BIOTECHNOLOGY

Skilled Technical Workforce Needs Assessment

Spring 2021

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CENTERS OF EXCELLENCE
FOR LABOR MARKET RESEARCH

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Acknowledgments

Recently McKinsey expanded on several trends from 2021 with the strength to continue into a post-pandemic normal.[1] Their analysis asserts that the fight against COVID-19 caused a "bio-pharma revolution [that] accelerated the formation of partnerships, both public and private, and the development of manufacturing infrastructure to scale up production in the biopharma industry." Further, the "pandemic fundamentally changed the way the industry operates, and its reputation in the United States has improved markedly."

Through a collaboration between the California Community Colleges (CCC) Life Sciences/Biotechnology Initiative Task Force and the Centers of Excellence for Labor Market Research, this report is a response to the growing attention on biotechnology and focuses on a crucial but underappreciated science and engineering area: the Skilled Technical Workforce (STW). In the report to follow, the focus is on seven STW occupations considered middle-skill in that they require some college or training but not necessarily a four-year degree.

This report represents a multi-year effort to identify the opportunities and challenges facing students, incumbent workers, businesses, educators, and others involved with the STW. It offers recommendations for how community college educators can work together to foster STEM skills attainment, so that all Californians can participate in and benefit from advances in science and technology.

We welcome feedback on this report. If you have comments or questions, please contact the COE via email at info@coeccc.net.

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[1] McKinsey: Trends that will define 2021 and beyond: Six months on… https://www.mckinsey.com/industries/public-and-social-sector/our-insights/trends-that-will-define-2021-and-beyond-six-months-on?cid=eml-web. Accessed August 10, 2021.

Executive Summary

In collaboration with the California Community Colleges Life Sciences/Biotech Initiative, the Centers of Excellence for Labor Market Research has conducted a study of the biotechnology industry in California, assessing labor market demand for workers and the supply of students enrolled in biotechnology programs at community colleges as well as four-year colleges and universities.

Boasting more than 310,000 jobs across 12,000 business establishments, California has the largest biotechnology employment base in the nation. Industry projections forecast 8% growth in jobs through 2024, demonstrating that biotechnology jobs will continue to be in demand. Biotech occupations also pay well. In 2019, earnings for jobs in the biotechnology sector averaged $136,100 annually, which is $58,000 more than the average of all private sector industries.

This report examines seven entry-level biotechnology occupations that are complemented by community college training:

- Biological Technicians
- Chemical Technicians
- Food Science Technicians
- Inspectors, Testers, Sorters, Samplers, and Weighers
- Manufacturing Production Technicians
- Medical & Clinical Laboratory Technicians
- Quality Control Analysts

EXAMINED IN THIS REPORT

→ California's biotech industry landscape

→ State and regional employment for entry-level occupations

→ Community college and related higher education programs

→ Workforce preparation as aligned to employer needs

Considered part of the skilled technical workforce, these seven are considered middle-skill occupations in that they require some college or training but not necessarily a four-year degree. In 2019, these occupations employed 25,000 workers statewide and are projected to generate 2,500 job openings annually through 2024.

Two separate approaches (one liberal and one conservative) were applied to determine whether community colleges are meeting demand for biotech workers (six of the seven entry-level occupations). The liberal and conservative approaches provide high and low estimates of the number of students being prepared to enter these jobs and two measures of employer demand.

Conservative analysis — Based on occupational projections, the six entry-level biotech occupations are expected to yield 1,878 job openings each year. On average approximately 442 students completed a biotechnology award related to the entry-level occupations each year from a community college or a four-year college or university. As a result, an undersupply of 1,436 workers to fill these jobs may exist each year.

Liberal analysis — Due to intense employment pressures resulting from the pandemic, employers are reportedly hiring students before they reach graduation. As a result, the research team calculated the number of job-ready students (those who had completed some introductory coursework but had not yet received an award) and determined there are a total of 1,940 job-ready biotech students statewide. The research team also identified 8,240 job postings statewide associated with the six occupations and used this number as a second proxy for employer demand. The comparison of these two numbers indicates that an undersupply of as many as 6,223 biotechnology professionals annually may exist for the six entry-level occupations.

Medical and clinical laboratory technicians was analyzed separately as students must meet specific educational requirements to obtain state licensure. The analysis finds that there is a statewide undersupply of 570 qualified professionals since 663 job annual openings are projected for this occupation and on average, 70 students complete awards each year.

Additional findings

Regional employment — Biotech employment in the seven entry-level occupations is largely concentrated in three regions: the San Francisco Bay Region, the Los Angeles/Orange County Region, and the San Diego/Imperial Region. There is also a smaller but significant concentration of biotechnology employment in the South Central Coast Region.

Employment demand — Of the seven occupations, three have the most annual job openings: Medical and clinical laboratory technicians; inspectors, testers, sorters, samplers, and weighers; and biological technicians. Medical and clinical laboratory technician jobs are projected to grow 18% over the next five years and offer the most annual openings, a total of 663.

Worker and student demographics — Students enrolled in programs related to the seven entry-level occupations tend to be more racially and ethnically diverse than the current biotech workforce. A higher percentage of students are women compared to the biotech workforce overall. While a significant number of students are in their 20s, about 33% of biotechnology students are age 30 or older, and 40% of MLT students are age 30 or older.

Job postings — Job titles occurring the most frequently in online postings include laboratory technician, laboratory assistant, research associate, and test engineer. The most sought-after technical skills for the entry-level occupations are quality assurance and control, chemistry, and biology. The most common fundamental skills in job postings are communication, research, and detail oriented.

In-demand skills and certifications — The job posting analysis shows the most sought-after technical skills for the entry-level occupations are quality assurance and control, chemistry, and biology. The most common fundamental skills in job postings are communication, research, and detail oriented. The certifications requested most often in job postings are Certified Medical Laboratory Technician (MLT), Phlebotomy Certification, Clinical Laboratory Scientist (CLS), and American Society for Quality (ASQ) Certification.

Summary of recommendations

1. **Regional growth patterns differ** — Employment demand over the next five years for the Los Angeles/Orange County region is projected to be slight, only 2%, while employment contraction of 4% is projected for the South Central Coast region. By comparison, employment is projected to grow by 13% in the San Francisco Bay region and by 10% in the San Diego/Imperial region for the same seven occupations. Community colleges in these regions may wish to reassess program alignment with local employer needs and work with their advisory committees to review areas that may undergo weakened employment demand.

2. **Prioritize in-demand occupations** — Community colleges should continue to target pathways that feed into the three occupations with the largest number of projected job openings: medical and clinical laboratory technicians (663 annual openings); inspectors, testers, sorters, samplers, and weighers (663 annual openings); and biological technicians (571 annual openings).

3. **Focus on retraining and incumbent worker training** — The substantial proportion of biotechnology and MLT students who are age 30 or older indicates a training opportunity for community colleges as these individuals may be returning mid-career to retrain or upskill for biotechnology careers.

4. **Validate labor market demand locally** — There is growing evidence that, over the next several years, reaction to the COVID-19 pandemic will expand investment in the biotechnology industry, intensifying the need for more workers in the state. As such, it is possible that near-term employer demand is much greater than the occupational projections included in this report estimate. Community colleges may want to reach out to employer partners and industry stakeholders to confirm or adjust expectations for job growth or decline and rate of job vacancies in entry-level biotech occupations.

Introduction

The COVID-19 pandemic caused the global disruption of daily life and the economy, with the world turning to biotechnology to provide vaccines, testing, and treatments that would save lives and allow for the return to more normal operations, thus opening the door for a much-needed economic recovery.

The biotech industry immediately responded by quickly developing and manufacturing tests to detect the active virus and antibodies. The research and development (R&D) of vaccines and treatments quickly progressed into clinical trials followed by emergency approval of three vaccines and an extensive campaign to vaccinate the general public. The resulting mass manufacturing of test kits, vaccine, and treatments have helped fuel the creation of more entry-level jobs in biotech.

In addition, the intense attention toward and recognition of biotech's groundbreaking and life-changing scientific advancements have resulted in new venture capital investments to spur the creation of innovative new processes and technologies by biotech firms throughout the nation, with the highest investment in California.

The industry currently is and historically has been an important sector within California's economy. Over the past dozen years, the biotechnology industry has demonstrated that it is a strong and steady job generator, growing jobs at a pace well above the national average. In fact, the industry fared much better than the overall economy through the Great Recession and into the first few years of the recovery.[2]

Other indicators of the industry's critical role in the state's economy include:

- Nationally, California has the largest biotechnology employment base in the nation with more than 310,000 jobs across 12,000 business establishments.[3]
- Over $42 billion in life sciences/biotechnology-related venture capital investments were made in California between 2016 and 2019, which is nearly double the venture capital dollars invested in the next closest state (Massachusetts, $22.1 billion) during that period.[4]
- California's academic and research institutions received more National Institutes of Health (NIH) funding than any other state in 2019, close to $4.6 billion.[5]
- On average, earnings reported by California biotechnology employers averaged $136,100 annually, which is $58,000 more than the average earnings across all private sector industries.[6]

A primary reason for the resiliency of the biotechnology industry is the diverse set of markets it serves. These markets encompass medical and clinical diagnostics and treatments, including biomedical drugs and devices, as well as industrial products and processes in bio-remediation, bio-fuels, and bio-plastics. In addition, biotech is an important contributor to agriculture and food production, with new advances in the areas of cell-based meats, animal health, and crop protection.

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[2] **Impact of the COVID-19 pandemic on industry data:** Current industry employment numbers rely on 2019 data from the labor market analytics firm Emsi and precede the pandemic; as a result, it is not impacted. However, projected employment, including annual openings, are modeled on recorded (historical) employment figures and incorporate several underlying assumptions, including the assumption that the economy during the projection period will be at approximately full employment or potential output. At this time, it is not possible to quantify the economic impact of COVID-19 on projections of occupational employment.

[3] EMSI 2020.2

[4] "2020 California Economic Impact Report," Biocom, June 23, 2020, https://www.bio.org/sites/default/files/2020-06/BIO2020-report.pdf.

[5] *Ibid.*

[6] EMSI 2020.2

Biotech and the Community Colleges

In recognition of the important role of biotech in California's economy and the increased attention that is being directed toward the educational preparation of students entering this field, the Center of Excellence for Labor Market Research (COE) conducted a study to determine the scope of the biotech industry statewide and by region. This study examines employer demand for seven distinct entry-level occupations that contribute to the skilled technical workforce and that are considered middle skill, requiring some college or training but less than a four-year degree.

In-demand skills, education requirements, and certifications are identified in this report. A main objective of the study was to determine whether the programs that postsecondary institutions, particularly the community colleges, have created and launched are preparing enough students to satisfy employer demand in regions across California.

BIOTECH PATHWAYS & COMMUNITY COLLEGES

Biotech pathways reach from K-12 schools to the California Community Colleges (CCC) and beyond. These programs offer exciting opportunities for students that align with the Chancellor's Vision for Success goals. Community college biotechnology programs are part of a robust career pathway that begins with articulated high school programs and extends to community colleges through a series of stacked credentials, an associate degree, and seamlessly to a bachelor's degree and graduate degree. The pathway includes multiple entry and exit points as students can take time off to work at any point.

Once hired, employees in the biotechnology industry are encouraged by their companies to continue their education, and it is not uncommon for biotechnology companies to offer tuition reimbursement programs to their employees. Rather than giving individuals just a job, biotechnology allows them to initiate a career that allows trainees to advance as far as they want. And biotechnology offers a true pathway that provides opportunities for students from modest means to enter a high-tech field that offers high wages and opportunities for upward mobility.

Research Approach

The methodology used by the research team was to generate both labor market demand data and community college supply data so that the two could be compared to determine if California Community Colleges with related courses or programs are meeting the labor market demand for the seven entry-level biotech occupations that were identified for this study. Both state and regional data were considered for the analysis. The research team utilized multiple data sources and methods to gather the necessary data to assess the training gap between community college supply and workforce demand.

At a practical level, federal industry classifications do not provide for one overarching industry code that encompasses the biosciences. Instead, more than two dozen industries must be combined and grouped to best organize and track the industry in its primary activities. As a result, the North American Industry Classification System (NAICS) was used to drill down to industry subsectors most associated with biotechnology. Since the NAICS

codes represent industry employment across scientific and non-scientific staff at all levels, it was necessary to narrow the occupations to those relevant for career education programs at community colleges.

In addition, the Standard Occupational Classification (SOC) System was used to identify and track current employment and projected demand for the seven occupations using data from the labor market analytics firm Emsi, including analysis of current worker demographics. Analysis of employer requirements for worker skills, education, and certifications was conducted using real-time job posting data through Burning Glass Labor Insight. The research team employed a supply-and-demand approach to approximate the available labor force being prepared by community colleges and four-year colleges and universities and employer needs for the skilled technical biotechnology workforce.

The postsecondary supply of students prepared to enter the workforce was determined using several data sources: the California Community College Chancellor's Office Data Mart, Launchboard, Integrated Postsecondary Education Data System (IPEDS), and the CCC Curriculum Inventory. The California Community Colleges Life Sciences/Biotech Sector team provided supplemental data as well. Please refer to Appendix A for more details on this study's methodology.

Industry Overview

The biotechnology industry is best understood as a group of diverse subsectors with a common link—the application of biological scientific knowledge. Biotechnology harnesses cellular and biomolecular processes to develop technologies and products that have many applications. Biotech can be applied to combatting debilitating and often rare diseases. Other biotechnology processes can reduce our environmental footprint, improve food production, and make industrial manufacturing processes safer, cleaner, and more efficient.

The industry can be broken into five subsectors. These subsectors are defined by the TEConomy/BIO State Initiatives as:

- **Agricultural feedstock and industrial biosciences** — Firms engaged in agricultural production and processing, organic chemical manufacturing and fertilizer manufacturing. The subsector includes industry activity in the production of ethanol and other biofuels.
- **Bioscience-related distribution** — Firms that coordinate the delivery of bioscience-related products including pharmaceuticals, biotherapeutics and medical devices.
- **Drugs and pharmaceuticals** — Firms that develop and produce biological and medicinal products and manufacture pharmaceuticals, biotherapeutics and diagnostics.
- **Medical devices and equipment** — Firms that develop and manufacture surgical and medical instruments and supplies, laboratory equipment, electromedical apparatus including MRI and ultrasound equipment, dental equipment and supplies.
- **Research, testing, and medical laboratories** — Firms engaged in research and development in biotechnology and other life sciences, life science testing laboratories and medical laboratories. Includes contract and clinical R&D organizations.[7]

Industry Outlook

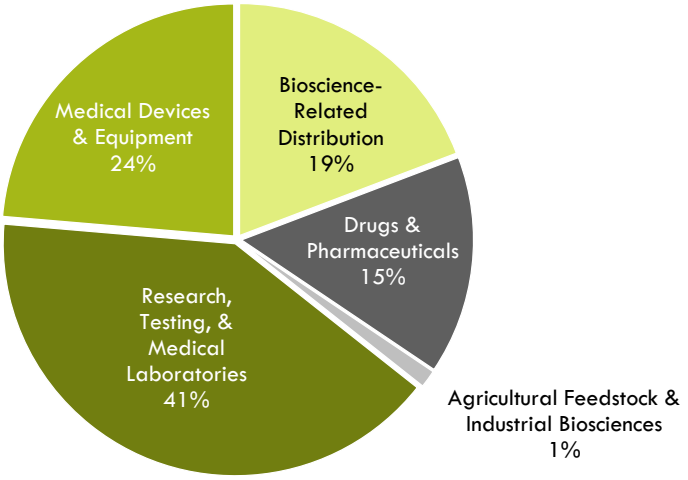
Exhibit 1 shows the five biotech subsectors by 2019 employment in California.[8] As the largest biotechnology subsector, research, testing, and medical laboratories accounts for 41% of all biotechnology industry employment. This largest biotechnology subsector reported 126,500 jobs in 2019, representing 19.4% of the national employment. The second largest subsector is medical devices and equipment, 24% of employment, followed by bioscience-related distribution at 19%.

An analysis of historical and projected biotechnology industry employment in California shows that from 2009 to 2019 employment in the industry increased more than 29%. Comparatively, employment across all industries in California increased 19% over the same period. Looking forward to 2024, employment in the biotechnology industry is projected to increase by about 8%, demonstrating steady growth but at a slower pace than in previous years. In comparison, employment across all industries is projected to increase by 6% through 2024, which is approximately 2% slower than the biotechnology industry.

[7] Ibid.

[8] **Impact of the COVID-19 pandemic on occupational data:** Employment numbers from the labor market analytics firm Emsi predate the COVID-19 pandemic. Projected employment, including annual openings, are modeled on recorded (historical) employment figures and incorporate several underlying assumptions, including the assumption that the economy during the projection period will be at approximately full employment or potential output.

Exhibit 1. Biotechnology subsectors by percent of employment



LOOKING BACK

In just the past five years, the biotech industry in California reported:

→ Growth of 67,500 jobs, with the majority in Research, Testing & Medical Laboratories (+45,200),

→ Growth of 3,300 businesses, and

→ An increase in annual earnings of $14,100 while average earnings across all industries decreased by $5,000.

