No other community college in Washington State offers a Biotech program. Alumni survey respondents indicated they chose to attend Shoreline's program because of its quality. (p. 21-22)

Labor Market Opportunities

1. Occupation growth for Biological Technicians is projected to grow by 8 percent between 2018 and 2022. This occupation is listed as In Demand in King County and Balanced in Snohomish County. (p. 23)

2. Biotech employment grew 13 percent between 2014 and 2017. Biotech manufacturing businesses grew by 55 percent and employment grew by over 12 percent between 2010 and 2017. (pp. 23-24)

INTRODUCTION

In an effort to maintain the highest quality post-secondary education and meet regulatory requirements, Shoreline Community College hired Phippen Consulting, LLC in spring of 2019 to conduct a program review of its Biotechnology (Biotech) Program.

METHODOLOGY

Meetings

- One one-and-a-half-hour meeting with Division Dean, program chair, and Institutional Review staff to identify major issues of focus.
- Two two-hour meetings with staff and faculty to discuss all aspects of their program.

Documents Reviewed

- One survey of alumni and former students (n=26, 28 percent response rate)
- One survey of the advisory committee (n=15, 42 percent response rate)
- Student demographic data
- Class cancellation and waitlists
- Student completion data
- Student completion ratios for Biotech, Shoreline, and the state
- Student grade distributions
- Comparative data on student-faculty ratios
- Comparative data on full-time to part-time faculty ratios
- Program and course level fill rates
- Labor market data
- Job openings data from EMSI
- Program level learning outcomes
- College and program website and planning guides
- Annualized FTEs, headcount, and percent of enrollment by program and by certificate/degree

Surveys

The program review incorporates results from the following surveys: alumni and former students; and advisory committee. The alumni and former student survey was distributed by Shoreline's Marketing and Communications Department using MailChimp and Survey Monkey. One email and one follow-up email were sent to former students resulting in a response rate of 28 percent.

The advisory committee survey was distributed by the department's NSF evaluator. The response rate was 42 percent.

Exceptions

In addition to the above methodology, the program review process at Shoreline typically includes a meeting with the program's advisory committee to discuss the labor market and industry trends, as well as a comprehensive survey of current students. Neither of these were completed for this program review.

Both of these data points are critical for a thorough program review. However, the Biotech program is in receipt of a National Science Foundation (NSF) grant. In its second year, the NSF grant requires a thorough external evaluation. Phippen Consulting attempted to work with the external evaluator to collect the data required for the program review, but unfortunately the timelines did not match. There was some limited information available from an advisory committee survey completed for the NSF evaluation, which was incorporated into this program review. In addition, a current student survey was completed by the NSF evaluator, but the data was not available in time for this report. Biotech faculty agreed to share the data with Shoreline's Institutional Review staff when it is complete.

In discussing these exceptions with Institutional Review staff, we noted that the Biotech program is well studied and that the current student survey data will be available to Institutional Review at a later date. To supplement the limited advisory committee data, this program review incorporates findings from Washington State Employment Security's regional economist, and Life Sciences Washington, an industry association, on the industry growth. Also, advisory committee minutes show strong engagement from members and high relevancy of the curriculum. For these reasons, we decided to produce this program review without this data.

CURRICULUM

Curriculum Review

Due to advances in technology and emerging industry trends, the education and skills required of new employees evolve rapidly. To respond, Biotech faculty applied for and received a National Science Foundation grant in 2017, designed with extensive input from the advisory committee and recent program alumni. The department has used this grant to both update courses as well as create new courses based on industry input.

The department uses an innovative process to engage their advisory committee to update existing and/or create new courses. The process includes a structured procedure to elicit committee input on key curricular components. This intensive work results in data faculty can use to restructure, update, or create a course. Using this

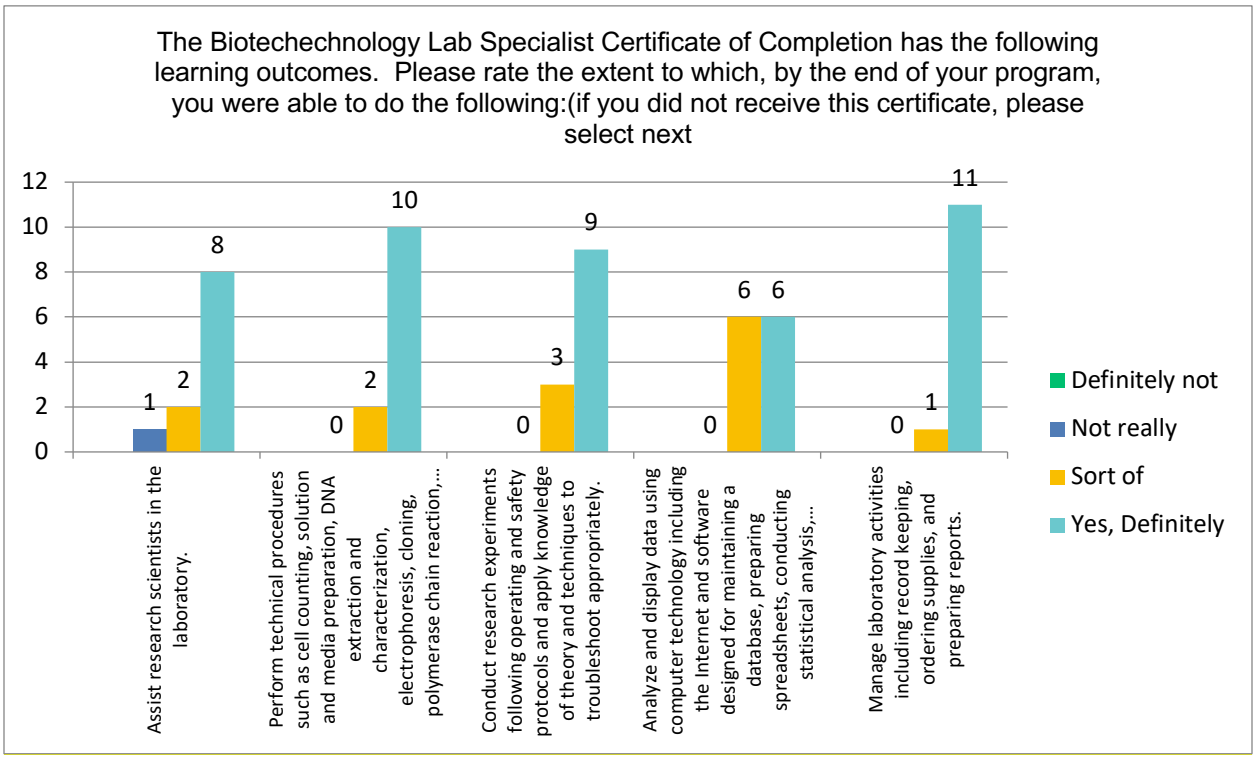
process, they have updated several courses over the past two years including BIOL 249, BIOL 266 and BIOL 286. The department plans to next use this process to update BIO 285. They have also used this practice to create a new course, Advanced Bioinformatics, which is currently being finalized.

