

SUPPLY AND DEMAND ANALYSIS

LIFE SCIENCES & BIOTECH

MIDDLE SKILLS WORKFORCE

In California

OCTOBER 2014



PREPARED BY:

JOHN CARRESE, CENTERS OF EXCELLENCE FOR LABOR MARKET RESEARCH

EVGENIYA LINDSTROM, CENTERS OF EXCELLENCE FOR LABOR MARKET RESEARCH

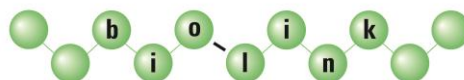
GLORIA BAÑUELOS, LIFE SCIENCES/BIOTECH INITIATIVE

WENDIE JOHNSTON, LIFE SCIENCES/BIOTECH INITIATIVE

JOSIE SETTE, LIFE SCIENCES/BIOTECH INITIATIVE

SANDRA SLIVKA, LIFE SCIENCES/BIOTECH INITIATIVE

ELAINE JOHNSON, BIO-LINK NATIONAL ATE CENTER FOR BIOTECHNOLOGY & LIFE SCIENCES





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Inform Connect Advance

For more information on this report contact:

John Carrese, COE Director
San Francisco Bay Area Region
jcarrese@ccsf.edu
415-452-5529

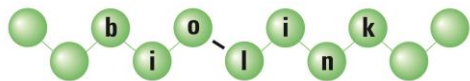
Evgeniya “Zhenya” Lindstrom, COE Director
San Diego & Imperial Counties Region
zhenya.lindstrom@chaffey.edu
909-652-7753



For more information about California Life Sciences/Biotech Initiative contact:

Sandra Slivka Ph.D.
Statewide Sector Navigator
Life Sciences/Biotech
sslivka@sdccd.edu
619-388-7490
www.calbiotechcareers.org

For more information about Bio-Link contact:



Elaine Johnson
PI/Executive Director
Bio-Link Next Generation National ATE Center
for Biotechnology & Life Sciences
ejohnson@biolink.ucsf.edu
415-487-2472
www.bio-link.org

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Introduction

The California Community Colleges *Doing What Matters for Jobs and the Economy* (DWM) program has charged community colleges with having the right number of programs in the right locations. This will ensure we are producing the right number of graduates, with the right skills to meet the needs of employers in ten priority and emergent sectors. By aligning supply with demand in this way, employers will be more productive because they will have the key talent they need to succeed. Furthermore, the alignment of supply and demand will need to be fine-tuned going forward as the labor market changes¹.

In order to facilitate the alignment of programs to employer needs in each of the ten priority sectors, the Statewide Sector Navigators and Regional Deputy Sector Navigators (DSNs) were selected in each of the ten priority and emergent sectors. The California Community College (CCC) system has also charged the Centers of Excellence for Labor Market Research (COEs), part of the DWM program, to identify industries and occupations that have unmet employee development needs and introduce partnership potential for colleges.

The Life Sciences/Biotechnology sector is one of the ten priority sectors. The CCC Life Sciences/Biotech Sector Navigator and regional DSNs (SN/DSN team) partnered with the regional COEs and Bio-Link Next Generation National ATE Center for Biotechnology and Life Sciences to conduct a study of this sector in California. This combined “research team” set out to answer the following question: “Are the community colleges with Biotechnology courses or programs in the state meeting the demand employers have for middle skilled (operational laboratory) workers?”

The research team utilized multiple data sources and methods to gather the necessary data to assess the training gap between supply and demand. The study provides both a state and regional analysis of the supply and demand as well as a look at skill, education, and certification requirements by employers.

Research Methodology

The methodology used by the research team was to generate both labor market demand data and college supply data so that the two could be compared to determine if California’s community colleges with related courses or programs are meeting the labor market demand for biotechnicians. Both state and regional level data was considered for demand and supply analysis. To accomplish this “training gap analysis”, the research team needed to start on the “demand side” of the equation to define the biotechnology industry in the state using NAICS (North American Industry Classification System) codes. Since the NAICS codes represent the total industry that employs scientific and non-scientific staff at all levels, it was necessary to narrow the occupations to those relevant to community colleges. Then employment data on these occupations was pulled. Finally on the “supply side”, college capacity to produce job ready biotechnicians needed to be determined, so that supply could be matched to demand to

North American Industry Classification System (NAICS)

The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The U.S. NAICS Manual includes definitions for each industry, background information, tables showing changes between 2007 and 2012, and a comprehensive index.

¹ For more information about the Doing What Matters program: www.doingwhatmatters.cccco.edu

determine if there was an over or undersupply of biotechnicians to the regional and state labor markets.