Exhibit 2. Historical and projected percentage change in biotech industry employment, 2009-2024

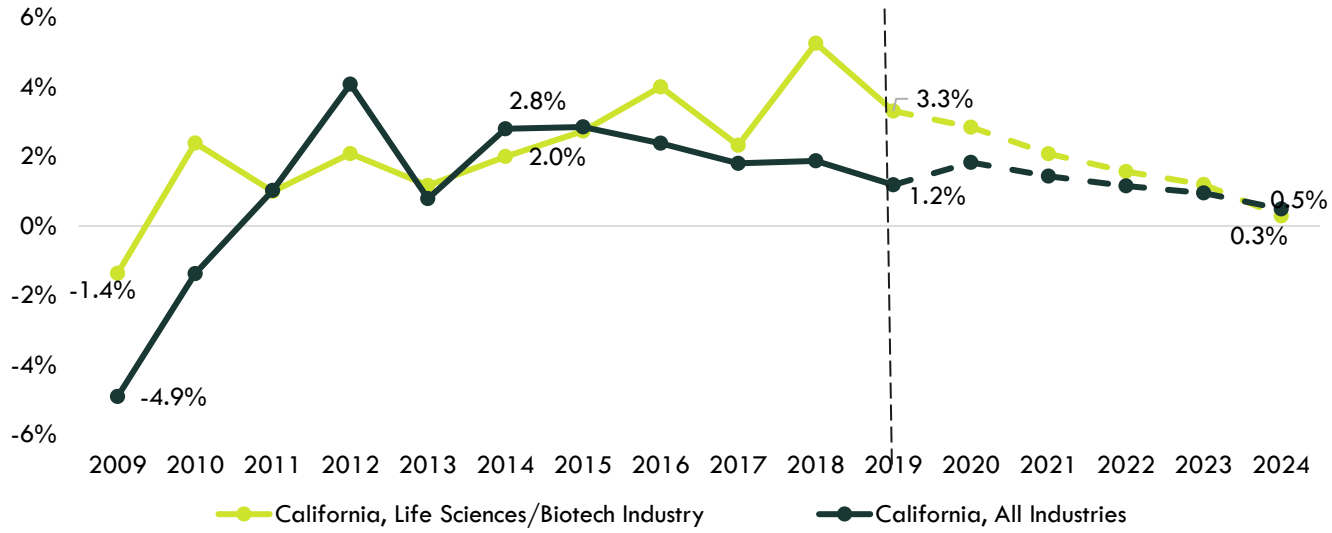


Exhibit 2 shows the annual percentage change in employment for the biotechnology industry and all industries in California. Between 2019 and 2024, biotechnology employment is projected to increase each year, but at a progressively slower rate, following a similar trend for all industries in California.

Looking forward, biotechnology firms are projected to add nearly 25,500 jobs statewide through 2024, representing a growth rate of 8% (Exhibit 3). Collectively, California is projected to add more than 3 million jobs, with a growth rate of 6% across all industries.

Exhibit 3. Outlook for biotechnology industry employment in California

Industry	2019 Jobs	2024 Jobs	Change	% Change
Life Sciences/Biotechnology	310,830	336,221	25,491	8%
All Industries	20,003,848	21,096,625	3,153,386	6%

Industry Employment by Region

Within California, there are three geographic regions where the biotechnology industry is concentrated and economically significant: the San Francisco Bay Region, the Los Angeles/Orange County Region, and the San Diego/Imperial Region.

Nearly two-thirds of California's biotechnology firms and more than 80% of the state's biotech professionals work in these regions (Exhibit 4). The San Francisco Bay Region alone is home to 25% of the firms in the industry and the greatest share of biotech jobs at more than 111,500. The Los Angeles/Orange County Region accounts for the largest concentration of firms at 28% or close to 3,400.

Exhibit 4. Number of biotechnology firms and employees by region, 2019

Region	2019 Firms	% of Firms	2019 Jobs	% of Jobs
San Francisco Bay	2,973	25%	111,527	36%
Los Angeles/Orange County	3,398	28%	88,288	28%
San Diego/Imperial	1,567	13%	53,195	17%
County Not Reported	*1,952*	*16%*	*17,255*	*6%*
South Central Coast	664	6%	14,171	5%
Inland Empire/Desert	585	5%	10,538	3%
North/Far North	464	4%	9,425	3%
Central Valley/Mother Lode	405	3%	6,378	2%
TOTAL	**12,009**		**310,830**	

The largest three regions are also expected to continue to lead California's biotech industry employment. Between 2019 and 2024, biotech industry employment in the three regions is projected to increase annually by 9% (Exhibit 5). Employment in the San Francisco Bay and San Diego/Imperial regions is projected to grow by 11% - potentially adding more than 18,000 jobs, while employment in the Los Angeles/Orange County Region is projected to grow at a slower overall rate of 4% resulting in as many as 4,000 new jobs.

While the regions mentioned above represent the bulk of biotechnology activity in the state, it is also important to consider the growing number of firms and employment in the remaining four regions.

- Through 2024, industry employment is projected to increase by 14% in the Central Valley/Mother Lode Region, which is the fastest growth rate across all seven regions and represents the addition of 896 jobs. In the North/Far North Region, 8% growth represents as many as 800 new jobs.
- However, biotechnology industry employment is projected to contract by 5% in the Inland Empire/Desert Region, a potential contraction of 568 jobs, and by 3% or 442 jobs in the South Central Coast Region.

Importantly, there are almost 2,000 biotechnology firms accounting for more than 17,000 jobs that fall into a "county not reported" category. Jobs in this category represent employers who have multiple establishments within the state, but report all those establishments in aggregate, without geographical distinctions.[9]

[9] "Glossary: County not reported," Emsi, accessed May 3, 2021, https://kb.economicmodeling.com/glossary/county-not-reported/.

Exhibit 5. Five-year outlook for biotechnology industry employment by region

Region	2019 Jobs	2024 Jobs	Change	% Change
San Francisco Bay	111,527	124,039	12,512	11%
Los Angeles/Orange County	88,292	92,065	3,773	4%
San Diego/Imperial	53,203	58,800	5,597	11%
South Central Coast	14,171	13,729	(442)	(3%)
Inland Empire/Desert	10,545	9,977	(568)	(5%)
North/Far North	9,434	10,230	796	8%
Central Valley/Mother Lode	6,381	7,277	896	14%
Total	293,553	316,117	22,564	8%

Key Takeaways

- Over the next five years, biotech employment is expected to grow at a faster rate (8%) than overall employment in California (2%).
- In 2019, the biotech industry accounted for about 311,000 jobs, and as many as 25,500 jobs are projected to be added through 2024.
- The San Francisco Bay Region leads the state with the most biotech jobs (about 111,500), followed by the Los Angeles/Orange County Region with more than 88,000 jobs.
- Several other regions have strong projected employment growth: Central Valley/Mother Lode, 14%; San Francisco Bay, 11%; and San Diego/Imperial, 11%. These regions are projected to add a substantial number of jobs through 2024.

Occupational Landscape

Using the Standard Occupational Classification (SOC) codes, 20 occupations related to the biotechnology industry were identified. From that group of 20, two subgroups were created. Seven (7) entry-level biotechnology occupations were selected for this study (Exhibit 6) as they met the COE definition for middle skill occupations and are complemented by training programs offered through community colleges.[10] The remaining 13 occupations were categorized as pathway occupations as they typically require a bachelor's degree or higher.

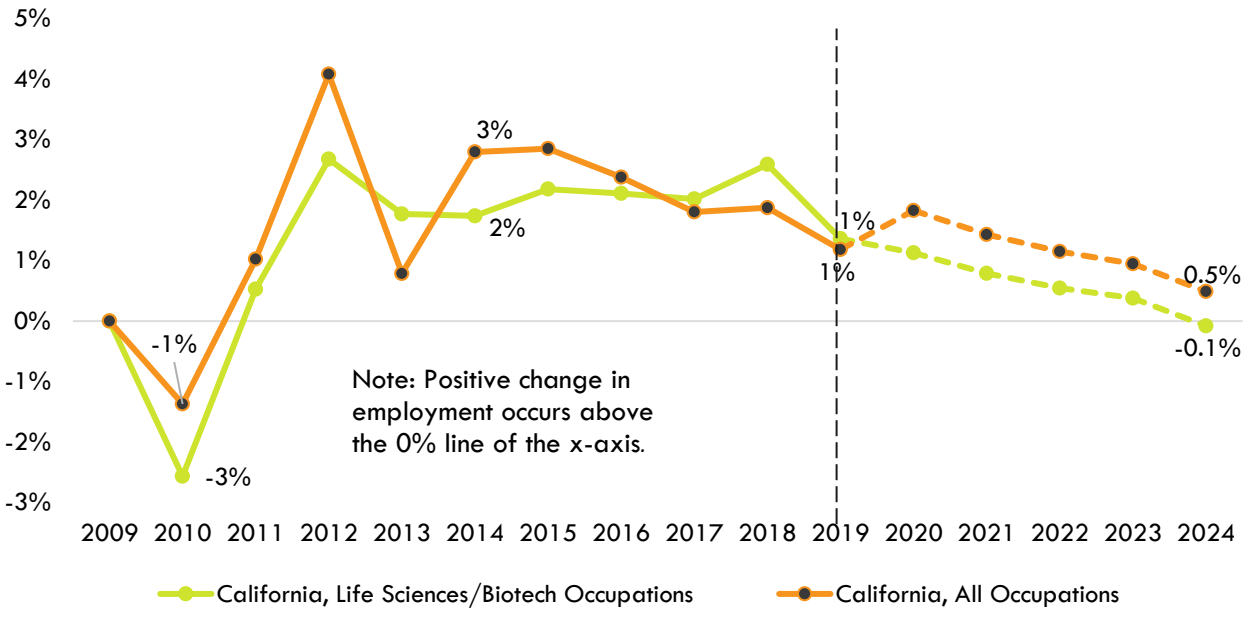
In 2019, employment in the seven entry-level occupations comprised more than 30% of the combined employment for all 20 biotech occupations (Exhibit 6).[11] Both entry-level and pathway occupations are expected to grow at a rate significantly faster than the state average, with entry-level occupations increasing 8% and pathway occupations expected to grow by 9%.

Exhibit 6. Current employment, projected growth, and median hourly wages for biotechnology occupations

Metric	Entry-level Occupations	Pathway Occupations
2019 Employment	21,478	45,173
5-year Projected Growth	8%	9%
Median Hourly Wage	$24	$46
Annual Projected Openings	2,540	4,925

Exhibit 7 compares the historical and projected group of 20 biotechnology occupations compared to all occupations. Between 2011 and 2019, biotech employment grew at an average rate of 2% annually. Between 2019 and 2024, employment in the 20 biotech occupations is projected to increase, but at a progressively slower rate each year, which follows the projected trend for all occupations in California.

Exhibit 7. Historical and projected percentage change in occupational employment, 2009-2024



[10] The COE classifies middle-skill jobs as: a) occupations that require an education level of some college, an associate degree, or an apprenticeship; b) occupations that require a bachelor's degree, but in which more than one-third of the existing labor force has an educational attainment of some college or associate degree; or c) occupations that require a high school diploma or equivalent or no formal education, but also require short- to long-term on-the-job training where multiple community colleges offer existing programs.

[11] Impact of the COVID-19 pandemic on occupational data: Current employment numbers (2019) precede the pandemic and not impacted. However, projected employment, including annual openings, are modeled on recorded (historical) employment figures and incorporate several underlying assumptions, and may incorporate some of the pandemic impact but not all.

Entry-level Occupations

As stated previously, from the group of 20 biotechnology occupations, seven entry-level occupations were selected for this study (listed in Exhibit 8). These seven occupations are considered part of the skilled technical workforce, met the COE definition for middle skill occupations, and are complemented by training programs offered through community colleges.

It is important to note that on average 20% of students entering community college biotech programs in California already hold a bachelor's degree and, presumably, are entering these programs to obtain skills to increase employability. Many biotech employers consider a bachelor's degree a minimum requirement for most entry-level positions; however, according to findings gathered by the Life Sciences/Biotech Sector team, an increasing number of employers are open to accepting an associate degree for entry-level jobs.

Exhibit 8. Entry-level biotechnology occupations

Entry-level Occupations
• Biological Technicians
• Chemical Technicians
• Food Science Technicians
• Inspectors, Testers, Sorters, Samplers, and Weighers
• Manufacturing Production Technicians
• Medical & Clinical Laboratory Technicians
• Quality Control Analysts

Entry-level Occupations	
2019 Employment:	**21,478 jobs**
2024 Outlook:	**8% projected growth**
Median Wage:	**$24/hour**
Annual Demand:	**2,540 openings**

The current number of workers employed in the entry-level occupations group comprise over 30% of the employment for all 20 biotech occupations identified by the study. Both entry-level and pathway occupations are projected to grow at a rate significantly faster than the state average, with entry-level occupations increasing 8% over the next five years.

For data analysis purposes, several entry-level occupations included in this report are embedded into hybrid occupations that incorporate more than one SOC code; as a result, employment and occupational projections may be overstated.[12] These hybrid occupations are due to changes in how certain occupations are categorized in the SOC code.

The remaining 13 occupations are grouped as pathway occupations because they require a bachelor's degree or higher. Pathway occupations are important because on average, nearly 20% of students enrolled in community college biotech programs have a bachelor's degree or higher and have returned to acquire additional skills.[13]

Outlook for Entry-Level Occupations

Exhibit 9 shows the current and projected employment for the seven entry-level occupations. Through 2024, with a growth rate of 8%, 12,700 job openings are projected for the seven occupations (an average of 2,540 job openings annually).

The largest occupation in the entry-level group is medical and clinical laboratory technicians with more than 6,250 jobs in 2019. This occupation has strong projected growth of 18% and is expected to generate 663 annual job openings. However, as noted earlier, the data for medical and clinical laboratory technicians also includes data for medical and clinical laboratory technologists; therefore, due to the overlap between these two occupations, the number of annual openings is overstated for this entry-level occupation.[14]

The second largest occupation — inspectors, testers, sorters, and weighers — is projected to contract by 4% over the next five years but will likely still generate as many as 660 annual openings due to replacement needs.

[12] For more information, see the Bureau of Labor Statistics website: https://www.bls.gov/oes/oes_ques.htm.
[13] The Methodology and Definitions section contains descriptions for the seven entry-level occupations and lists the 13 pathway occupations.
[14] To be employed as a medical and clinical laboratory technologist, a bachelor's degree is typically required. As a result, the employment data reported for this occupation (Medical and Clinical Laboratory Technicians) represents jobs requiring two degree levels.

Following closely with 10% projected growth in new jobs and replacements of about 480 annually, the number of annual openings for biological technicians through 2024 could exceed 570.

Exhibit 9. Current employment and projected demand for entry-level biotech occupations (2019-2024)

Occupation (SOC Code)	2019 Employment	% 5-yr Change	5-yr Change	5-yr Replacements	5-yr Openings	Annual Openings
Medical and Clinical Laboratory Technicians (29-2012)	6,254	18%	1,096	2,220	3,316	663
Inspectors, Testers, Sorters, Samplers, & Weighers (51-9061)	5,389	(4%)	(228)	3,314	3,314	663
Biological Technicians (19-4021)	4,557	10%	461	2,393	2,854	571
Chemical Technicians (19-4031)	1,978	7%	131	989	1,120	224
Manufacturing Production Technicians (17-3029.09)	1,609	8%	133	780	914	183
Quality Control Analysts (19-4099.01)	1,158	10%	119	689	809	162
Food Science Technicians (19-4011.02)	532	10%	52	322	374	75
TOTAL	**21,478**	**8%**	**1,764**	**10,708**	**12,700**	**2,540**

Occupational Employment by Region

Combined, the annual openings for the San Francisco Bay, Los Angeles/Orange County, and San Diego/Imperial regions represent 86% (2,182) of the total annual openings (2,540) for the entry-level occupations across the state. When each region is considered separately, the San Francisco Bay region is projected to have the highest need — 975 annual job openings for the group of entry-level occupations over the study period, the largest number across all regions (Exhibit 10).

The Los Angeles/Orange region is expected to add about 170 openings due to new jobs and account for more than 2,900 replacement openings – a total of 3,200 openings over the period or 640 openings annually. The San Diego/Imperial Region is projected to add more than 500 new jobs and replace workers in about 2,320 positions – averaging as many as 570 openings annually. Exhibit 11 compares three regions in the state with the most employment in the seven entry-level occupations.

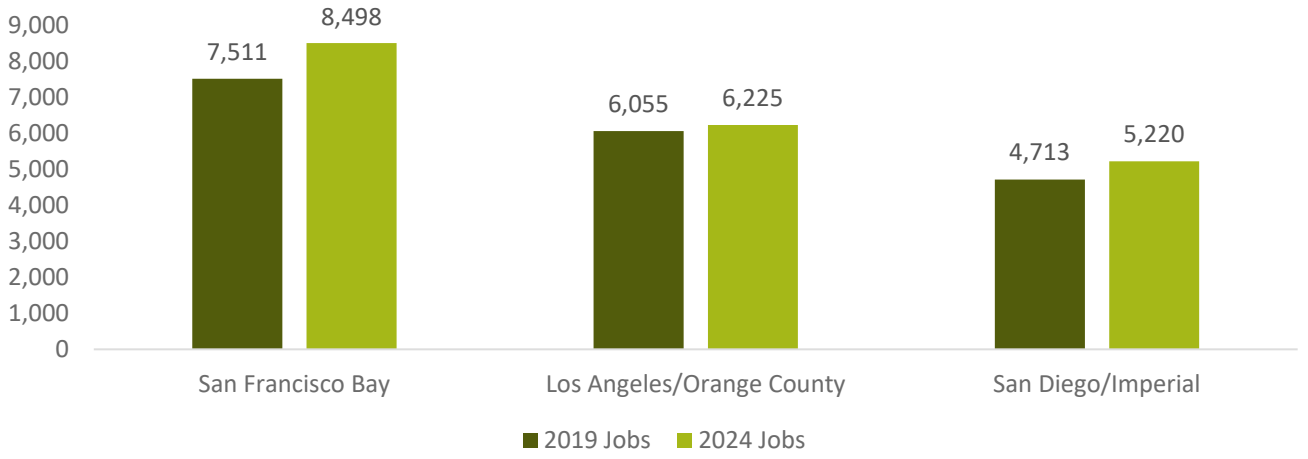
Exhibit 10. Employment outlook by region for the seven entry-level occupations (2019-2024)

Region	2019 Employment	% Change	Change	Replacements	Openings	Annual Openings
San Francisco Bay	7,511	13%	987	3,833	4,877	975
Los Angeles/Orange County	6,055	2%	170	2,938	3,197	639
San Diego/Imperial	4,713	10%	507	2,322	2,838	568
South Central Coast	1,015	(4%)	(58)	505	541	108
North/Far North	635	7%	47	314	361	72
Inland Empire/Desert	521	(3%)	(29)	269	285	57
Central Valley/Mother Lode	487	8%	48	233	281	56
TOTAL[15]	**20,937**		**1,670**	**10,414**	**12,379**	**2,476**

[15] Totals shown in Exhibits 9 and 10 may not match. Occupational employment shown in Exhibit 9 represents all 58 counties in California as well as the "county not reported." Exhibit 10 totals represent only the counties as defined by the regions and not the "county not reported."