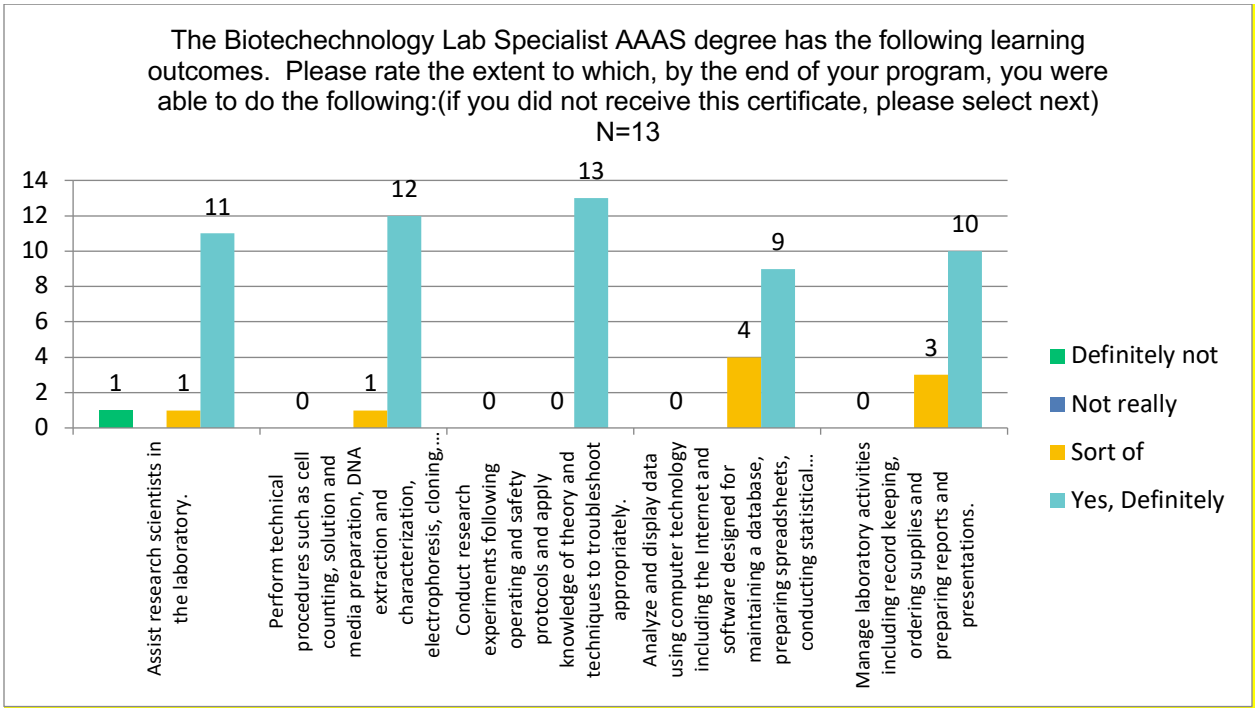
This process, also used by Shoreline's Clean Energy Technology program, should be documented and shared with other faculty as an emerging best practice.

Assessing Student Learning

Program Outcomes

Faculty currently use grades, scientific posters evaluated by industry representatives, and employment to ensure students are gaining program learning outcomes (PLOs). The following chart displays the rate to which former students felt they were able to perform the program learning outcomes (listed across the bottom) for the Biotech certificate and degree. They shared a high degree of achieving all PLOs.





The program outcomes for the Certificate of Completion and the AAAS are identical. Most professional-technical program attempt to differentiate the degree of learning that occurs between the abbreviated Certificate and the more extensive AAAS. In discussing this observation with faculty, they shared that the primary difference between the degree and the certificate are the pre-requisite and general education courses required in the first year of the degree. For this reason, they were comfortable with the program learning outcomes being identical.

BIOTECH Program Learning Outcomes (the same for the Certificate and the Associate of Applied Science degree)
• Assist research scientists in the laboratory
• Perform technical procedures such as cell counting, solution and media preparation, DNA extraction and characterization, electrophoresis, cloning, polymerase chain reaction, DNA sequence analysis, ELISA and other immunology techniques, maintenance of cell lines, transfection, and protein isolation and purification using various chromatographic techniques
• Conduct research experiments following operating and safety protocols and apply knowledge of theory and techniques to troubleshoot appropriately
• Analyze and display data using computer technology including the internet and software designed for maintaining a database, preparing spreadsheets, conducting statistical analysis, bioinformatics and graphical display
• Manage laboratory activities including record keeping, ordering supplies and preparing reports and presentations

The other observation of the program learning outcomes is that they are almost completely focused on skills and do not use language that describes the type and level of learning that is expected.

Faculty note that a formal complete curriculum review has not occurred since 2016. Because of changes in industry and education, they plan to conduct a new

review. It is recommended that the department update the program learning outcomes using Bloom's Taxonomy. In the 1960's, Bloom and his colleagues developed a system for understanding the type of learning being required from basic "did the student understand a concept" to the more advanced, "can the student analyze the quality of information and make or defend arguments based on this analysis."

Employers are increasingly requiring more critical thinking skills of their new employees, reflected at the higher levels of Bloom's Taxonomy. Both the alumni and former student survey and the advisory committee survey indicated that the program is teaching students at fairly high levels, so updating the learning standards in the PLO's is likely more about ensuring that the PLOs accurately represent the program and provide the guideposts necessary for a well-structured professional-technical program.

There are several handbooks and online resources available that suggest verbs and test questions aligned with Bloom's Taxonomy that make this process fairly straightforward.

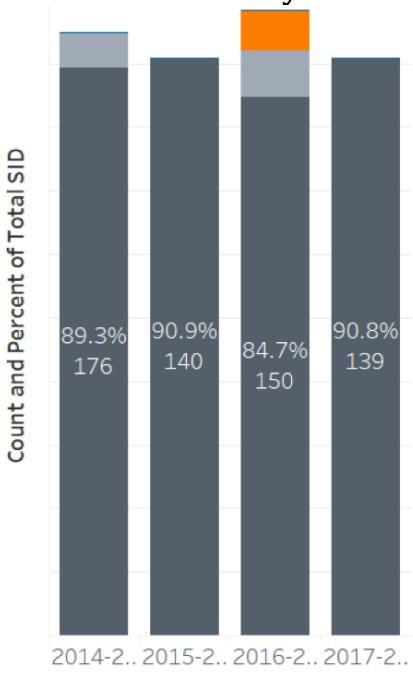
After updating the program learning outcomes, the department should consider mapping courses to the outcomes. Institutional Review has developed an easy to follow process for this exercise. This will help faculty understand where learning and assessment occurs throughout the program, identifying gaps that could improve uptake of program learning outcomes.

Updating the PLOs and conducting the mapping exercise will give faculty and the advisory committee a complete understanding of the current program and help them identify areas that need addressing.

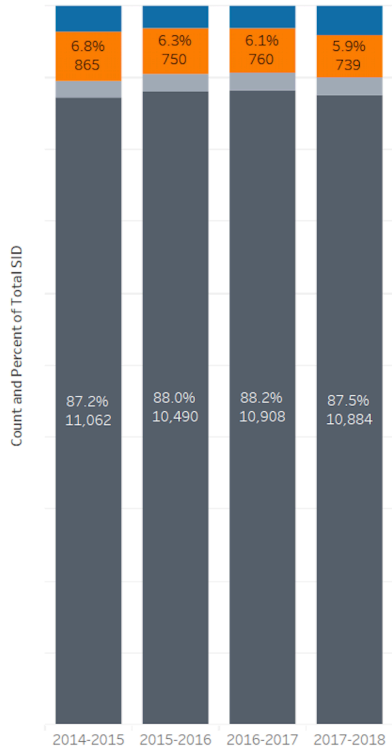
Grades

An examination of Biotech course success and grades reveals that Biotech pass rates and grades are comparable to the average pass rates and grades of Shoreline's Professional-Technical programs during the same time period. Biotech faculty use grading rubrics that are normed and faculty have been trained on their use.

BIOTECH Course Success by Academic Year



Professional-Technical Program Course Success by Academic Year

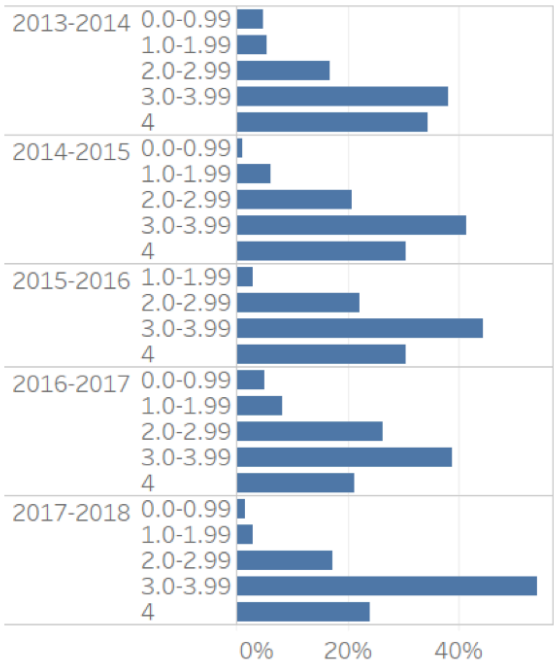


Drop = ('W', 'V', 'Z', 'NC')
No Pass Lower = 0.0 - 0.99
No Pass Upper = 1.0 - 1.99
Pass = 2.0 or higher

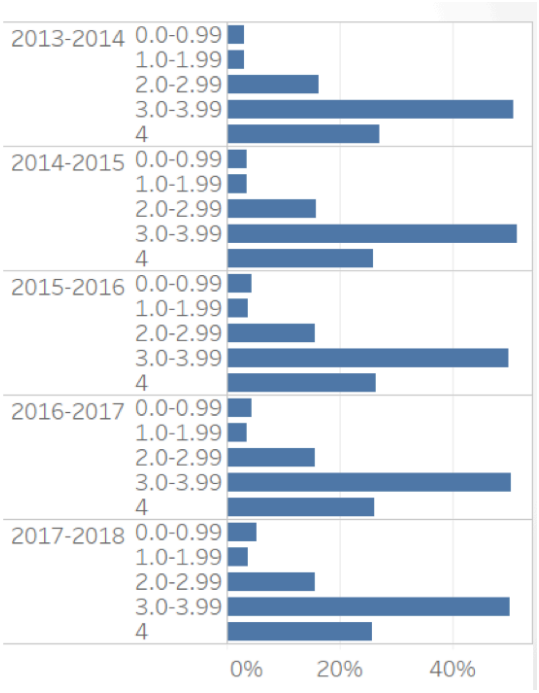
Note. Student counts fewer than 10 are not reported.