Of the remaining four regions, the South Central Coast is home to the largest number of workers in the entry-level occupation group. Though employment is projected to decline slightly in the South Central Coast region, replacements are still expected to exceed 500 openings over the period, an annual average of 108 openings.

Exhibit 11. Entry-level employment outlook for regions in California with the most employment



Source: Emsi 2020.2

Occupational Wages

Exhibit 12 shows wage data for each of the entry-level occupations in California.

- The occupation with the highest hourly wage range (entry-level, median, and experienced wages) is **manufacturing production technicians** which ranges from $25.43 to $42.57 hourly.
- **Inspectors, testers, sorters, samplers, and weighers** has the lowest entry-level and median wages, $14.89 and $19.41, respectively.
- **Food science technicians** has the lowest experienced wage ($25.66).

Wage Progression

→An analysis of wage data from 2016 through 2019 shows that median wages increased approximately 6% over recent years.

→At 2% cumulative per year, this amounts to a 10% aggregate increase over a five-year period for the entry-level occupations.

→Median wages for **biological technicians** declined by 3% and wage levels for **chemical technicians** remained flat.

All seven occupations record entry-level wages above the California Family Needs Calculator self-sufficiency standard wage, commonly referred to as a living wage, of $13.04 for one single adult in California in 2020. This living wage "measures the minimum income necessary to cover all of a non-elderly (under 65 years old) and non-disabled individual or family's basic expenses — housing, food, childcare, health care, transportation, and taxes— without public or private assistance." While the living wage for one single adult across all counties in California for 2020 is $13.04, there are significant variations across family sizes and regions.[16]

[16] "Family Needs Calculator," Insight Center, 2021. Additional living wage information included in the Methodology and Definitions section.

Exhibit 12. Wages for the seven entry-level occupations in California[17]

Occupation (SOC)	Entry-Level Earnings	Median Earnings	Experienced Earnings
Manufacturing Production Technicians (17-3029.09)	$25.43	$33.56	$42.57
Quality Control Analysts (19-4099.01)	$19.65	$25.61	$33.07
Medical and Clinical Laboratory Technicians (29-2012)	$19.52	$26.69	$37.44
Biological Technicians (19-4021)	$19.21	$24.09	$30.15
Chemical Technicians (19-4031)	$16.39	$21.32	$28.34
Food Science Technicians (19-4011.02)	$16.22	$20.67	$25.66
Inspectors, Testers, Sorters, Samplers, and Weighers (51-9061)	$14.89	$19.41	$27.02

While the data included in Exhibit 12 reflects statewide wages, there is significant variation in wages for these occupations across California. The San Francisco Bay Region has the highest median wages for three of the seven entry-level occupations: (biological technicians, quality control analysts, and inspectors, testers, sorters, samplers, and weighers).

The North/Far North Region has the highest median wages for two occupations (food science technicians, and medical and clinical laboratory technicians). The South Central Coast Region has the highest median wage for manufacturing production technicians, and the Inland Empire has the highest median wage for chemical technicians ($23.20).

Key takeaways

- The seven entry-level biotech occupations totaled close to 21,500 jobs in 2019. With 8% projected growth, demand for these occupations could exceed 2,500 annual openings statewide.
- The three occupations with the most annual job openings in California are medical and clinical laboratory technicians; inspectors, testers, sorters, samplers, and weighers; and biological technicians.
- Employment for the seven occupations is concentrated in the San Francisco Bay Area, the Los Angeles/Orange County Region, and the San Diego/Imperial Region.
- The highest entry-level wage is earned by manufacturing production technicians, $25.43 per hour. The remaining six occupations have entry-level wages between $14 and $20 per hour.

[17] Wage data at the 25th and 75th percentile is used here as a proxy for entry-level and experienced earnings. EMSI 2020.2.

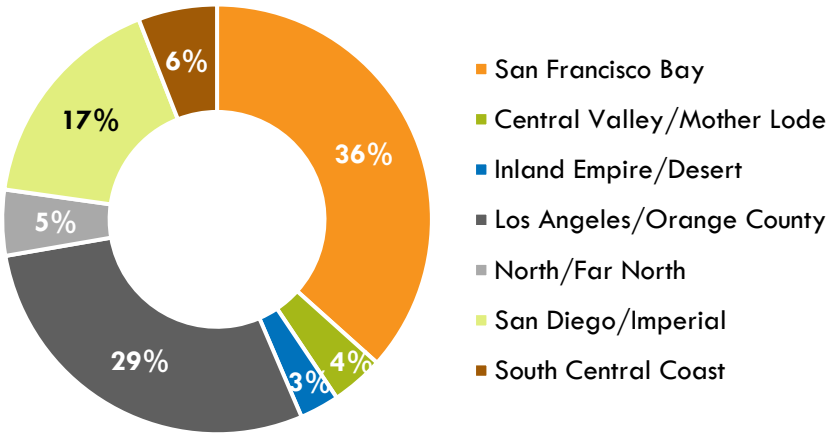
Current Workforce: Employer Demand in Job Postings

Online job postings can provide valuable insights into employer demand for specific jobs and skill sets. Using Burning Glass' Labor Insight Real-Time Labor Market Information Tool, job posting data was compiled for the seven entry-level biotech occupations to examine top job titles, skills, certifications, education requirements, and employers.[18] A total of 11,322 job postings in California for the 2019 calendar year were analyzed.[19] Exhibit 17 shows the distribution of these job postings across California regions.

- With 4,264 job postings in the San Francisco Bay Region and 3,362 job postings in the Los Angeles/Orange County Regions, these two regions combined account for 66% of all online job advertisements during the study period (2019).
- There were 1,939 postings in the San Diego/Imperial Region, and 530 in the South Central Coast Region.

While job postings offer an excellent perspective into evolving employer needs, as a direct measure of demand for specific occupations these data should be used with caution. Unlike occupational projection estimates that are developed using historical employment patterns, employer surveys, population data and other employment indicators, 'job posting demand' is typically measured as the count of job postings during a given study period. These data are subject to variability by collection methods, employer intentions and other issues.

Exhibit 17. Percent of job postings by region



Entry-level biotech occupations

Medical and clinical laboratory technicians had the most job postings, a total of 4,733 (Exhibit 18). Inspectors, testers, sorters, samplers, and weighers was mentioned in the second highest number of postings, 1,959, and quality control analysts occurred in 1,757 job postings.

[18] Job posting totals may be over- or under-inflated for a variety of reasons; these include an employer posting more than one job ad for the same position, using one job posting for multiple openings or for year-round recruitment purposes, or misleading ads that do not represent actual available positions.

[19] For more information on the selection process and criteria utilized, refer to the methodology discussed in Appendix A. Appendix E provides additional job posting data. All job posting data courtesy of "Labor Insight™ Real-Time Labor Market Information Tool." http://www.burning-glass.com. 2021. **Impact of the COVID-19 pandemic on job posting data:** Data in this section is not impacted. The study analysis relied on 2019 data from Burning Glass which precedes the pandemic.

Exhibit 18. Number of job postings by occupation, 2019 (n=11,322)

O*NET Code	Occupation	Number of Job Postings
29-2012.00	Medical and Clinical Laboratory Technicians	4,733
51-9061.00	Inspectors, Testers, Sorters, Samplers, and Weighers	1,959
19-4099.01	Quality Control Analysts	1,757
19-4021.00	Biological Technicians	1,337
17-3029.09	Manufacturing Production Technicians	851
19-4031.00	Chemical Technicians	669
19-4011.02	Food Science Technicians	26
TOTAL		**11,322**

Common job titles

An analysis of job titles shows how employers commonly refer to the positions they are seeking to fill. Out of 11,322 job postings, the most common job title in job postings was laboratory technician which was listed in 805 job postings, followed by laboratory assistant in 399 job postings, and research associate in 325 job postings. The top five most common job titles account for approximately 15% of all postings studied.

Exhibit 19. Top job titles in job postings, 2019 (n=11,322)

Job Title	Number of Job Postings
Laboratory Technician	805
Laboratory Assistant	399
Research Associate	325
Test Engineer	134
Quality Assurance Specialist	129
TOTAL	**1,729**

In-demand skills

The technical skill most frequently requested in job postings for the entry-level biotech occupations was quality assurance and control in 4,043 job postings, followed by chemistry in 2,402 job postings, and biology in 1,941 job postings (Exhibit 16). Regarding fundamental skills, which are also known as soft skills or baselines skills, the most frequently listed were communication skills in 4,599 job postings, research in 3,416 job postings, and detail-oriented in 3,084 job postings (Exhibits 20 and 21).

Exhibit 20. Top technical skills in job postings, 2019 (n=11,322)

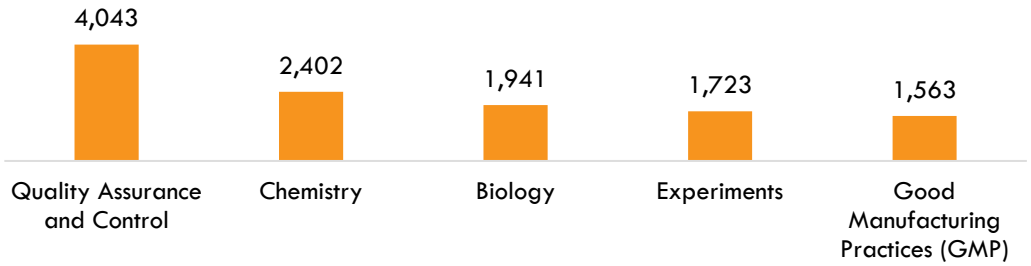
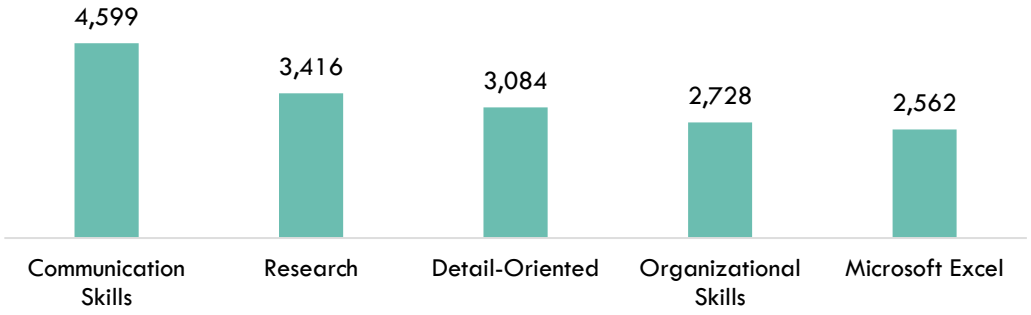


Exhibit 21. Top fundamental skills in job postings, 2019 (n=11,322)



Minimum education

Regarding minimum education requirements in job postings, 39% of employers requested a bachelor's degree as the minimum education required for the entry-level biotech occupations. Another 26% of posted jobs requested a high school degree or vocational training (Exhibit 22). Another 8% listed an associate degree, and 2% requested a graduate or professional degree. About one-fourth of the postings did not have an educational requirement.

Exhibit 22. Minimum education required in job postings, 2019 (n=11,322)

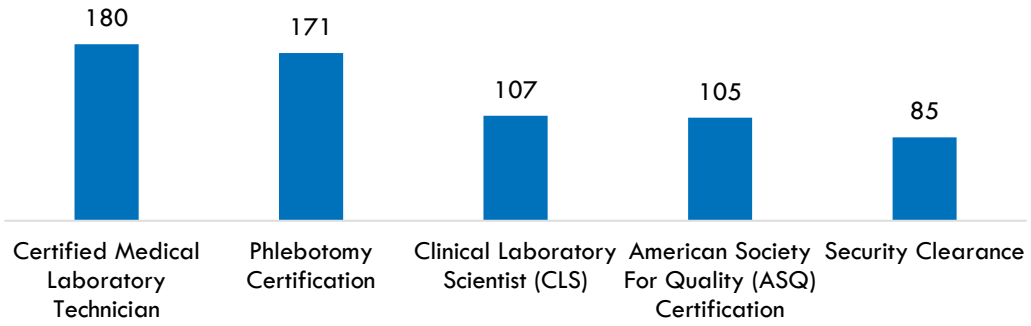
Education Level	% of Job Postings
Bachelor's Degree	39%
High School or Vocational Training	26%
Unspecified	25%
Associate Degree	8%
Graduate or Professional Degree	2%

Top certifications

Exhibit 23 shows the results of the "top certifications" data pull, based on the selection criteria. This perspective provides insight into the certifications that appear the most often in job postings related to the entry-level biotech occupations in California. However, some job postings requested more than one certification and some certifications identified are not necessarily certifications as much as employer standards to meet, such as requiring applicants to undergo a "security clearance."

Although certification numbers were relatively low in job postings, three areas do emerge in the data that apply to in-demand certifications requested for the seven entry-level occupations: Certified Medical Laboratory Technician, Phlebotomy Technician, and American Society for Quality (ASQ) Certification.

Exhibit 23. Top certifications in job postings, 2019 (n=9,719)



Industry and employer landscape

As shown in Exhibit 24, scientific research and development services leads with the most job postings, accounting for 43% of all postings identified (4,882 postings). Employment services follows with 1,793 postings. With 1,735 job postings, colleges, universities, and professional schools comprise the third top industry with the most postings for the entry-level life sciences occupations.

Exhibit 24. Job postings by 4-digit NAICS industry, 2019 (n=11,322)

NAICS	Industry Name	Number of Job Postings
5417	Scientific Research and Development Services	4,882
5613	Employment Services	1,793
6113	Colleges, Universities, and Professional Schools	1,753
3254	Pharmaceutical and Medicine Manufacturing	1,433
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	718
6215	Medical and Diagnostic Laboratories	558
3391	Medical Equipment and Supplies Manufacturing	195

Employers that advertised the most positions for the entry-level biotech occupations in 2019 were:

- University California, 928 job ads
- Gilead Sciences, 192 job ads
- Grifols, 133 job ads
- Danaher Corporation, 122 job ads
- Abbott Laboratories, 111 job ads

Higher Education Employers

As revealed by the industry and top employer job posting analysis, a large proportion of job postings for the entry-level occupations originate from colleges, universities, and professional schools. Higher education employment was not included in this study's industry definition but is a key employer for entry-level biotech occupations — in many cases, providing a direct pathway from degree program to employment.

Among job postings from universities and research institutions, common job titles are for laboratory assistants and laboratory technicians at various levels (Exhibit 21). Employers occurring most frequently in job postings are the University of California, University of Southern California, and the University of California Davis.

Exhibit 25. Top job titles and top employers with most job postings for research universities and institutions

Top Job Titles	Number of Job Postings
Laboratory Technician	805
Laboratory Assistant	399
Research Associate	325
Test Engineer	134
Quality Assurance Specialist	129

Top Employers	Number of Job Postings
University of California	928
University of Southern California	87
University of California Davis	60
UCLA Health	50
California State University	31

Key takeaways

- In the job posting analysis, the most common occupational titles were medical and clinical laboratory technicians; inspectors, testers, sorters, samplers, and weighers; and quality control analysts. Common job titles included laboratory technician, laboratory assistant, and research associate.
- Quality assurance and control, chemistry, and biology were the most sought technical skills in job postings for the entry-level biotech occupations. Communication, research, and detail oriented were the most common fundamental skills.
- Nearly 40% of job postings request a bachelor's degree, while 26% request a high school diploma, and just 8% specifically mention an associate degree. The most commonly requested certification is Certified Medical Laboratory Technician, which was mentioned in 180 job postings.

Future Workforce: Community College Programs and Awards

This section of the report provides an analysis of biotechnology programs offered by the California Community Colleges (CCCs) that confer bachelor's degrees, associate degrees, and certificates.[20] The four program areas selected for study are those that most closely prepare students for employment in the seven entry-level biotech occupations discussed in this report:

- 0430.00 Biotechnology and Biomedical Technology
- 0954.00 Chemical Technology
- 0955.00 Laboratory Science Technology
- 1205.00 Medical Laboratory Technology (MLT)

Organization of Analysis
The first three programs are directly related to preparing students to enter biotech jobs and are discussed separately from medical laboratory technology (MLT) programs due to differing employment requirements. MLT students must pass a state licensing exam to obtain employment as medical and clinical laboratory technicians. Only students with an associate degree or who have completed 60 semester or equivalent quarter units in chemical, physical, biological, or clinical laboratory sciences are eligible to take the licensing exam.

Biotech programs

The program assessment involved the analysis of four categories of student preparation for entering the biotech industry. Two categories account for associate degrees and certificates of achievement that appear on a student's transcript and that are recognized by the Chancellor's Office. A third category encompasses local certificates that are approved by individual colleges and are awarded to students but not recorded on a transcript. A fourth group identifies colleges that offer "courses only."