Grade distributions in the following table reveal fairly consistent and objective grading practices from year-to-year.

BIOTECH

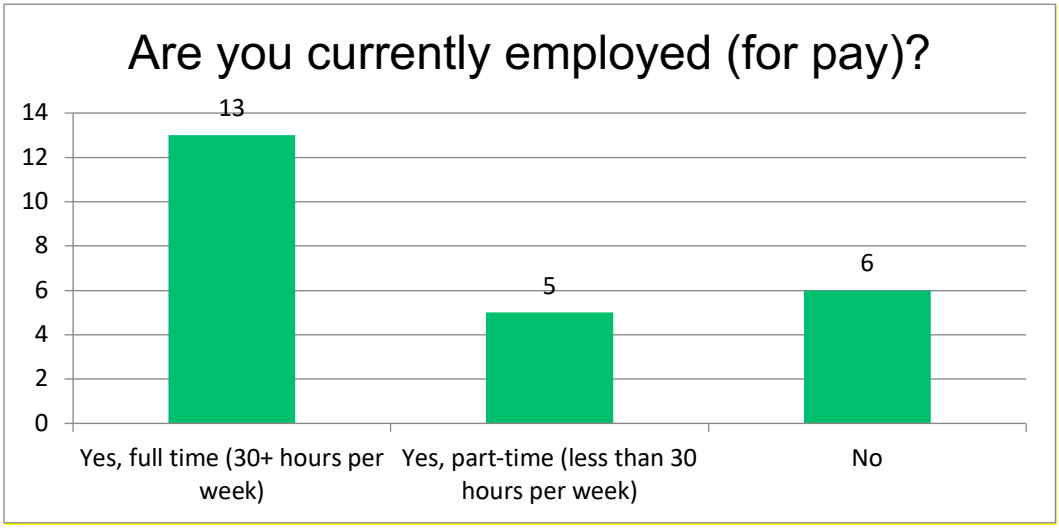


Prof-Tech



EMPLOYMENT OUTCOMES

To understand employment outcomes, two data sources are typically used. First, Biotech alumni survey responses regarding their employment status is considered. Almost 75 percent of alumni respondents reported that they were employed for pay part- or full-time, a slightly high number compared to other Shoreline professional-technical programs.



When responding to an open-ended question about their current jobs and responsibilities, 13 of 15 respondents indicated they were working in a field related

to the Biotech program. This is a high correlation and points to the relevancy of the program and the tight Biotech labor market.

The second data source is the Data Linking for Outcomes Assessment database compiled by the Washington State Board for Community and Technical Colleges linking program outcomes and employment data. This data shows the employment outcomes for alumni that completed their degree or certificate. The data does not show what jobs these individuals have.

Academic Year	Estimated Employment Rate for Completers	Estimated Employment Rate for Leavers
2012-2013	100%	38%
2013-2014	73%	76%
2014-2015	37%	81%
2015-2016	99%	100%
2016-2017	100%	98%

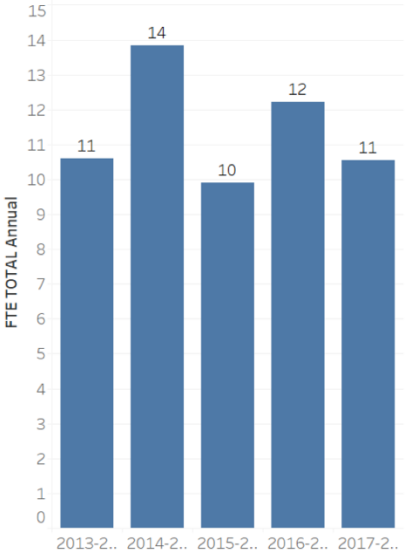
The variability in this data is attributed to the low levels of individuals matched in the database. For example, in the 2014-15 year, only three completers were matched in the database, with only one individual being employed.

Student Data Trends

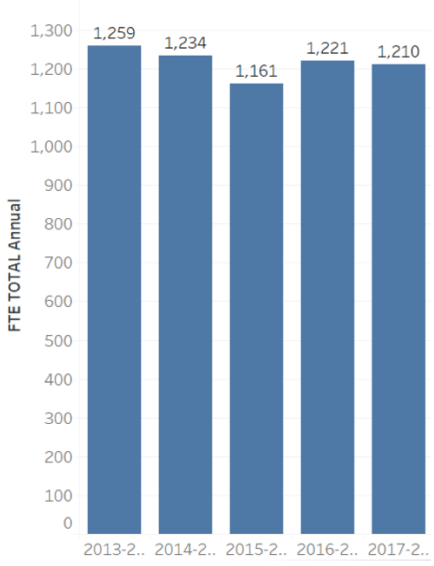
Enrollment

As the following table shows, Biotech FTE enrollment remained consistent between AY 2013 and 2017. Shoreline's professional-technical programs on average decreased by 4 percent during the same time period.

Biotech FTE by Academic Year



Prof-Tech FTE by Academic Year



Program reviews typically compare enrollment in the program compared to other programs in Puget Sound. However, as described in the Executive Summary, the Biotech program is unique in Washington State with no peers at the community college level, so a comparison of the size of Biotech to other comparable programs is not possible.

Student Demographics

The Biotech program students are more diverse on all accounts than the industry as a whole. While at least 57 percent of Shoreline's Biotech students are female, Data USA reports that 53 percent of the workforce is female.[1] The program instructors and lead faculty are mostly female, which will helps recruit and retain female students in the program.

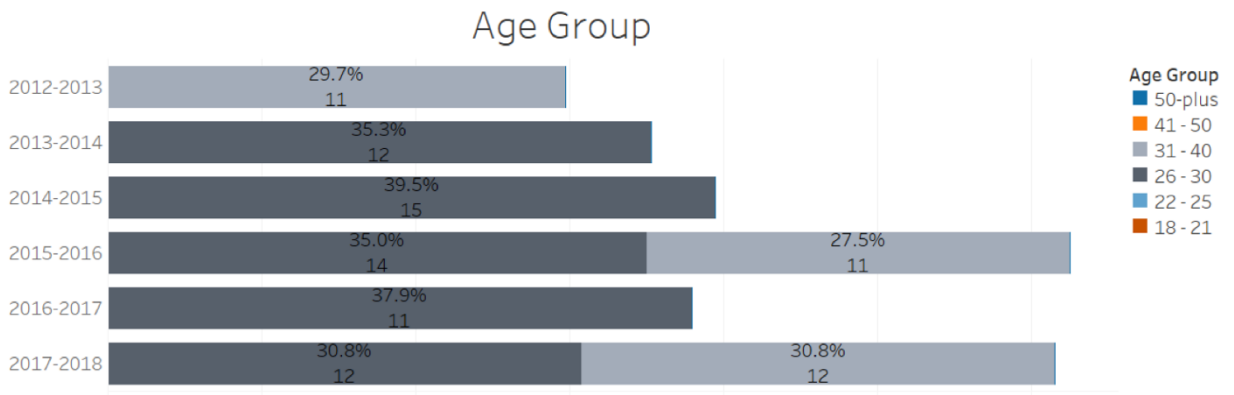
Biotech student's ethnicity shows significant variation from year to year. However, in any year it is much more diverse than industry, composed of 74 percent of white workers.

Compared to Shoreline's overall Professional-Technical programs on average, the Biotech program is more diverse on all accounts except with regard to age and Pell Eligibility. On both counts, a significant portion of Biotech students are incumbent workers who already have college degrees. This pushes the ages served and income levels higher than if students were younger. Also, between 10-18 percent (depending on the year) of Biotech students are international students, who are ineligible for Pell Grants.

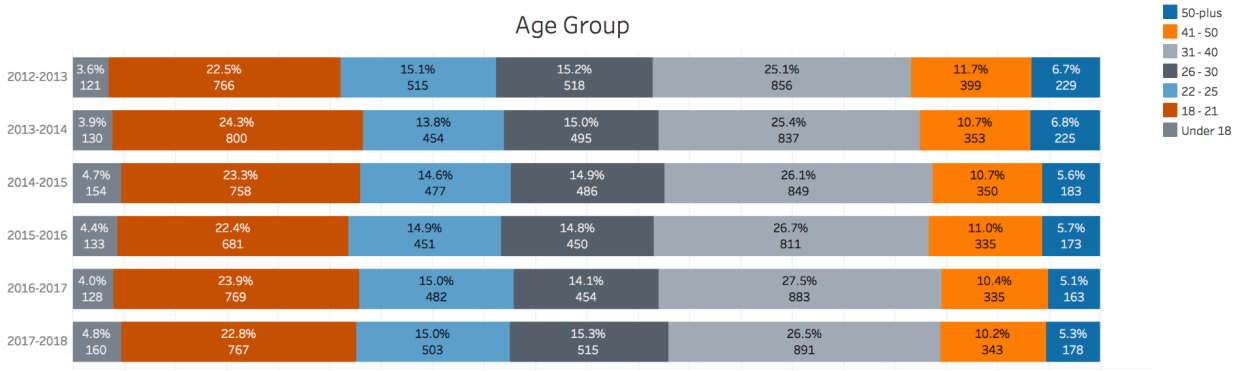
Student counts fewer than 10 are not included in the tables displayed below.

[1] *https://datausa.io/profile/soc/biological-technicians#demographics* Downloaded April 22, 2019.