LOOKING BACK

Since 2017, the number of California community colleges that address the needs of the entry-level biotechnology workforce has risen 20% from 29 to 35 colleges.

The largest growth is in the Los Angeles region, which has added four (4) new programs in recent years.

A total of 35 community colleges across California have programs or courses that address the needs of the entry-level biotechnology occupations identified at the time of this study. Among these colleges, they offer 68 certificate and degrees approved by the Chancellor's Office: 30 associate-degree programs and 38 certificate programs. Five (5) colleges offer local certificates. Five (5) colleges currently offer only biotech courses. In addition, Los Angeles Valley College offers a non-credit program in biotechnology.

Breakdown by Program Area (TOP Code)

- 0430.00 Biotechnology and Biomedical Technology: 24 colleges offer programs.
- 0954.00 Chemical Technology: LA Trade Tech is the only college with a chemical technology program.
- 0955.00 Laboratory Science Technology: Three colleges offer programs (Mt. San Antonio, Sacramento City, Berkeley City).
- 1205.00 Medical Laboratory Technology (MLT): Six colleges offer programs (College of the Canyons, DeAnza, Folsom Lake, Saddleback, San Diego Miramar, and Southwestern).

Breakdown by Community College Region
An overview of existing biotechnology programs issuing awards for biotechnology, chemical technology, and laboratory science technology in California shows that the Los Angeles/Orange County Region has the greatest number of community colleges (14) offering 32 programs, followed by the Bay Region which is home to 12 colleges offering 26 programs. The next largest concentration of programs is in the San Diego/Imperial Region where seven programs are offered through MiraCosta and Miramar community colleges.

[20] **Impact of the COVID-19 pandemic on postsecondary program data:** Data in this section is not impacted. The study analysis relied on data from academic years preceding the pandemic, from 2016-17 through 2018-19. College program offerings, counts and awards totals may vary due to reporting period or date of download.

Exhibit 26. Community college biotechnology offerings by region in 2018-19[21]

		Program Count by Award Type			
Region (# of Colleges)	**Colleges**	**Associate Degree**	**Certificate of Achievement**	**Local Certificates**	**Courses Only**
North/Far North (2)	American River, Sacramento City	2	2	0	0
Bay Region (12)	Berkeley City, Cabrillo, City College of San Francisco, Contra Costa, Laney, Las Positas, Merritt*, Ohlone, San Mateo, Skyline, Solano, West Valley	9	10	6	2
Central (2)	Fresno City, Merced	1	2	0	0
South Central Coast (3)	Allan Hancock*, Antelope Valley, Moorpark	2	4	0	1
San Diego/Imperial (2)	MiraCosta, Miramar	6	4	2	0
Inland Empire/Desert (1)	Mt. San Jacinto	0	0	0	1
Los Angeles/Orange County (14)	Citrus, East LA, El Camino, Fullerton, Irvine Valley, LA Mission, LA Trade Tech*, LA Southwest, Mt. San Antonio, Pasadena, Rio Hondo, Santa Ana, Santiago Canyon, West LA	9	18	3	1
TOTAL (35)		**29**	**40**	**11**	**5**

Source: Datamart, CalPass' Launchboard, and California Community Colleges Life Sciences/Biotech Sector team. *Merritt also has two specialty local certificates under 0430.00 in microscopy for Fluorescence Bioscience Microscopy, Illumina HiSeqDNA sequencing and Optical Microscopy. Allan Hancock no longer offers courses. LA Trade Tech has a Biotech program under TOP 0430 and a Chemical Technology program under TOP 0954.

On average, 469 awards (degrees and certificates) related to the entry-level biotech occupations are conferred by community colleges in California (Exhibit 27).[22] The Bay Region confers the greatest number of awards for biotechnology, chemical technology, and laboratory science technology programs annually, a total of 190.

Exhibit 27. Community college biotechnology awards by region, three-year average, 2016-17 to 2018-19*

Region	Bachelor's Degree*	Associate Degree	Certificate 30 < 60 Units	Certificate 18 < 30 Units	Certificate 6 < 18 Units	Total Awards*
North/Far North	0	18	5	3	0	**26**
Bay Region	12	55	8	27	88	**190**
Central	0	2	0	2	1	**5**
South Central	0	4	3	0	3	**9**
San Diego/Imperial	21	42	22	0	47	**132**
Los Angeles County	0	20	26	13	9	**68**
Orange County	0	8	1	14	16	**39**
TOTAL AWARDS	**33**	**149**	**65**	**59**	**163**	**469**

Sources: Data Mart and Cal-PASS Plus LaunchBoard. *Represents only year of data available (2018-19) as reported to NCES' IPEDS. Total awards is the sum of three-years averages for Associate degree and COAs, plus one year of CCC Bachelor's degree.

[21] Program count reflects degrees and certificates considered active as of program year 2018-19, reporting data as shown in Launchboard or as active in the Chancellor's Office Curriculum Inventory (COCI). Does not include noncredit offerings.
[22] The award totals represent a three-year average from the 2016-17 academic year to the 2018-19 academic year.

New program highlights

In the years since the previous Life Sciences and Biotech Middle Skills Workforce report in 2017, the number of California Community Colleges that address the needs of the entry-level biotechnology workforce rose from 29 to 35 colleges. In addition, there are eight colleges with new programs that are either recently opened, approved but not yet active or under development – potentially expanding the total number of community colleges with biotechnology programs to 46.

Biotechnology programs under development include a certificate in bioinformatics through Berkeley City College, and a Business of Biotechnology certificate created by College of San Mateo. In some cases, program development is occurring laterally and complements other related fields. These include programs such as fermentation (San Diego Mesa College) and plant/agricultural biotechnology (Allan Hancock College and LA Pierce College).

The Los Angeles region reported the largest growth in new programs and programs under development. In 2017, there were four (4) biotech/biomanufacturing programs in operation in the Los Angeles region: Citrus College, LA Trade Tech, Pasadena City College, and Los Angeles Valley College (non-credit program). Since 2017, there has been substantial growth in the number of biotech/biomanufacturing programs, with five (5) colleges adding these programs. Another seven (7) colleges have programs under development (Exhibit 28).

Exhibit 28. California Community Colleges with new programs or programs in development

Region	New and Active (since 2017 report)		Under Development	
Los Angeles	LA Mission East LA West LA	Rio Hondo LA Harbor	Cerritos (Fall 2022) Compton (Spring 2022) El Camino (Fall 2023) Glendale (Fall 2022)	LA City (Fall 2023) LA Pierce (Fall 2022)** Santa Monica (Spring 2023)
Other Regions	Cabrillo Las Positas* West Valley		Allan Hancock**	
TOTAL	**8**		**8**	

* Computational Biology; ** Agricultural Biotech.

Other biotechnology areas are also being addressed by community colleges across the state.

- Two new bachelor's degree programs in biomanufacturing are being offered by MiraCosta College and Solano College. Both programs began in Fall 2017 and graduated their first cohorts in May 2019. MiraCosta awarded 21 bachelor's degrees, and Solano awarded 12 degrees from the first cohorts.
- Solano College is the first community college in the nation to offer a Cell and Gene Therapy certificate, a program that was launched in Fall 2020.
- Laney College and Compton College are among colleges incorporating cell-based technologies into curriculum. Cell-based foods, also called "cultured," "clean," or "lab-grown" foods, are part of a growing industry and produced by applying the same technologies used in regenerative medicine.

MLT programs and awards

A separate analysis was conducted of existing medical laboratory technology (MLT) programs. A community college was included if it awarded any programs under TOP code 1205.00, excluding histotechnology programs, that have been approved by the Chancellor's Office. At the time of reporting, there were six (6) community colleges offering 11 MLT programs.

Exhibit 29. Community college MLT programs by region

		Program Count by Award Type	
Region	**Colleges**	**Associate Degree**	**Certificate of Achievement**
North/Far North	Folsom Lake	1	0
Bay Region	DeAnza	1	2
South Central	College of the Canyons	1	0
San Diego/Imperial	San Diego Miramar, Southwestern	2	2
Los Angeles/Orange	Saddleback	1	1
TOTAL PROGRAMS		**6**	**5**

Sources: Data Mart and Cal-PASS Plus LaunchBoard

The six community colleges offering MLT programs confer, on average, 96 degrees and certificates annually (Exhibit 30), including an average of 55 associate degrees.[23] The California Department of Public Health is responsible for licensing MLTs. To be considered for licensing, the academic component requires completion of an MLT associate degree or 60 credit units in coursework.[24]

Exhibit 30. Community college MLT awards by region, three-year average, 2016-17 to 2018-19

Region (# of Colleges)	College	Associate Degree	Certificate 30 < 60 Units	Certificate 16 < 30 Units	Certificate 6 < 18 Units	Total Awards
North/Far North (1)	Folsom Lake	14	0	0	0	**14**
Bay Region (1)	De Anza	2	1	5	0	**8**
South Central (1)	College of the Canyons	11	0	0	0	**11**
San Diego/Imperial (2)	San Diego Miramar, Southwestern	19	0	18	3	**40**
Los Angeles/Orange (1)	Saddleback	9	14	0	0	**23**
TOTAL AWARDS		**55**	**15**	**23**	**3**	**96**

Sources: CCC Curriculum Inventory, CCCCO Data Mart, and LaunchBoard

Impact from COVID-19

Since the onset of the COVID-19 pandemic, medical laboratories have been overwhelmed by skyrocketing demand for clinical testing. In March 2020, all MLT clinical rotations, required to meet the practicum component for licensure in California, were suspended. The Life Sciences/Biotech team partnered with the Health Workforce Initiative (HWI) team and the community college MLT program directors to appeal to the state Department of Public Health for a temporary exception to lower the requirement for clinical hours in California and to allow simulated laboratory hours to count toward the practicum requirement. If successful, this would have allowed students to apply for licensure and seek employment as new professionals in medical laboratories across the state. However, the exception was not approved and, as a result, program award and employment data for 2019-20 forward will likely reflect the impact of delayed clinical rotations.

[23] The award totals represent a three-year average from the 2016-17 academic year to the 2018-19 academic year.
[24] California Department of Public Health, https://www.cdph.ca.gov/Programs/OSPHLD/LFS/Pages/MLT.aspx. Accessed August 21, 2021.

Key takeaways

- At the time of the analysis, thirty-five (35) community colleges offer 69 Chancellor's Office approved programs that train for the entry-level biotechnology occupations identified for this study. Of the degree and certificates approved by the Chancellor's Office, there are 29 associate-degree programs and 40 certificate programs.
    - The Los Angeles/Orange County Region has the greatest number of colleges offering programs (14), followed by the Bay Region (12).
    - Each year on average, 469 total awards related to the entry-level biotech occupations are conferred by community colleges in California.
- In recent years (post-study period), eight additional community colleges have new biotech programs under development, and a ninth college, LA Harbor, launched a new program.
- There are six (6) community colleges in the state offering 11 MLT programs (not including histotechnology programs). On average each year, 96 awards (degrees and certificates) are conferred annually by MLT community college programs in California.

Future Workforce: Job-ready Students

This section estimates the annual supply of job-ready students prepared by biotechnology programs offered through the California Community Colleges. An expanded definition of potential labor force supply, the job-ready approach was developed to include a larger number of individuals who attend biotechnology programs but may not complete a community college degree or certificate in the process.

The job-ready approach was reviewed by the Life Science/Biotechnology team and affirmed as meeting the entry-level knowledge, skills, and abilities requirements for employment in the biotechnology occupations.[25] As a result, the analysis in this section is a more liberal assessment of potential labor force supply than the sum of certificates and degrees conferred by community colleges programs.

The method for calculating the number of "job-ready students" begins with the average number of community college students who have completed at least one non-introductory course in the associated TOP codes. That number is then multiplied by the average course success rate for the same programs. Averages represent the most recent three program years available.

Job-ready Students

Annually, about 1,800 job-ready students are prepared by community colleges to enter the biotech workforce.

Approximately 70 students are prepared each year to become licensed as MLTs.

This approach is based on the premise that the number of awards (associate degrees and certificates) granted annually by the community colleges is a conservative metric and not the only indicator of the student labor force prepared to meet biotechnology employment demand. The job-ready approach serves as the basis for determining a second estimate of supply to compare against the average annual number of degrees and certificates awarded.[26] On average, an estimated 1,822 job-ready students are produced by biotech programs offered by community colleges statewide (Exhibit 35).

Because students must pass a state licensing exam to be employed as medical and clinical laboratory technicians, the supply of MLT students is broken out separately from programs that prepare students to enter the general biotech workforce.[27] Seventy (70) MLT students complete an associate degree or a 60-unit certificate on average each year. It is important to note that the COE was unable to ascertain the average pass rate for students who take the MLT licensing exam in California. Therefore, the maximum number of job-ready MLT students produced by the community colleges could be fewer than 70 (assuming not all students may take or pass the licensing exam).

Exhibit 35. Estimated community college supply of job-ready biotech and MLT students[28]

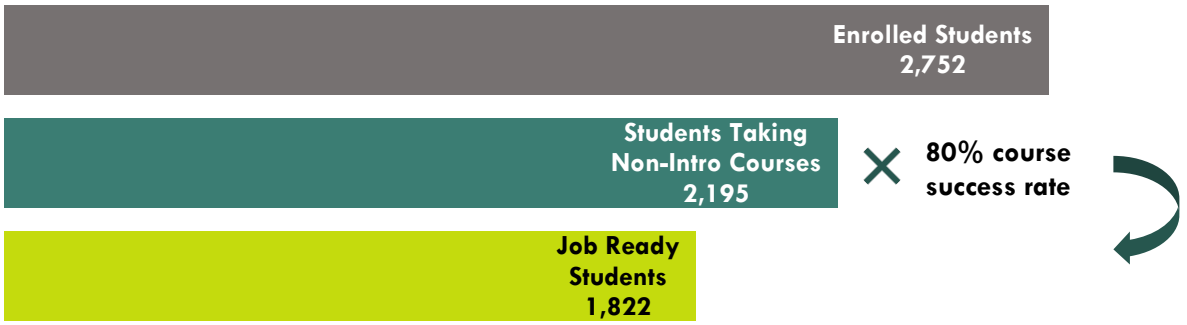
Region	Biotech (# of Students)	MLT (# of Students)
North/Far North	88	14
Bay Region	579	5
Central Valley	180	0
South Central	38	11
San Diego/Imperial	645	19
Inland Empire/Desert	0	0
Los Angeles County	146	0
Orange County	147	23
TOTAL	**1,822**	**70 (maximum)**

[25] The approach for the data analysis was informed through consensus from the California Community Colleges Life Science/Biotechnology team advising the study. The Methodology and Definitions section contains more detail about the job-ready methodology.
[26] Community College Pipeline: https://www.calpassplus.org/LaunchBoard/Community-College-Pipeline.aspx.
[27] The TOP code 1205.00 Medical Laboratory Technology (MLT) was analyzed separately from the remaining three TOP codes associated with biotech student preparation for the six other entry-level biotech occupations: 0430.00 Biotechnology and Biomedical Technology, 0954.00 Chemical Technology, and 0955.00 Laboratory Science Technology. Histotechnology programs were excluded.
[28] Three-year average (2016-17 through 2018-19) of students who received an associate degree or 60-unit certificate in MLT and therefore eligible to take the state licensing exam required for MLT employment.

Biotech job-ready students

Exhibit 36 shows the number of job-ready community college students in biotechnology (defined as students who completed at least one non-introductory course) compared to the total number of students enrolled in biotech courses overall.[29] On average, 83% enrolled in non-introductory biotech courses, and, after applying the average success rate for biotechnology courses, 66% of students met the job-ready definition.

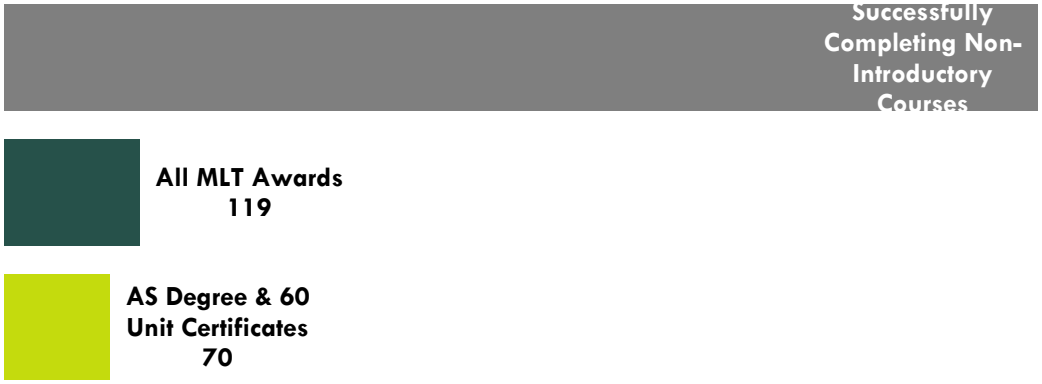
Exhibit 36. Comparison of students enrolled, students taking non-introductory courses, and job-ready students in biotechnology programs, 3-yr Annual Average (2016-17 to 2018-19)[30]



MLT job-ready students

Even more so than biotechnology, almost all students enrolled in an MLT program were also taking at least one non-introductory course (Exhibit 37).[31] Course success rates averaged 86% in the most recent three-year period.