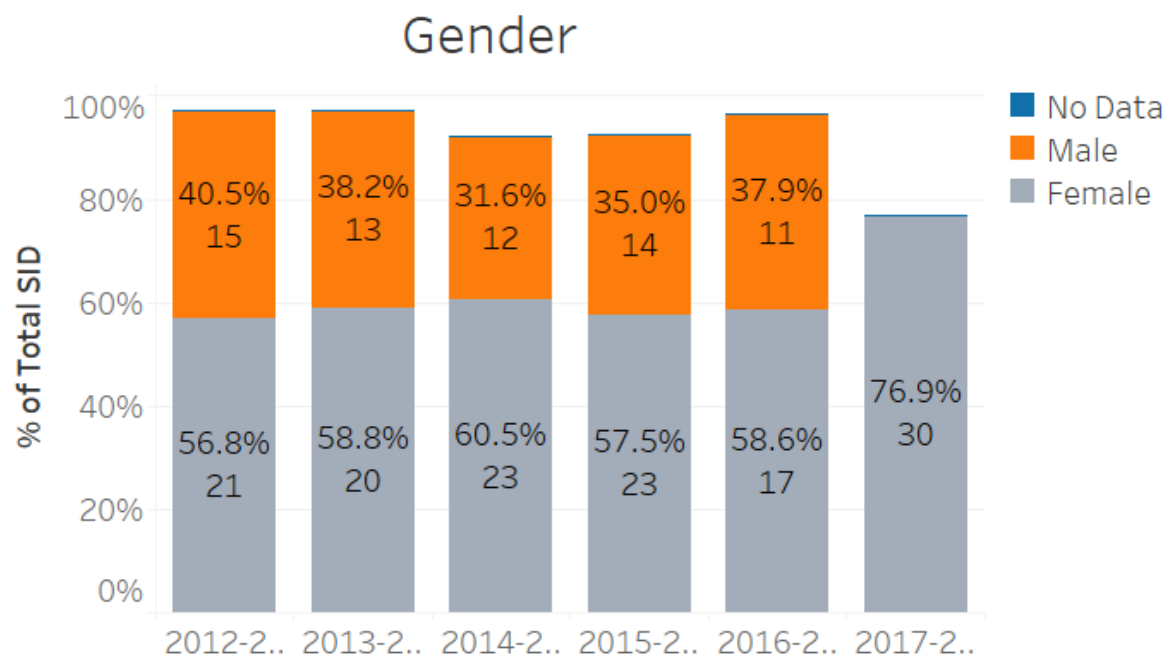
BIOTECH Mean Age



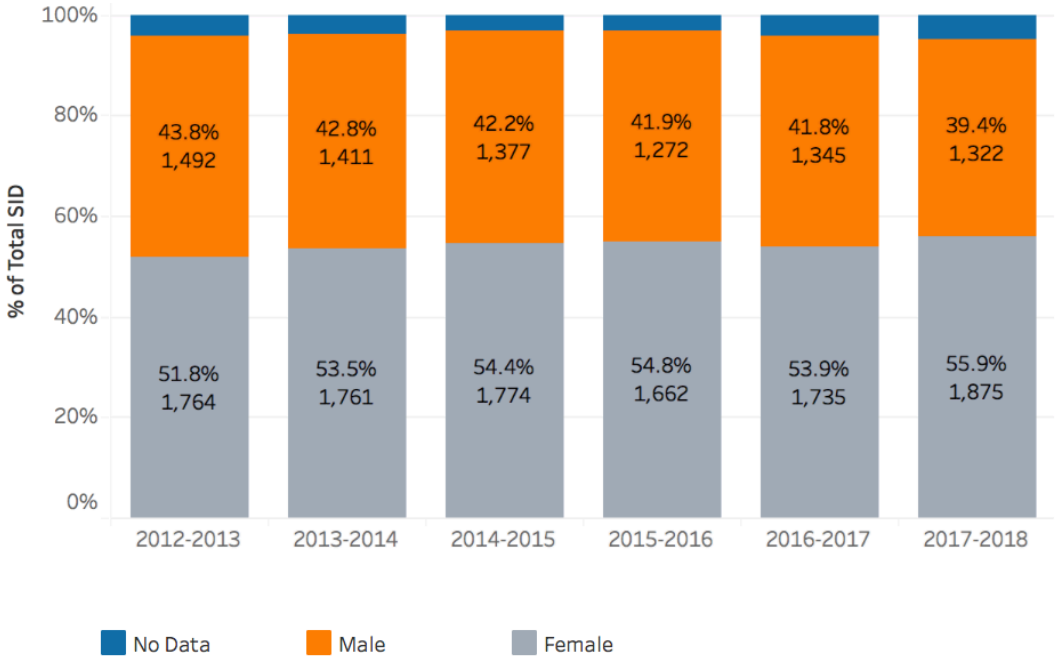
Prof-Tech Mean Age



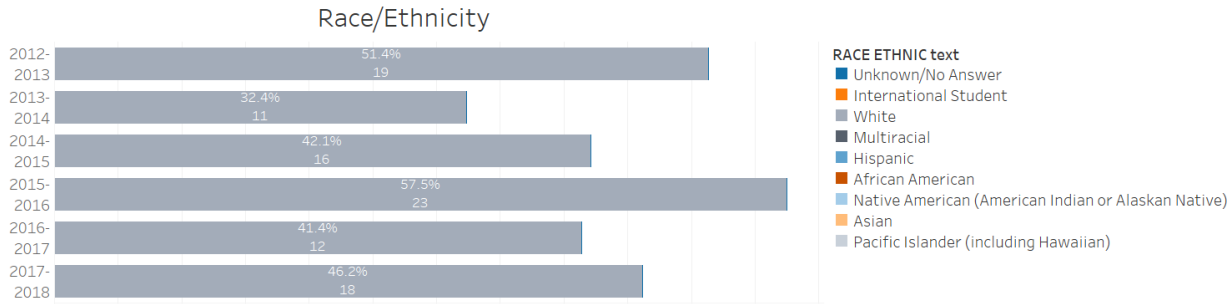
BIOTECH Sex



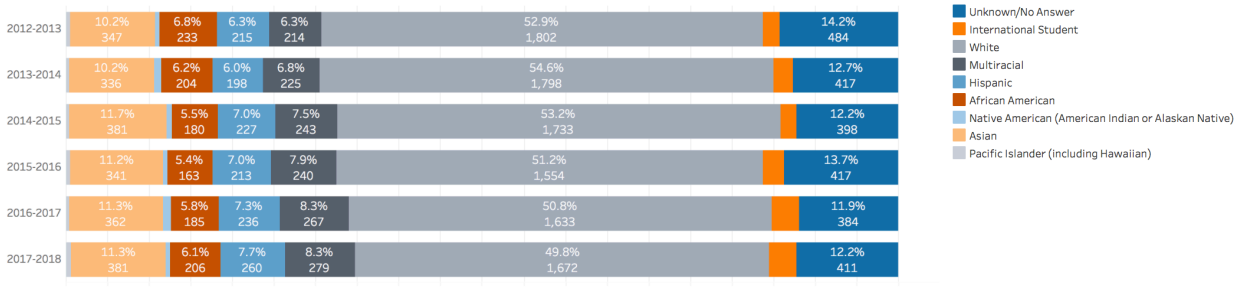
Prof-Tech Sex



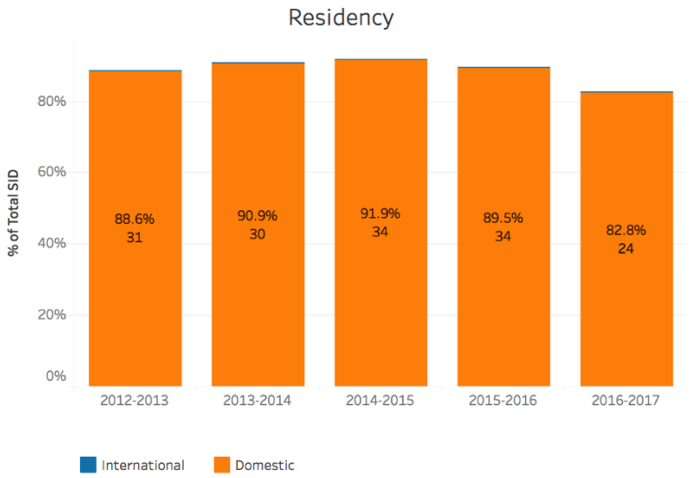
BIOTECH Race/Ethnicity



Prof-Tech Race/Ethnicity



Residency


Residency
% of Total SID
80%
60%
40%
20%
0%
88.6%
31
90.9%
30
91.9%
34
89.5%
34
82.8%
24
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
International
Domestic

Biotech Pell Eligibility **Prof-Tech Pell Eligibility**

To address low Pell Grant use, faculty should consider offering a FAFSA presentation to summer camp students.

Completion Data

The following table compares the Biotech program's ratio of students per workforce certificates and degrees earned to Shoreline Professional-Technical students and the state as a whole. Biotech students complete certificates and degrees at a lower rate compared to Shoreline Professional-Technical students and about comparable to statewide averages. This is in part due to the intensiveness of the program and also due to the fact that a majority of students are incumbent workers.

All Workforce Certificates and Degrees		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
State	Ratio	21%.	20%	20%	22%	20%	Unavail.
Shoreline	*Completions*	*1.317*	*1,229*	*1,273*	*1,164*	*1,300*	*Unavail.*
	Headcount	*5,203*	*4,681*	*4,205*	*4,132*	*4,862*	*5,089*
	Ratio	26%	26%	30%	28%	27%	*Unavail.*
Biotech	*Completions*	*5*	*12*	*3*	*14*	*10*	*11*
	Headcount	*52*	*49*	*56*	*54*	*55*	*49*
	Ratio	10%	24%	5%	26%	18%	22%

An analysis of Biotech completions reveals that the majority of completions are for the Certificate.

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Biotechnology Lab Spec - AAAS		2		4	3	2
Biotechnology Lab Spec -AAS-T	1	2				1
Biotechnology Lab Spec- Cert C	4	8	3	10	7	8
TOTAL	5	12	3	14	10	11

Waitlists and Fill Rates

There were no waitlist issues for the study period covered by this program review.

Fill rates are determined by comparing the number of students enrolled in a course during an academic year, with that course's capacity for the year. For this review, fill rates dating to 2013-14 were examined. Typically, classes that have consistently year-to-year low fill rates are flagged. No courses had consistently low fill rates year-over-year.

FACULTY

Biotech's chair fully participated in the program review. One associate faculty and one industry liaison occasionally participated. All participants were engaged, thoughtful, and had a good understanding of the needs of students and employers.

Biotech has one full-time faculty, five part-time faculty (each teaching one course per year), and a part-time industry liaison.

Faculty Workload