Exhibit 37. Comparison of number of students successfully completing non-introductory courses, all MLT awards, and MLT awards that qualify for state licensure exam, 3-yr Annual Average (2016-17 to 2018-19)



As noted previously, passing the state MLT licensing exam is required for employment as a medical laboratory technician in California. Only those with an associate degree or those who have completed 60 semester or equivalent quarter units in chemical, physical, biological, or clinical laboratory sciences are eligible to take the licensing exam. Specific course requirements include:

- 36 semester or equivalent quarter units in physical or biological sciences
- 6 semester or equivalent quarter units in chemistry
- 6 semester or equivalent quarter units in biology

[29] Three TOP codes were used to determine the supply of job-ready biotech students: 0430.00 Biotechnology and Biomedical Technology, 0954.00 Chemical Technology, and 0955.00 Laboratory Science Technology. Enrollment and course data from Launchboard.
[30] Annual average data for program years 2016-17 to 2018-19.
[31] The TOP code 1205.00 Medical Laboratory Technology (MLT) was used to determine the supply of job-ready MLT students.

For this analysis, only students completing an associate degree or a 60-unit certificate in an MLT program were considered job ready. On average, 70 job-ready students are prepared annually to take the licensing exam.

Other sources of job-ready students

One private post-secondary institution, Southern California Institute of Technology in Anaheim, offers an award of at least 1 but less than 2 academic years certificate program in biomedical technology, conferring an annual average of 64 awards.

An examination of four-year colleges and universities (both public and private) and proprietary institutions in California was conducted to find baccalaureate-level degrees and undergraduate certificates as well as short-term training programs of up to seven months related to biotechnology offered by four-year postsecondary institutions.[32] As shown in Exhibit 38, these programs confer on average 252 total awards annually.

Exhibit 38. Bachelor's degrees in biotechnology in California[33]

Region (# of Colleges)	Colleges	Bachelor's	Postbaccalaureate Certificates	Master's	All Awards (Annual Average)
North/Far North (2)	Simpson University, UC Davis	60	0	0	60
Los Angeles County (5)	Azusa Pacific University, Cal Poly-Pomona, CSU Long Beach, CSU Los Angeles, University of Southern California	38	6	14	58
San Diego/Imperial (1)	CSU-San Marcos	22	0	17	39
South Central Coast (1)	CSU-Channel Islands	0	0	29	29
Orange County (2)	CSU-Fullerton, UC Irvine	0	0	25	25
San Francisco Bay Region (2)	CSU-East Bay, University of San Francisco	0	3	18	21
Central Valley (1)	CSU-Fresno	0	0	9	9
Online only	Devry University	11			
TOTAL		**131**	**9**	**112**	**252**

California Community Colleges' Baccalaureate Program

MiraCosta and Solano community colleges were early participants of the California Community Colleges Baccalaureate Program and launched biotechnology-related bachelor's degree programs during the study period. Awards data from these programs are included with all other community college award totals and job-ready calculations (see Exhibits 27 and 36).

Key takeaways

- Combining the 1,822 community colleges students, 64 awards from other two-year postsecondary programs, and an average of 131 bachelor's degrees from four-year universities, as many as 2,071 students meet the job-ready criteria for the occupations of study.
- Seventy (70) MLT students complete an associate degree or a 60-unit certificate, meeting the minimum requirement for licensing in California and considered job-ready for this study.

[32] The CIP code 26.1201 Biotechnology was used for this analysis.

[33] Data represents a three-year average of awards for the period 2016-17 to 2018-2019. All higher education institutions that participate in any federal financial assistance program are required to report completion data to National Center for Educational (NCES) as authorized by Title IV of the Higher Education Act. Does not include the CCC Bachelor's Degree programs.

Supply and Demand Analysis

To assess if postsecondary programs are on pace to meet industry needs, the supply and demand analyses for biotechnology and MLT program areas were developed independently and utilize different approaches.[34] The different approaches were determined based on the available data and understanding of educational requirements for licensing and employment for the occupations. [35]

Biotech analysis

For the six biotech occupations, the gap analysis was divided into two scenarios. The first scenario includes the previously discussed measures that are considered conservative estimates – demand is determined using occupational employment projections and matched against the average annual number of students receiving awards. The second scenario includes measures that are considered liberal estimates – demand is determined using the number of relevant job postings in a 12-month period and matched against the average annual number of students identified as job-ready.

Conservative

As discussed in the *Occupational Landscape* section, 1,878 annual job openings are projected for the six entry-level biotechnology occupations.[36]

On average, approximately 442 students at both community colleges, other two-year postsecondary institutions, and four-year colleges and universities completed a biotechnology award (bachelor's degree, associate degree, or certificate of at least 30 units).[37]

- Based on this calculation, it appears that postsecondary institutions are **undersupplying** the labor market by as many as 1,436 biotechnology professionals annually.[38]

Liberal

As shown in the *Current Workforce: Employer Demand in Job Postings* section, over a 12-month period, there were 8,240 job postings associated with entry-level biotechnology occupations.

Using the job-ready definition for community college students, combined with average annual awards of bachelor's degrees, there are as many as 1,940 job-ready students entering the workforce each year.[39]

- Using these estimates, postsecondary institutions could potentially be **undersupplying** the labor market by as many as 6,223 biotechnology professionals annually.

[34] The assumption of the gap analysis is that biotech students are prepared to enter the six entry-level biotech occupations, while the MLT students are prepared to enter the medical and clinical laboratory technician occupation.

[35] **Impact of the COVID-19 pandemic on biotechnology gap analysis:** Data in this section is not impacted. The study analysis relied on Emsi data from 2019 and postsecondary data from academic years preceding the pandemic, from 2016-17 through 2018-19. Emsi projections could be conservative. Please note, the annual projected job openings provided by Emsi might be underestimated.

[36] This data was restricted to demand for the NAICS codes associated with the biotechnology industry.

[37] A traditional gap analysis typically takes the count of annual job openings (demand) and subtracts the number of postsecondary awards (supply) to determine if there is an undersupply or oversupply of students.

[38] Calculation: 1,878 annual job openings – 442 awards = undersupply of 1,436. On average each year, community colleges awarded 33 bachelor's degrees, 149 Associate degrees, and 65 certificates of at least 30 units, 64 certificates from other two-year postsecondary programs, and 131 bachelor's degrees are conferred by four-year colleges and universities related to the entry-level biotechnology occupations; these combine to total 442.

[39] Calculation: 8,240 job postings – 2,017 job ready biotechnology students = undersupply of 6,223. On average each year, 1,822 job-ready community college students, 64 certificates from other two-year postsecondary programs, and 131 bachelor's degrees are conferred by four-year colleges and universities related to the entry-level biotechnology occupations; these combine to total 2,017.

MLT analysis

For the MLT analysis, other considerations impacted how demand and supply could be compared. On the demand side, the occupational employment data available does not distinguish between medical laboratory technicians (MLTs) and clinical laboratory scientists (CLS'). This is unfortunate because the educational requirements for each role are quite distinct and significantly different. As such, the annual projected openings cannot be solely attributed to just the need for MLTs.

On the supply side, California licensing for new entrants to the MLT profession requires attainment of 60 units of instruction or an associate degree from an accredited MLT program. As a result, supply data were limited to the number of students awarded certificates of 60-units or more or associate degrees and therefore be eligible to take the MLT state licensing exam.

For the gap analysis, demand for medical and clinical laboratory technologists is projected at 663 openings annually and supply averaged to a maximum of 70 MLT students each year. The difference between the annual demand and the supply of students who are considered job-ready shows an undersupply of 570 medical and clinical laboratory technologists.[40]

Key takeaways

- Both comparisons of demand for the six entry-level biotech occupations and supply prepared through related programs established there is likely a significant undersupply of qualified biotechnology professionals for these jobs – the undersupply estimates range from 1,436 to as many as 6,223 workers.
- Similarly, there appears to be an undersupply of 570 medical and clinical laboratory technologists statewide based on a comparison of employer demand and the supply by community colleges of job-ready MLT students. However, demand is exaggerated as it also estimates openings for clinical laboratory scientists as well as MLTs so the undersupply for MLTs is likely lower than 570.

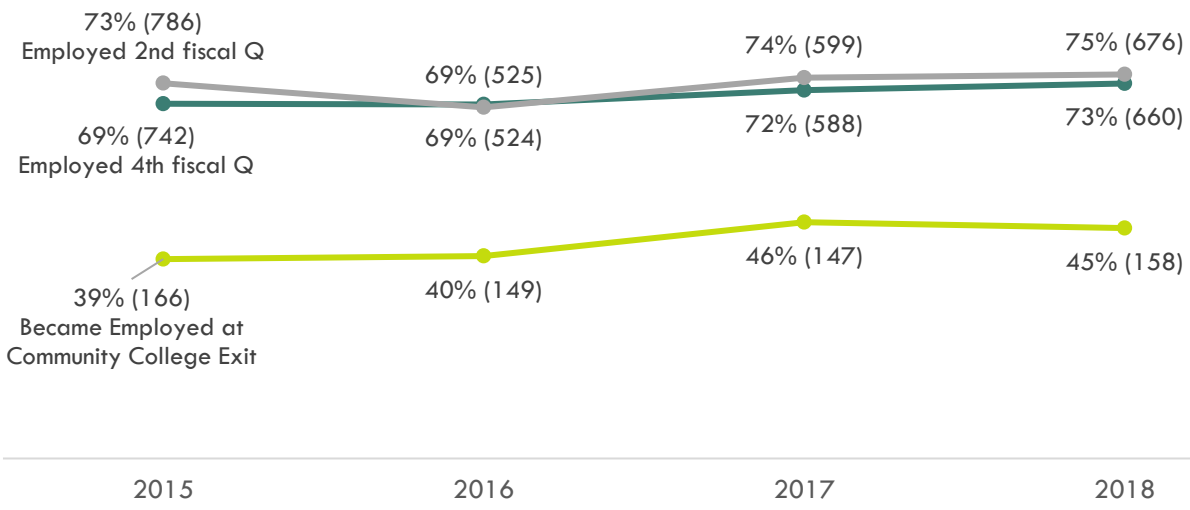
[40] Four-year awards or supply of students entering the workforce as clinical laboratory scientists were not incorporated.

Student Employment Outcomes

Through LaunchBoard, community college student employment outcomes data shows how biotech and MLT students fare in the labor market after completion. The data provides insight into the proportion of students employed, earnings above a living wage, and median salaries after exiting a program.

Exhibit 39 presents employment outcomes of biotech students from 2014-15 to 2018-19.[41] Looking at students overall, high percentages of students were employed during the 2nd or 4th fiscal quarter after exit. For example, 73% of biotech students in their 4th fiscal quarter after exit were employed in 2017-18 (shown in dark green). Among students who were unemployed when they first entered the community college system, fewer than one-half (39%-46%) reported "becoming employed" upon their exit from community college during the four-year time period (shown in light green).

Exhibit 39. Employment outcomes of biotechnology students, 2014-15 to 2017-18[42]



CTE Employment Outcomes Survey (CTEOS)

The CTE Employment Outcomes Survey (CTEOS) is a statewide study to assess employment outcomes of students who have participated in career technical education (CTE) coursework at California Community Colleges. Students are surveyed at least one year after exit from community college. The survey focuses on their experience while attending college and their current employment status.

Approximately 75% of biotech students who completed a program and responded to the survey reported being employed in a job very closely or closely related to their field of study, 12 -18 months after exit. Of those 52% selected "very close" and 23% selected "close."

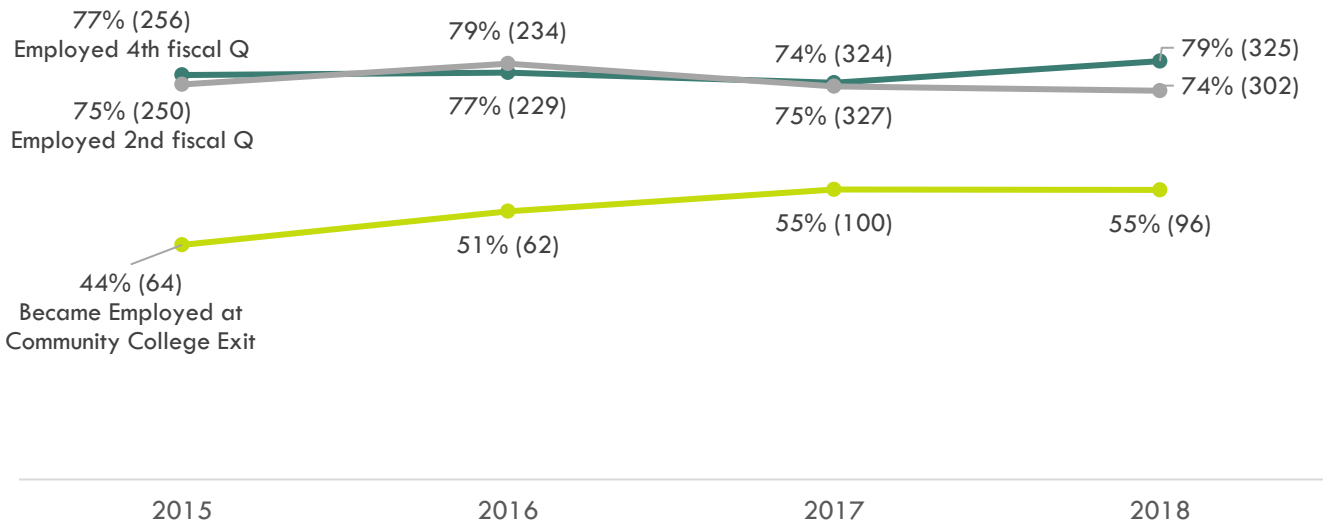
Similar employment trends are present when examining the outcomes of MLT students (Exhibit 40). Looking at students overall, similar percentages of students are employed by the 2nd or 4th fiscal quarter after exiting a community college program, though at slightly higher levels than students in biotechnology programs. As shown below, 79% of MLT students in their 4th fiscal quarter were employed after exit in 2018 (shown in dark green). Also faring slightly better than their biotechnology counterparts, among MLT students who were unemployed when

[41] This section provides a brief overview of the employment and earnings of students who were enrolled in a biotechnology or medical laboratory technology program and exited the community college system during 2015-2018. Only data for TOP 0430.00, TOP 0954.00 (Biotechnology) and TOP 1205.00 (MLT) are presented; data for TOP 0955.00 were not available for the reporting time period.

[42] Please note: Data was only available for the TOP codes 0430.00 Biotechnology and Biomedical Technology and 0954.00 Chemical Technology. 0955.00 Laboratory Science Technology was not available.

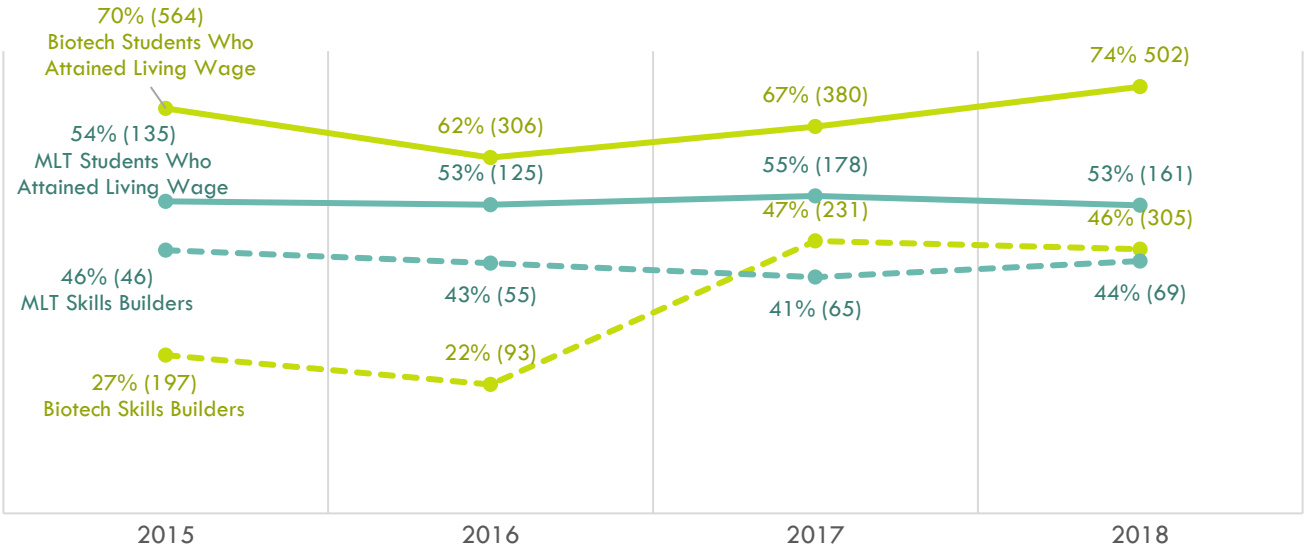
they first entered the community college system, about one-half (44%-55%) reported "becoming employed" upon their exit from community college during the same time frame (shown in light green).

Exhibit 40. Employment outcomes of MLT students, 2014-15 to 2017-18[43]



While MLT students were slightly more likely to be employed than biotechnology students, biotechnology students were slightly more likely to attain a living wage (Exhibit 41). During the academic years 2014-15 to 2017-18, 62% to 74% of biotechnology students attained a living wage upon exiting the community college system. More than half of MLT students, 53% to 55%, attained a living wage during the same period.[44]

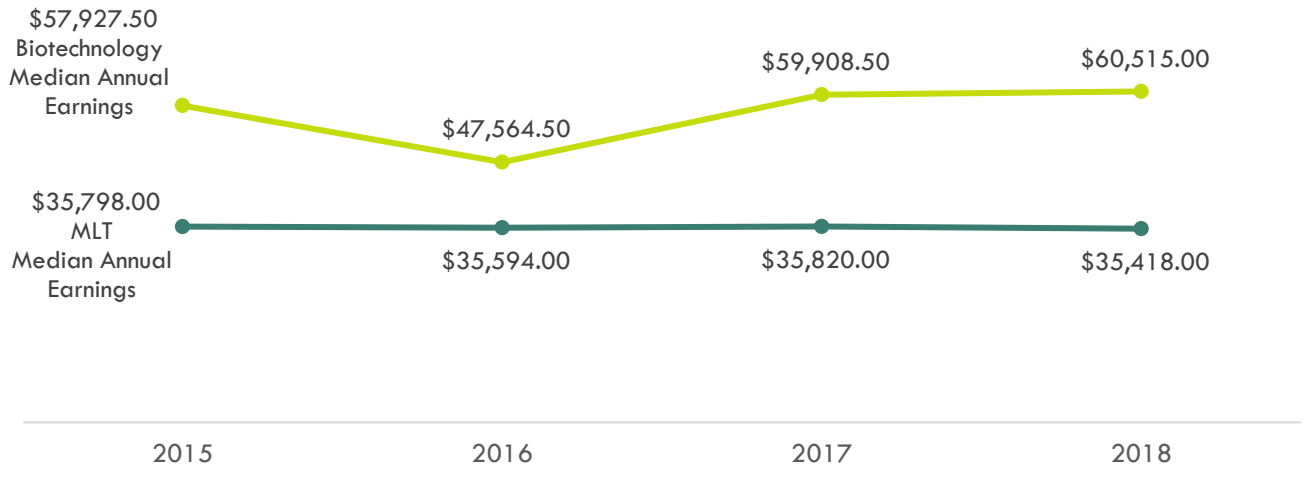
Exhibit 41. Living wage attainment, MLT and biotechnology students, 2014-15 to 2017-18



[43] Please note: This chart reflects data only for the TOP code 1205.00 Medical Laboratory Technology.
[44] The term "skills builder" describes a student who does not necessarily complete a degree or certificate but who takes one higher-level CE course or more to gain employment or advancement in the biotech field.

Biotechnology students also earned higher annual salaries during the same time period (Exhibit 42). The median annual salary earned by a biotechnology student after exit in 2014-15 was close to $58,000, rising to over $60,000 by 2017-18, while the median annual salary for a MLT student remained steady at about $35,000 annually.

Exhibit 42. Median annual earnings for MLT and biotechnology students, 2014-15 to 2017-18



Key takeaways

- Student outcomes data for the 2017-18 academic year shows that by the 4th fiscal quarter after exit from community college, 73% of biotech students and 79% of MLT students were employed.
- In addition, 74% of biotech students and 53% of MLT students obtained a living wage.
- Biotech students earned a median salary of $60,515 while MLT students earned $35,418.

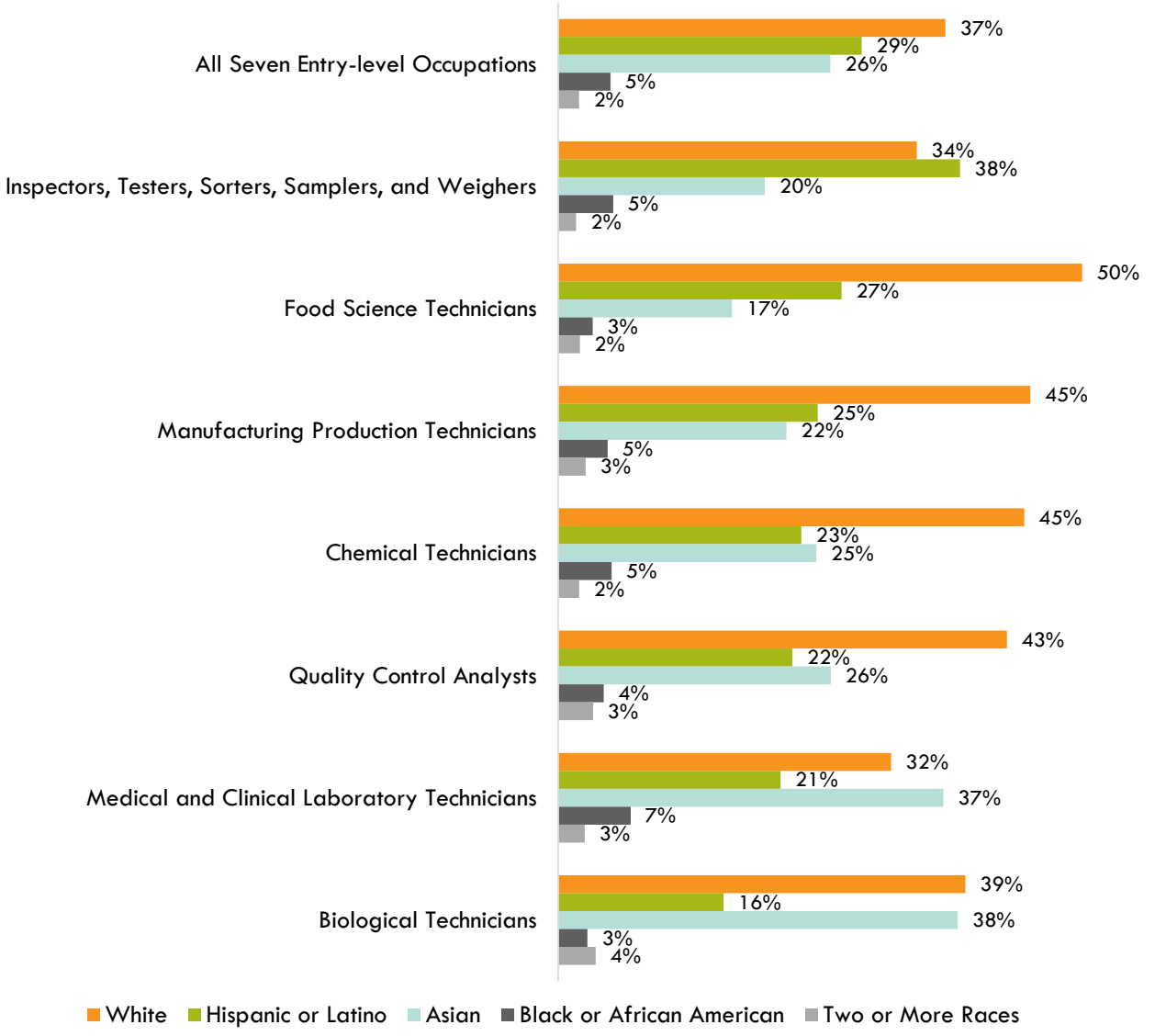
Demographics: The Current Workforce

The following section examines statewide demographics of workers employed in the seven entry-level biotechnology occupations. Data is available for three areas: race and ethnicity, sex, and age.[45]

Race/ethnicity

Exhibit 43 shows the distribution of workers employed in each occupation by race and ethnicity. Across all seven entry-level occupations, 29% of workers are Hispanic or Latino, 37% are white, 26% are Asian, and 5% are Black or African American.[46]

Exhibit 43. Race/ethnicity of workers in entry-level biotechnology occupations



[45] Demographic data from EMSI 2020.2 preceded the pandemic.

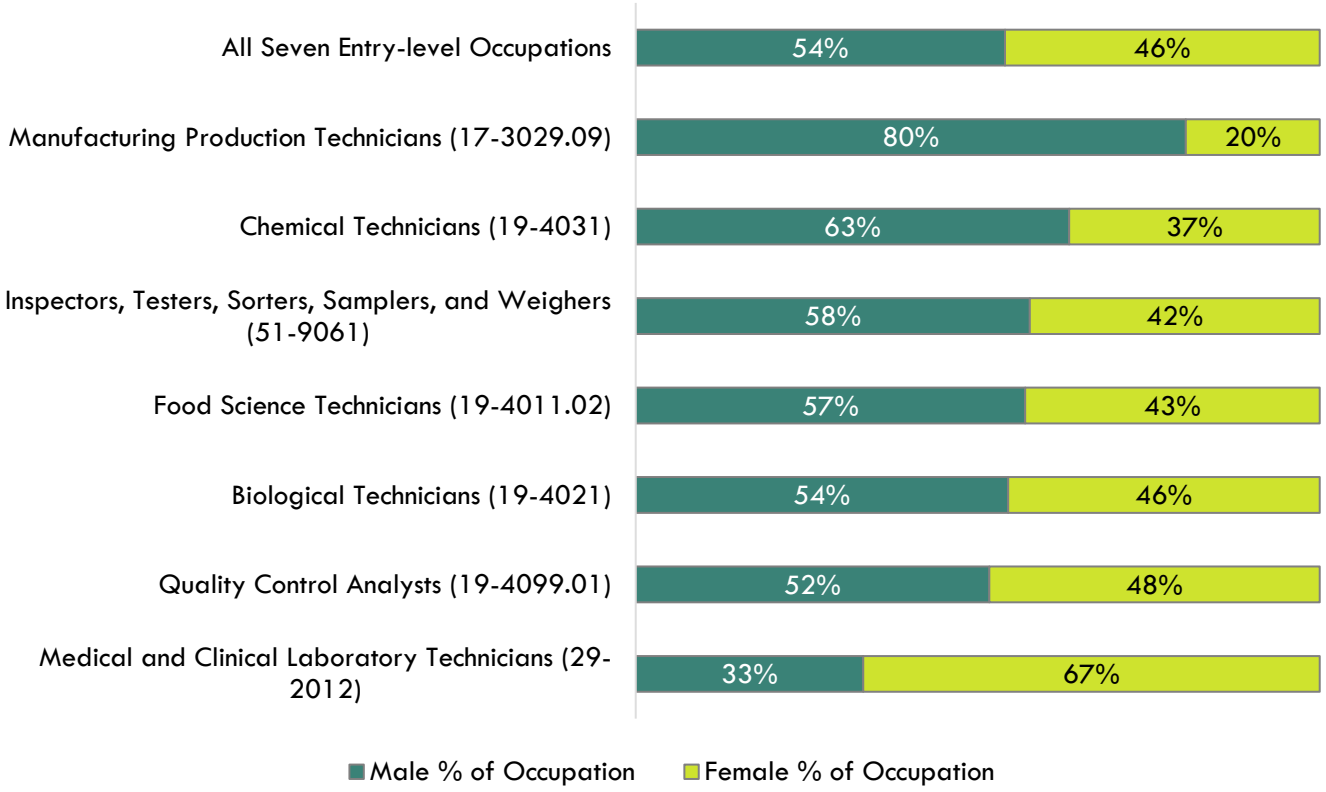
[46] Percentages for American Indians/Alaska Natives and Native Hawaiian/Other Pacific Islanders were below 1% and are not shown in Exhibit 43.

Gender

Exhibit 44 shows the distribution of workers by gender. Currently, the American Community Survey conducted by the U.S. Census Bureau does not include questions or collect data on gender identity and only includes data on biological sex. However, the Census Bureau has conducted focus groups to assess the feasibility of asking about gender identity in the Current Population Survey (CPS).[47] For these reasons, this section includes data on the two biological sexes included in the American Community Survey: female and male.

Male workers make up a slight majority, 54%, among all workers across all seven entry-level occupations. Quality control analysts is almost evenly divided, with 51.7% male workers and 48.3% female workers. Only one occupation, medical and clinical laboratory technicians has a female majority workforce, 66.7%. Male workers are significantly overrepresented among manufacturing production technicians, 80.4%.

Exhibit 44. Gender of workers in entry-level biotechnology occupations

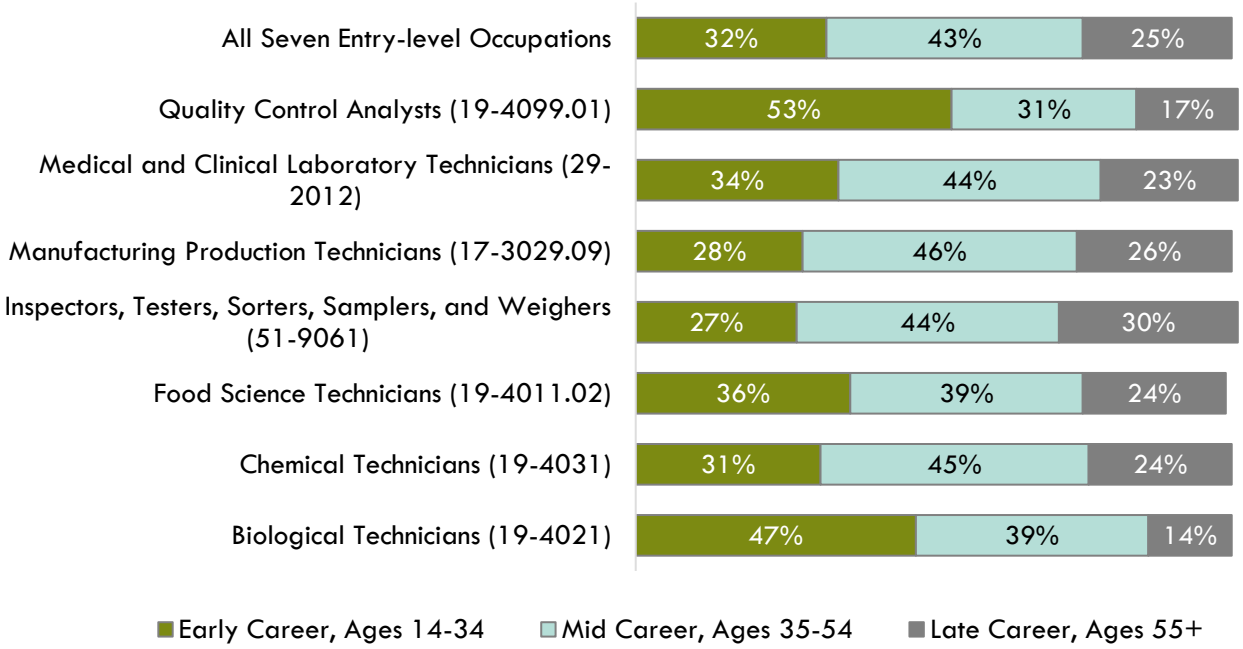


[47] Jessica L. Holzberg, Renee Ellis, Matthew Virgile, Dawn V. Nelson, Jennifer Edgar, Polly Phipps, and Robin Kaplan, "Assessing the Feasibility of Asking About Gender Identity in the Current Population Survey: Results from Focus Groups with Members of the Transgender Population," working paper Number RSM 2018-05, United States Census Bureau, April 2, 2018, https://www.census.gov/library/working-papers/2018/adrm/rsm2018-05.html.

Age

Exhibit 45 shows the distribution of workers by age. The largest concentration of early career workers, ages 14 to 34, occurs among quality control analysts, accounting for 53% of workers, followed by biological technicians 47%. Inspectors, testers, samplers, and weighers has the highest percentage of workers ages 55 and above, 30. Across all occupations, workers ages 14 to 54 make up 75% of the workforce.

Exhibit 45. Age of workers in entry-level biotechnology occupations



Educational attainment

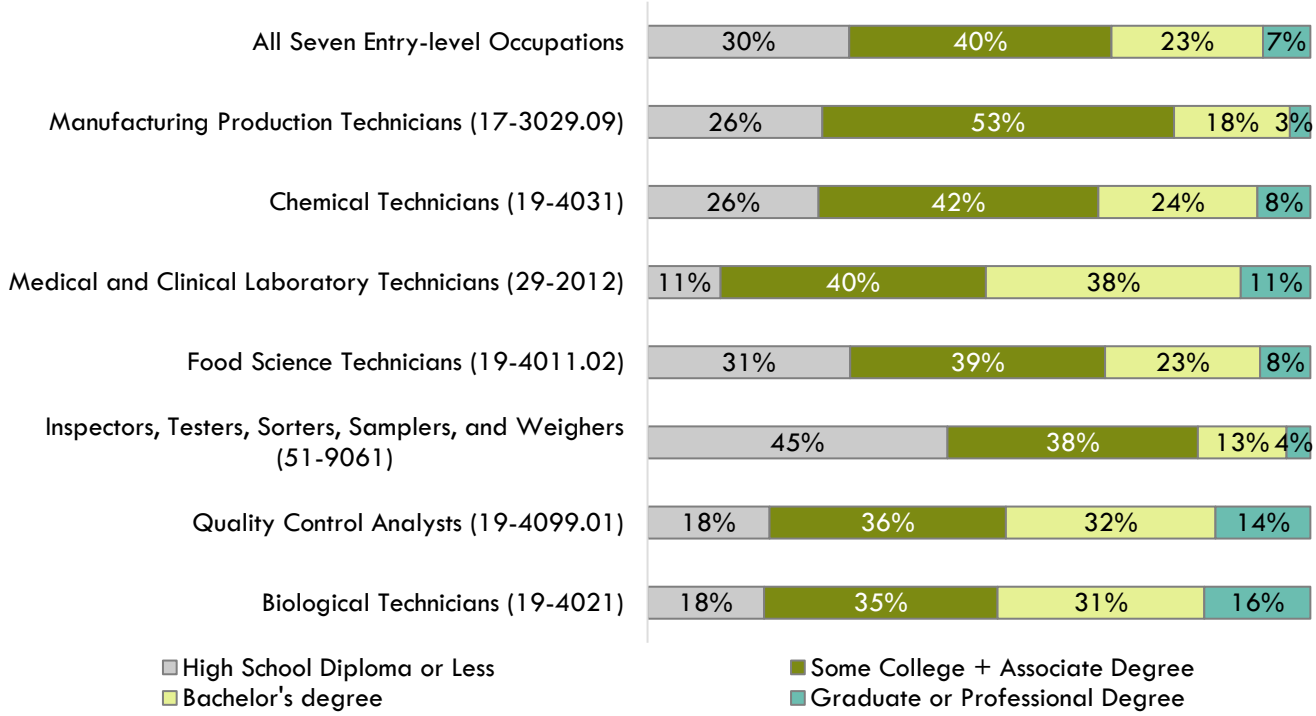
Exhibit 46 shows national educational attainment of workers age 25 and older by occupation, sorted in descending order by the percentage of workers who have completed some college or an associate degree.[48] It is important to note that this data is currently only available at the national level and may not be representative of the educational attainment of workers in these occupations in California.