Historically, Biotech operates at lower student-to-faculty ratio than Shoreline's average Professional-Technical ratio. This is due to the extensive laboratory work required in the program.

Year	BIOTECH	PROF-TECH
AY 2013	1:8	1:13
AY 2014	1:10	1:13
AY 2015	1:7	1:12
AY 2016	1:10	1:13
AY 2017	1:8	1:13

Professional Development

Faculty report appreciating the 10-hour required training by Shoreline Community College. They report their professional development funds do not cover the cost of professional conferences. In addition, they would like additional pedagogical training.

One faculty member is going to an educator conference in Chicago for the first time (though this is funded by the NSF grant, not the college.

Resources

Biotech is an equipment-intensive program. Graduates of the program must be able to use equipment found in a wide variety of laboratories. The program uses NSF and Perkins grant funds to purchase equipment and receives some donations from industry.

The alumni and advisory committee surveys noted the extensive hands-on work this program provides. Some comments from the alumni survey indicated that the laboratory preparation offered at Shoreline greatly exceeds that available at four-year colleges and universities, including the University of Washington.

Faculty note that they need a new overhead projector. Their current one is quite old and is used every day, all day. They also could use a new flow cytometer – the existing one is old and not reliable. At the time of this writing, the incubators used for tissue culture are also failing. The Shoreline Biotech Program is unique in the State in offering a tissue culture class with hands-on facilities for all students in the course. The incubators are also used by the Biotech start-up renting space in the lab (Theripion) and are used for the summer camp outreach program.

Partnerships

Active Partners

The Biotech advisory committee has 20 core members and 10 rotating members representing the industry. Based on open-ended responses to the advisory committee survey, the majority of committee member respondents seemed engaged in the work of the committee and in Shoreline's program. Faculty also stipulated to this engagement.

The Shoreline School District has a new CTE director who is attempting to forge stronger connections between the school district and the college. The initial work has been focused on relationship building. Both sides look forward to moving forward with concrete results.

Program Updates

Faculty are considering the following updates to their program:

- Adding an afternoon block to increase accessibility for Associate Degree students. Since the majority of students in the AAAS program have morning and evening classes with large gaps of time in the afternoon.

- Updating planning guides so that AAAS students get some Biotech curriculum in first year to help persistence of AAAS students.

COMPETITION

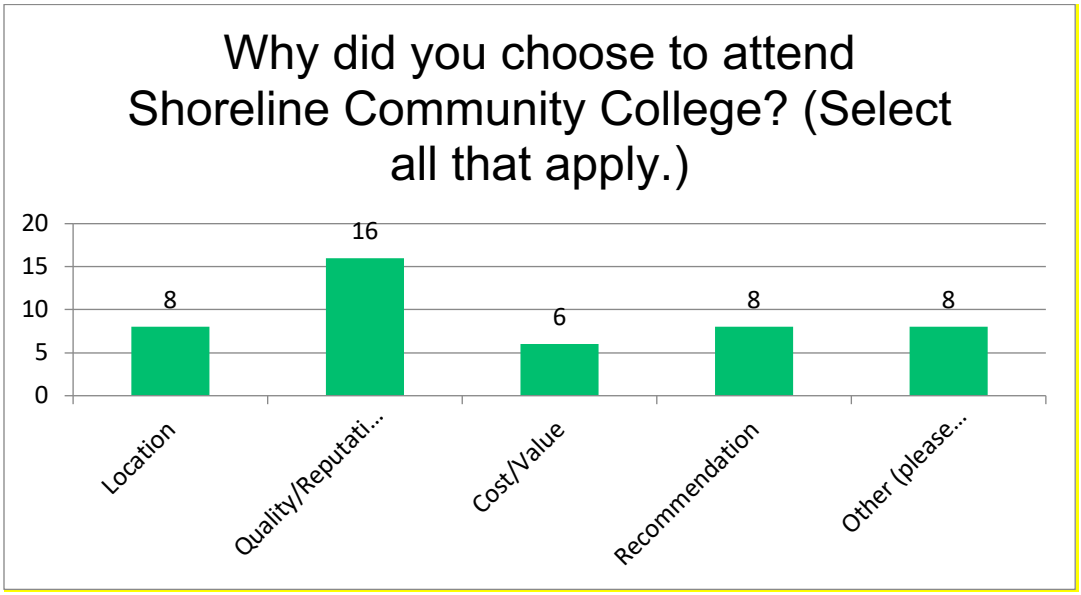
Shoreline's Biotech program does not have direct competitors in Washington State. Some Puget Sound schools offer a biology degree or biology courses, but none offer professional technical training or an AAAS in Biotechnology. Biotech is mature, nationally recognized, and more advanced than any of its peers.

In order to meet industry needs, the program will need to grow. Shoreline's program currently operates at about 16 FTE per year. Industry demand is much higher than what any one college could fill and eventually other community colleges will build programs to help meet this demand. A recent report commission by Cascadia College recommended that Bellevue, Lake Washington, Edmonds, Everett, and Cascadia add Biotech courses and programs. Shoreline should be working hard at this point to grow its market share while it can. Some concrete steps that could be considered include:

- Exploring opportunities to launch a Biotechnology biomanufacturing training program.
- Consider pursuing Career Path funding allocated in the latest state appropriation. This funding will allow Shoreline to build its pipeline of high school students interested in the program.
- Consider applying to become the Center of Excellence for Life Sciences. This designation by the State Board of Community and Technical Colleges allows an institution to serve as the hub between industry and colleges, helping other colleges achieve excellence in a particular industry.

To accomplish any of these objectives, Biotech faculty will need additional support. The demands of administering the NSF grant while also teaching and running a busy program has the lead faculty working at her limits.

Additional data regarding the quality of Shoreline's program can be found in the alumni and former student survey. A third of responses to a question about why students chose to attend Shoreline indicate that quality was a factor. Typically, Shoreline professional-technical students indicate they choose Shoreline because of location over other factors, such as quality.



LABOR MARKET OPPORTUNITIES

The following chart portrays the labor market for this program, based on data available from the State of Washington.

SOCTITLE	KING DD LIST	SNO DD LIST	2018 Jobs	2020	2022	% Change
Biological Technicians	Demand	Balanced	1,836	1,916	1,978	8%

The Biotechnology industry has rapidly grown over the past several years. The following table from the Employment Security Department's regional economist shows significant growth in the Biotechnology biomanufacturing industry and employment, providing support that a Biotech biomanufacturing program would be welcomed by industry.

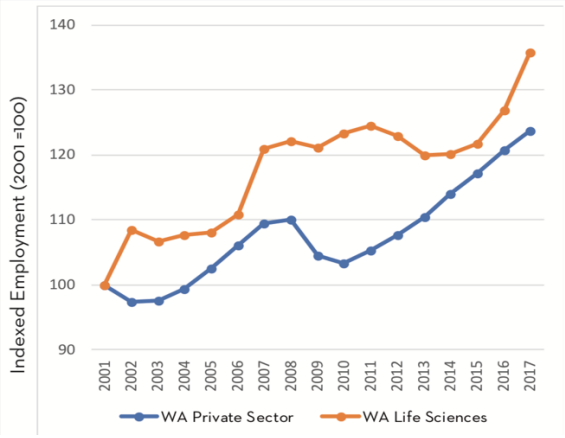
	2010				2017		
Industry Title	**count of establishments**	**avg employ-ment**	**avg wage**		**count of establishments**	**avg employ-ment**	**avg wage**
Pharmaceutical and medicine manufacturing	27	496	$76,392		62	1,030	$90,435
Navigational, measuring, medical and control instruments manufacturing	106	7,587	$85,911		143	8,056	$103,832
Total	132	8,083	$85,327		204	9,086	$102,313

Source: Employment Security Department/ LMEA, U.S. Bureau of Labor Statistics; Quarterly Census of Employment and Wages

Geography: King and Snohomish Counties

Manually screened for confidentiality. At the requested geographies and the 4-digit NAICS level, no suppressions were necessary.

Finally, Life Science Washington, an industry trade group, reports that life science employment in Washington State grew 13 percent between 2014 and 2017, outpacing private sector growth and providing a buffer during the past two recessions.



Life Sciences Washington, 2019