Of the seven entry-level occupations, manufacturing production technicians has the highest percentage of workers that have completed some college or an associate degree, a total of 53%, and biological technicians has the lowest percentage, 35%. Across all seven entry-level occupations, 40% of workers have completed some college or an associate degree; this percentage is higher than that of workers with a bachelor's degree or a graduate degree, a combined total of 30%.

However, several occupations have a larger proportion of workers with a bachelor's degree or higher: medical and clinical laboratory technicians, 49%; biological technicians, 47%; and quality control analysis, 46%.

[48] "Educational attainment for workers 25 and older by detailed occupation, "Bureau of Labor Statistics, 2019, https://www.bls.gov/emp/tables/educational-attainment.htm.

Exhibit 46. National educational attainment for workers in entry-level biotechnology occupations



Key takeaways

- Of the seven entry-level occupations, inspectors, testers, sorters, samplers, and weighers has the highest percentage of Hispanic or Latino workers, 38%. Medical and clinical laboratory technicians has the highest percentage of Black workers, 7%, and biological technicians has the highest percentage of Asian workers, 38%.
- Most of the entry-level occupations are evenly split between male and female workers. Only one occupation, medical and clinical laboratory technicians has a female majority workforce, 66.7%. Male workers are significantly overrepresented among manufacturing production technicians, accounting for 80.4% of the workforce.
- The largest concentration of early-career workers, ages 14 to 34, occurs among quality control analysts, accounting for 52% of workers, followed by biological technicians 47%. Inspectors, testers, samplers, and weighers has the highest percentage of experienced workers who are nearing retirement; workers ages 55 to 64 account for 22% of this occupation, and workers 65 and older make up 8%.
- Educational attainment data shows that the seven entry-level occupations have a substantial percentage of middle-skill workers and confirms the selection of the seven occupations for this study.

Demographics: The Future Workforce

This section discusses demographic characteristics of students in biotechnology and MLT programs over a five-year period, during the academic years 2014-15 to 2018-19.[49]

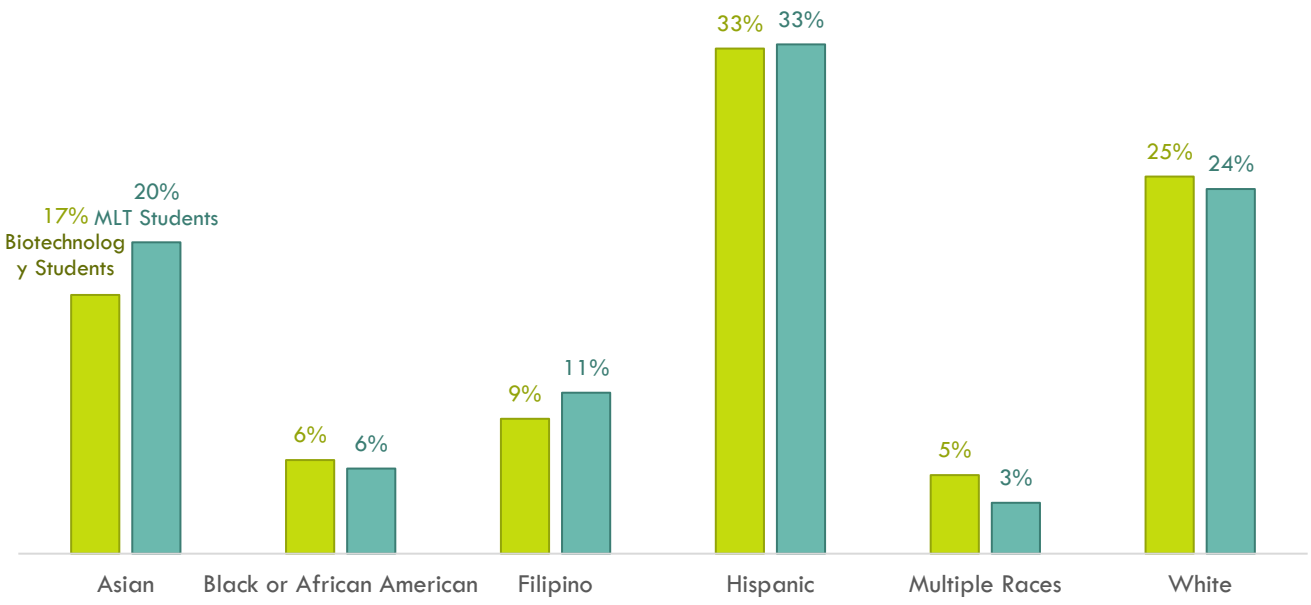
Race/ethnicity

Regarding race and ethnicity, the largest percentage of students enrolled in biotechnology and MLT programs during the five-year period identified as Hispanic, 33% (Exhibit 47). White students accounted for 25% of biotechnology students and 24% of MLT students. Asian students comprised the third largest group, 17% of biotechnology students and 20% of MLT students.

Proportions of Asian and Filipino students were slightly higher in MLT programs, while proportions of white students and students reporting multiple races were slightly higher in biotechnology programs. Black students represented 6% of enrolled students in biotechnology and MLT programs. Due to the low enrollment numbers of American Indian/Alaskan Native and Native Hawaiian/Pacific Islander students in either program, data for these students were unavailable for this report.

Compared to current worker demographics, student demographics are more diverse. White workers comprise roughly 48% of workers in the six entry-level life sciences occupations, while only 24-25% of students are white. About 28% of workers in the six occupations identify as Hispanic, compared to 33% of students. Interestingly there is a higher percentage of Asian workers, about 31%, in the six occupations, which is higher than the 17-20% of students identifying as Asian in related programs. The percentage of students identifying as Black is roughly the same percentage as Black workers in the six occupations, around 5%.

Exhibit 47. Race/ethnicity of students in biotechnology and MLT programs



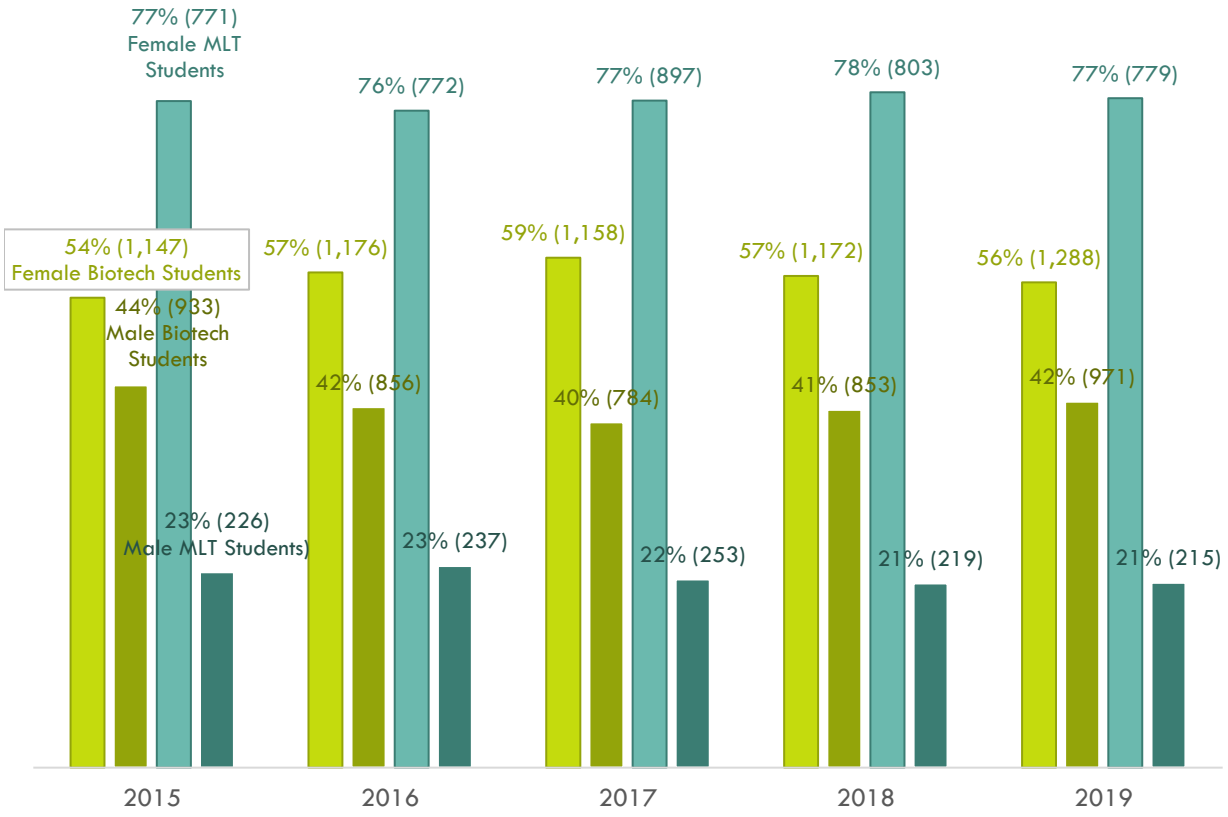
[49] **Impact of the COVID-19 pandemic on student demographics:** Data in this section is not impacted. The study analysis relied on postsecondary data from academic years preceding the pandemic, from 2014-15 through 2018-19.

Gender

Across all five years, females were represented in higher percentages in biotechnology and MLT programs, ranging from 54%-57% in biotechnology programs and 76%-78% in MLT programs (Exhibit 48). Male students comprised 40%-44% of students in biotechnology programs and 21%-23% in MLT programs.

There is wide variation in gender among workers in the six entry-level occupations. For example, 80% of manufacturing production technicians are male while 67% of medical and clinical lab technicians are female. However, men comprise roughly 66% of workers in all six entry-level occupations. By comparison, in 2018-19 women accounted for 56% of biotech students and 77% of MLT students.

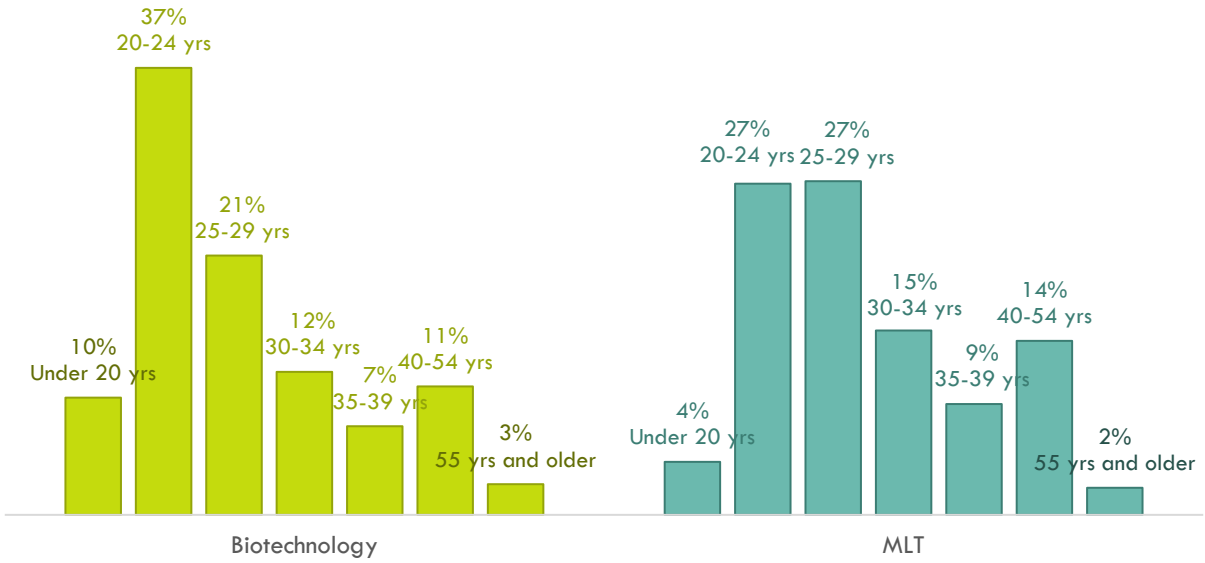
Exhibit 48. Gender of students in biotechnology and MLT programs, 2014-15 to 2018-19



Age

Students ages 20-24 comprise the largest age group of students enrolled in biotechnology programs, 37%, while students ages 20-29 represented the largest age group among MLT students (Exhibit 49).[50] About a third of biotechnology students are over the age of 30; by comparison, 40% of MLT students are over the age of 30. Roughly 42% of workers in the six occupations are under the age of 35.

Exhibit 49. Age of students in biotechnology and MLT programs, five-year average



Key takeaways

- Race/ethnicity of students is more diverse than the current workforce, with 75% of students identify as diverse, non-white ethnicities. Depending on the entry-level occupation, 30% to 50% of workers identify as white.
- While male workers comprise a larger proportion of workers in the entry-level occupations, female students comprise a higher percentage of students in biotechnology and MLT programs. By comparison, there is one occupation—medical and clinical laboratory technicians—that has a female majority workforce, 66.7%.
- Students in biotechnology and MLT programs are primarily 29 and younger. However, 33% of biotechnology students are age 30 or older, and 40% of MLT students are age 30 or older.

[50] Data for Exhibit 49 represents a five-year average, 2014-15 to 2018-19.

Conclusion

With more than 310,000 jobs in 2019, California leads the nation in biotech industry employment. Spanning many different cutting-edge disciplines from biofuels to biomedical research, including cell therapy, gene therapy, and gene editing, these jobs pay well and are projected to remain in demand by employers given the forecasted continuation of venture capital investments. The development of the COVID-19 mRNA vaccines is also expected to spur more job creation due to increased interest in the development of rapid-response treatments for many different diseases.

To estimate the need for biotech professionals across the state, this study focused on seven entry-level occupations that are complemented by community college training. These occupations accounted for 25,000 jobs statewide in 2019 and collectively have 8% projected new job growth, which, when combined with the ongoing need for replacement workers, translates to more than 2,500 job openings each year.

Using a combination of approaches to estimate both supply and demand, this report found that there is likely a significant undersupply of biotech workers of as many as 1,430 to more than 6,220 annually. Additionally, for medical and clinical laboratory technologists and technicians (MLTs and CLS'), the undersupply of qualified workers could be as high as 570 annually.

Finally, based on methodological choices as well as recent events, employer demand may be well above the occupational projections included in this report. This is primarily based on the high number of job postings matched to the seven entry-level occupations but also confirmed by input from industry partners as relayed by the Life Sciences/Biotech team. Additionally, the industry definition used for the study excluded employment in the entry-level occupations found in research universities.

Regional demand

Study Finding: Employment is largely concentrated in three regions of the state: the San Francisco Bay Region, the Los Angeles/Orange County Region, and the San Diego/Imperial Region. But there is a small concentration of biotech employment in the South Central Coast Region as well. The San Francisco Bay and San Diego/Imperial regions have strong projected growth for the seven entry-level occupations. However, employment demand over the next five years for the Los Angeles/Orange County region is projected to be slight, only 2%, while employment contraction of 4% is projected for the South Central Coast.

Recommendation: Community colleges in these regions should continue to assess and align programs that complement areas of growth in their localized biotech industries. Community colleges in the Los Angeles/Orange County and South Central Coast regions may wish to reassess program alignment with local employer needs and work closely with their advisory committees to review areas that may undergo weakened employment demand.

Entry-level occupations

Study Finding: The study examined projected job growth for the seven entry-level occupations and determined that not all of the occupations are expected to increase at the same pace or offer the same level of employer demand.

The three occupations with the most annual job openings are:

- Medical and clinical laboratory technicians
- Inspectors, testers, sorters, samplers, and weighers
- Biological technicians

Employer demand is expected to be more limited for three of the seven occupations which have fewer than 200 annual openings projected statewide:

- Manufacturing production technicians
- Quality control analysts
- Food science technicians

Recommendation: Community colleges should continue to target pathways that feed into the three occupations with higher projected openings — medical and clinical laboratory technicians; inspectors, testers, sorters, samplers, and weighers; and biological technicians.

Worker and student demographics

Study Finding: Students enrolled in programs related to the seven entry-level occupations tend to be more racially and ethnically diverse than the current workforce. A higher percentage of students tend to be female compared to the workforce overall. While a significant number of students are in their 20s, about 33% of biotechnology students are age 30 or older, and 40% of MLT students are age 30 or older.

Recommendation: The substantial proportion of biotech and MLT students who are age 30 or older may indicate an opportunity for community colleges as mid-career individuals or displaced workers may be returning to school to either retrain to enter the biotech field or achieve career advancement in the biotech field.

Job titles

Study Finding: Previous studies have noted that job titles more accurately depict the types of occupations that employers are filling rather than Standard Occupational Classification titles. With that in mind, the job titles that are most in-demand include: laboratory technician, laboratory assistant, research associate, quality assurance specialist, and manufacturing technician. Quality assurance is a theme that emerged in the analysis of job titles in job postings. Seven of the top 15 job titles use the term "quality," such as quality control analyst, quality specialist, and quality control technician.

Recommendation: Assess if programs are well aligned with job titles commonly used by employers and potentially target preparing students to enter biotech jobs that are geared toward quality assurance and control. Quality assurance and control also figured highly as an in-demand technical skill among job postings by biotech employers.

Industry qualifications

Study Finding: In job postings, the most sought-after technical skills for the entry-level biotech occupations are quality assurance and control, chemistry, and biology. The most common fundamental skills in job postings are communication, research, and detail oriented. The certifications that appear the most often are Certified Medical Laboratory Technician in 179 job postings, Phlebotomy Certification in 170 job postings, and Clinical Laboratory Scientist in 107 job postings.

Recommendation: Programs geared toward preparing workforce ready students may want to evaluate whether the above mentioned technical and fundamental skills have been sufficiently integrated into their curriculum. Data on certifications was limited, but employer feedback could indicate how desirable the top certifications listed in job postings are for potential job candidates.

Gap analysis

Study Finding: To determine whether community colleges in the state are preparing enough students to enter the entry-level biotech occupations, MLT programs training for medical and clinical laboratory technicians were broken out from biotechnology programs that train for the remaining six entry-level occupations. This research approach was adopted due to the state licensing requirement for medical and clinical laboratory technicians. The analysis finds that there is a potential undersupply of 570 MLT or clinical laboratory scientists (CLS) professionals to meet current demand.

Recommendation: In consultation with employer partners, community colleges should consider expanding existing MLT programs to meet employer demand.

Methodology and Definitions

Regional analysis

Regional analyses used in the report reflects the following regional designations as defined by the California Community College's Chancellor's Office. The table below details all colleges assigned to a region.

Region	Geography	Colleges
North Far North	**Far North**: Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama, Trinity **Greater Sacramento (North)**: El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, Yuba	**Far North:** Butte, College of the Redwoods, College of the Siskiyous, Feather River, Lassen, Mendocino, Shasta **Greater Sacramento (North)**: American River, Cosumnes River, Folsom Lake, Lake Tahoe, Sacramento City, Sierra, Woodland, Yuba
Bay Region	San Mateo, Monterey, Santa Cruz, San Benito, Santa Clara, Alameda, Contra Costa, Marin, Napa, Solano, Sonoma, and San Francisco counties	Cabrillo, Canada, College of San Mateo, DeAnza, Evergreen Valley, Foothill, Gavilan, Hartnell, Mission, Monterey Peninsula, San Jose City, Skyline, West Valley, Berkeley City, Chabot, City College of San Francisco, College of Alameda, College of Marin, Contra Costa, Diablo Valley, Laney, Las Positas, Los Medanos, Merritt, Napa Valley, Ohlone, Santa Rosa Junior, Solano
Central Valley/Mother Lode	Alpine, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, Tuolumne	Bakersfield, Cerro Coso, Porterville, Merced, San Joaquin Delta, College of the Sequoias, Clovis, Reedley, Fresno City, Madera College, West Hills Coalinga, West Hills Lemoore, Taft, Columbia, Modesto Junior College
South Central Coast	San Luis Obispo, Santa Barbara, and Ventura counties, and northern Los Angeles County.	Allan Hancock, Antelope Valley, College of the Canyons, Cuesta, Moorpark, Oxnard, Santa Barbara City, Ventura
Inland Empire/Desert	Riverside and San Bernardino counties	Barstow, Chaffey, Copper Mountain, College of the Desert, Mt. San Jacinto, Palo Verde, Moreno Valley, Norco, Riverside City, Crafton Hills, San Bernardino Valley, Victor Valley
Los Angeles/Orange County	Los Angeles and Orange counties	**Los Angeles:** Cerritos, Citrus, Compton, El Camino, Glendale, Long Beach City, East Los Angeles, LA City, LA Harbor, LA Mission, LA Pierce, LA Southwest, LA Trade Tech, LA Valley, West Los Angeles, Mt. San Antonio, Pasadena City, Rio Hondo, Santa Monica **Orange County:** Coastline, Cypress, Fullerton, Golden West, Irvine, North Orange Continuing Education, Orange Coast, Saddleback, Santa Ana, Santiago Canyon
San Diego-Imperial	San Diego and Imperial counties	Cuyamaca, Grossmont, Imperial, MiraCosta, Palomar, San Diego Continuing Education, San Diego City, San Diego Mesa, San Diego Miramar, Southwestern

Industry analysis

NAICS Code	Description
	AGRICULTURAL FEEDSTOCK & INDUSTRIAL BIOSCIENCES
311221	Wet Corn Milling
311224	Soybean and Other Oilseed Processing
325193	Ethyl Alcohol Manufacturing
325311	Nitrogenous Fertilizer Manufacturing
325312	Phosphatic Fertilizer Manufacturing
325314	Fertilizer (Mixing Only) Manufacturing
325320	Pesticide and Other Agricultural Chemical Manufacturing
	DRUGS & PHARMACEUTICALS
325411	Medicinal and Botanical Manufacturing
325412	Pharmaceutical Preparation Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
	MEDICAL DEVICES & EQUIPMENT
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334516	Analytical Laboratory Instrument Manufacturing
334517	Irradiation Apparatus Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing
339114	Dental Equipment and Supplies Manufacturing
	RESEARCH, TESTING, & MEDICAL LABORATORIES
541380*	Testing Laboratories (12%)
541713*	Research and Development in Nanotechnology (75%)
541714	Research and Development in Biotechnology (except Nanobiotechnology)
541715*	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology) (46%)
621511	Medical Laboratories
	BIOSCIENCE-RELATED DISTRIBUTION
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers
424210*	Drugs and Druggists' Sundries Merchant Wholesalers (94%)

*Includes only a portion of these industries engaged in relevant life sciences activities. Source: TEConomy, 2020.

Occupational analysis

Occupational employment projections were obtained for the entry-level and pathway occupational groups and then staffing patterns were applied to approximate employment levels and projected growth and/or decline specific to the target occupations within the core industry employers - the 20-specific life sciences/biotechnology North American Industry Classification System (NAICS) codes as detailed in the industry analysis.

Occupational employment definitions:

Total Job Openings (New + Replacements) — Sum of projected growth (new jobs) and replacement needs. When an occupation is expected to lose jobs, or retain the current employment level, number of openings will equal replacements.

Replacements — Estimate of job openings resulting from workers retiring or otherwise permanently leaving an occupation over the five-year period. Workers entering an occupation often need training. These replacement needs, added to job openings due to growth, may be used to assess the minimum number of workers who will need to be trained for an occupation.

Annual Openings — Annual openings are calculated by dividing the number of years in the projection period by total job openings. In this case, the 2019-2024 Job Openings is divided by five to represent the average number of annual openings over the five-year period.

Wages — By grouping all wages for a single occupation, **e**ntry-level wages are derived from the 25th percentile. Experienced wages are derived from the 75th percentile.

Entry-level and pathway occupations

Occupation (O*NET Code)	Description
Biological Technicians (19-4021)	Assist biological and medical scientists in laboratories. Set-up, operate, and maintain laboratory instruments and equipment, monitor experiments, make observations, and calculate and record results. May analyze organic substances, such as blood, food, and drugs.
Chemical Technicians (19-4031)	Conduct chemical and physical laboratory tests to assist scientists in making qualitative and quantitative analyses of solids, liquids, and gaseous materials for research and development of new products or processes, quality control, maintenance of environmental standards, and other work involving experimental, theoretical, or practical application of chemistry and related sciences.
Food Science Technicians (19-4011.02)	Perform standardized qualitative and quantitative tests to determine physical or chemical properties of food or beverage products.
Inspectors, Testers, Sorters, Samplers, and Weighers (51-9061)	Inspect, test, sort, sample, or weigh nonagricultural raw materials or processed, machined, fabricated, or assembled parts or products for defects, wear, and deviations from specifications. May use precision measuring instruments and complex test equipment.
Manufacturing Production Technicians (17-3029.09)	Set-up, test, and adjust manufacturing machinery or equipment, using any combination of electrical, electronic, mechanical, hydraulic, pneumatic, or computer technologies.
Medical and Clinical Laboratory Technicians (29-2012)	Perform routine medical laboratory tests for the diagnosis, treatment, and prevention of disease. May work under the supervision of a medical technologist.
Quality Control Analysts (19-4099.01)	Conduct tests to determine quality of raw materials, bulk intermediate and finished products. May conduct stability sample tests.

Pathway occupations related to the biotechnology industry

Pathway occupations are especially significant to biotech and MLT workforce preparation at the community college level. Based on student data, 18% of biotech students and 27% of MLT students previously graduated from a four-year institution.

Entry-level Occupations	Pathway Occupations
1. Biological Technicians 2. Chemical Technicians 3. Food Science Technicians (part of SOC 19-4011 Agricultural and Food Science Technicians) 4. Inspectors, Testers, Sorters, Samplers, Weighers 5. Manufacturing Production Technicians (part of SOC 17-3029 Engineering Techs, Except Drafters, All Other) 6. Medical & Clinical Laboratory Technicians (part of SOC 29-2018 Clinical Laboratory Technologists and Technicians) 7. Quality Control Analysts (part of SOC 19-4099 Life, Physical, and Social Science Technicians, All Other)	1. Biochemists & Biophysicists 2. Biomedical Engineers 3. Biostatisticians (part of SOC 15-2041 Statisticians) 4. Chemists 5. Clinical Data Managers (part of SOC 15-2041 Statisticians) 6. Clinical Research Coordinators (part of SOC 11-9121 Natural Science Mgrs.) 7. Compliance Officers 8. First-Line Supervisors/Mgrs. of Production and Operating Workers 9. Laboratory Managers (part of SOC 11-9121 Natural Science Mgrs.) 10. Manufacturing Engineers (part of SOC 17-2199 Engineers, All Other) 11. Medical Scientists, Except Epidemiologists 12. Microbiologists 13. Sales Representatives, Wholesale & Mfg., Technical & Scientific Products

Please note: The group of pathway occupations has larger employment and annual openings than the group of entry-level occupations, but the pathway group is composed of more occupations, a total of 13, than the entry-level group of occupations, a total of seven (7).

Pathway employment, projected growth, and median hourly wage

Pathway Occupations

45,173 current employment (2019)

9% 5-year projected growth

$46 median hourly wages

4,925 annual projected openings

Postsecondary supply analysis

Data on student enrollment and unique student headcount were obtained for three academic years (2016-17 through 2018-19) from the California Community Colleges Chancellor's Office (CCCCO) MIS system as submitted to Educational Results Partnership (ERP) for the back-end data to Cal-PASS Plus LaunchBoard.

In addition, community college biotech programs across the state responded to a survey from the Life Sciences/ Biotechnology team to gather more information about new Biotechnology programs and courses in development, including two bachelor's degree programs; biotechnology pathways; dual enrollment and articulation for secondary and postsecondary pathway programs and K-12 outreach initiatives.

Job-ready student analysis
To estimate the annual supply of biotechnology job-ready students produced by community college programs in the state, the three year (2017-19) average annual number of students who took non-introductory courses in biotechnology related programs of study,[51] as a proxy for the potential number of job-ready students. There are 2,195 students who met these criteria. This number was then multiplied by the average course success rate for these students (83%) during 2017-19, to arrive at an estimated 1,822 job-ready students produced by community colleges in the state.

The annual supply of job-ready students produced by community college Medical Laboratory Technology (MLT) programs in the state was estimated by identifying the number of students on average annually during 2017 to 2019 who received an associate degree or 60-unit certificate in MLT, which are the educational requirements to be eligible for the Medical Laboratory Technician state licensing exam.[52] There are on average annually 70 students during this three year period who received an associate degree or 60-unit Certificate in MLT.

For other postsecondary institutions (public and private), average annual awards data appropriate to the level of education for the occupations was included.

Living Wage Thresholds in California[53]

Household Size	Median Living Wage	Average Living Wage
1 adult	$13.04	$15.29
1 adult, 1 school-age child	$24.68	$28.38
1 adult, 2 school-age children	$30.36	$35.53

*Median and average living wage data calculated from county-level data. No state living wage data set was available.

[51] TOP 0430, TOP 0954, and TOP 0955.
[52] Licensing Authority: California Department of Public Health Laboratory Field Services Personnel Licensing section. Passing the licensing exam is required to be employed as an MLT in the state.
[53] "Family Needs Calculator," Insight Center, 2021, https://insightcced.org/family-needs-calculator/.

Program Inventory

The table below lists the inventory of biotech-related courses and programs currently offered by California Community Colleges by program area, region, and college.

Active Programs & Courses	Region	College	Bachelor's Degree	Associate Degree	Certificate of Achievement	Local Certificate	Non-Credit Program	Program Under Development	Courses Offered; No Degree or Certificate
Biotechnology	North/Far North	American River College		✓	✓				
	Bay Area	Berkeley City College		✓	✓				
		Cabrillo College			✓	✓			
		City College of San Francisco		✓	✓				
		Contra Costa College		✓	✓				
		Ohlone College		✓	✓				
		Skyline College		✓	✓				
		Solano College		✓	✓				
	Central Valley	Merced College		✓	✓				
	South Central Coast	Antelope Valley College							✓
		Moorpark College		✓	✓				
	Inland Empire	Mt. San Jacinto College							✓
	LA/OC (LA)	Citrus College		✓					
		East LA College			✓				
		LA Harbor College		✓	✓				
		LA Mission College		✓	✓				
		LA Trade Tech College							
		Pasadena City College		✓	✓				
		Rio Hondo College			✓				
		West LA College			✓				
	LA/OC (OC)	Fullerton College		✓	✓				
		Irvine Valley College			✓	✓			
		Santa Ana College		✓	✓	✓	✓		

Active Programs & Courses	Region	College	Bachelor's Degree	Associate Degree	Certificate of Achievement	Local Certificate	Non-Credit Program	Program Under Development	Courses Offered; No Degree or Certificate
		Santiago Canyon College		✓	✓				
	San Diego	MiraCosta College		✓	✓				
		San Diego Miramar College		✓	✓	✓			
Biomanufacturing	Bay Area	Laney College		✓	✓				
		Ohlone College			✓				
		Skyline College			✓				
		Solano College	✓						
	LA/OC	Citrus College			✓				
		LA Trade Tech College		✓	✓				
		LA Valley College					✓		
		Santa Ana College			✓				
		Santiago Canyon College			✓				
	San Diego	MiraCosta College	✓	✓	✓				
Medical Laboratory Technician Training	North/Far North	Folsom Lake College		✓					
	Bay Area	De Anza College		✓	✓				
	South Central Coast	College of the Canyons		✓					
	LA/OC	Saddleback College		✓	✓				
	San Diego	San Diego Miramar College		✓	✓				
		Southwestern College		✓					
Bioengineering	Bay Area	Ohlone College		✓					
Computational Biology	Bay Area	Las Positas College		✓					
Bioinformatics		Las Positas College							✓
		Ohlone College							✓
Biostatistics		Ohlone College			✓				
Business of Biotechnology		Laney College							✓

Active Programs & Courses	Region	College	Bachelor's Degree	Associate Degree	Certificate of Achievement	Local Certificate	Non-Credit Program	Program Under Development	Courses Offered; No Degree or Certificate
Biomedical Device Manufacturing	South Central Coast	Moorpark College			✓				
		Ventura College			✓				
Chemical Technology	North/Far North	Sacramento City College		✓	✓				
	LA/OC	LA Trade Tech College		✓	✓				
Chemistry Technician	LA/OC	East LA College		✓	✓				
Analytical Chemistry	Bay Area	Berkeley City College		✓					
Brewing	Bay Area	Santa Rosa College			✓				
Fermentation Management	San Diego	San Diego Mesa College		✓					
Fluorescence Bioscience Microscopy	Bay Area	Merritt College			✓				
Food Safety	LA/OC	Santiago Canyon College			✓				
Food Technologies	Bay Area	Ohlone College							✓
Histotechnician Training	Bay Area	Merritt College			✓				
	LA/OC	Mt. San Antonio College		✓					
Optical Microscopy	Bay Area	Merritt College			✓				
Pharma	Bay Area	Solano College							✓
Pharmacy Technology	LA/OC	Santa Ana College		✓	✓		✓		
Quality & Regulatory	Bay Area	Laney College				✓	✓		
		Solano College							✓
	LA/OC (LA)	Citrus College							✓
		Compton College							✓
		East LA College							✓
		LA Mission College							✓

Active Programs & Courses	Region	College	Bachelor's Degree	Associate Degree	Certificate of Achievement	Local Certificate	Non-Credit Program	Program Under Development	Courses Offered; No Degree or Certificate
	LA/OC (OC)	Fullerton College							✓
		Irvine Valley College							✓
	San Diego	MiraCosta College							✓
		San Diego Miramar College							✓
Stem Cells & Cell-Based Technologies	Bay Area	Solano College			✓				
Stem Cell Technologies	LA/OC	Pasadena City College			✓				

The table below details community college biotech-related courses and programs under development by program area, region, and college.

Programs Under Development	Region	College	Bachelor's Degree	Associate Degree	Certificate of Achievement	Local Certificate	Non-Credit Program	Program Under Development	Courses are Currently Being
Biotechnology	Bay Area	Contra Costa College					✓	✓	
		West Valley College			✓			✓	
	LA/OC	El Camino College			✓			✓	✓
		Cerritos College		✓	✓			✓	
		Glendale Community College		✓	✓			✓	
		LA City College			✓			✓	
		LA Pierce College		✓	✓			✓	
		Santa Monica College		✓	✓			✓	
Biomanufacturing	LA/OC	Compton College		✓	✓			✓	
Agricultural Biotechnology	LA/OC	LA Pierce College		✓	✓			✓	
Plant/Agricultural Biotechnology	South Central Coast	Allan Hancock College		✓	✓			✓	
Cannabis Technologies	South Central Coast	Allan Hancock College							✓
Fermentation	LA/OC	Rio Hondo College		✓	✓			✓	✓
Bioinformatics	Bay Area	Berkeley City College			✓			✓	
Business of Biotechnology	Bay Area	College of San Mateo			✓			✓	
Genetics & Genomics	Bay Area	Merritt College			✓			✓	✓

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