Defining Industries

The Life Sciences/Biotechnology sector is a complex and quickly evolving group of industries, spanning many NAICS codes and industry subsectors. An industrial definition of the biosciences is challenging due to its diverse mix of technologies, products, R&D focus, and companies themselves. The industry includes companies engaged in advanced manufacturing, research activities, and technology services but has a common thread or link in their application of knowledge in the life sciences and how living organisms function. At a practical level, federal industry classifications don't provide for one over-arching industry code that encompasses the biosciences. Instead, more than two dozen detailed industries must be combined and grouped to best organize and track the industry in its primary activities. The Battelle/BIO State Initiatives reports have developed an evolving set of major subsectors that group the bioscience industry into five key components, including: 1) Agricultural feedstock and chemicals, 2) Bioscience-related distribution, 3) Drugs and pharmaceuticals, 4) Medical devices and equipment, 5) Research, testing, and medical laboratories.² Appendix A lists specific NAICS codes that comprise each of the Battelle's five industry subsectors.

Defining Occupations

Once the sector was defined the research team looked at the specific occupations that are the focus of community college programs. After comparing the occupational titles and job titles that employers use, the team found that Standard Occupational Classification (SOC) codes do not work well for the life sciences/biotechnology jobs as many employers describe jobs for biotechnology workers differently.

Despite the challenges with the codes, the research team was able to categorize relevant occupations into two groups. **Group 1** included those occupations that the research team felt community college students would be best prepared for (6 SOC code occupations). These occupations are often referred to as “middle skills jobs”³ and represent the technician level jobs of the sector. Group 1 is the main focus of the study. **Group 2** included those occupations that are considered part of a biotech “pathway” and would require at least a bachelor's degree or higher (14 SOC code occupations). Although many students find work without advanced degrees, employers still look for individuals with more than a community college certificate or degree for even middle skills jobs.

Standard Occupational Classification (SOC) system

The Standard Occupational Classification (SOC) system is used by Federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition.

The goal of this ‘narrow’ occupational definition was to get a true view of the ‘demand’ side of the industry statewide and in the three key regions in the state: the San Francisco Bay region, the Los Angeles/Orange County region and the San Diego region. These are the regions that are economically important to the state and thus are the key focus of this study.⁴

² Battelle/BIO State Bioscience Jobs, Investments and Innovation 2014

³ Middle skills jobs generally require workers to have some education and training beyond their high school diploma but less than a bachelor's degree (source: “The Future of the U.S. Workforce: Middle Skills Jobs and the Growing Importance of Postsecondary Education, Achieve, 2012)

⁴ See Appendix B for the definitions of the regions by county and Appendix C for visual representation of the geographic distribution of firms, employment, and revenue.

Demand Data

The COE team took the lead on generating the data to determine the regional and state labor market demand for the Group 1 occupations, i.e. technician level biotechnology occupations for which community colleges have programs. Multiple data sources were used to generate the demand data for the Life Sciences/Biotechnology sector:

1) **EMSI data sets** were used to look at projected demand over the next five years (2013-18) for a cluster of six occupations that community college students would be best prepared for in the biotechnology sector. The definition of the biotechnology sector used for this study was developed by Battelle and includes 25 different NAICS codes. Data for the Group 1 occupations was pulled using SOC codes but only within the industries that define the biotechnology sector. In addition, wage data for these occupations was researched.

2) **Burning Glass data** was used to look at online job postings in California for the 2013 calendar year to better understand the demand for each of the six occupations in Group 1 based on on-line job postings. This data includes job postings by top employers; by top skills and certifications in demand; and by educational requirements. Burning Glass data was also used to define the actual job titles used by employers when posting job openings. These titles are often different than the occupational titles (SOC codes) of the six occupations that were selected for the EMSI data pull. It is important for community college program leads to understand the job titles, skills and educational requirements that are commonly posted by employers in the sector so they can adapt programs to prepare students for these positions. The selection criteria used for the Burning Glass data pull can be found in Appendix D.

3) **Info USA data** was reviewed to better understand the number and type of establishments in the state and by region, for the various industry subsectors that make up the overall biotechnology sector as well as the sales volume of establishments by industry subsector and region. The InfoUSA data on biotechnology establishments was pulled using Battelle's 25 NAICS codes that define the sector.

Economic Modeling Specialists Intl., (EMSI)

Economic Modeling Specialists Intl., (EMSI) labor market information is compiled from 90+ data sources and updated quarterly. EMSI's composite dataset includes occupational wages, industry trends, employment growth/decline and concentration.

Burning Glass Labor/Insight™

Burning Glass Labor/Insight™ is an interactive, report-generating application that gives users real-time access to a comprehensive database of demand (jobs) data. It is powered by Burning Glass's unique technology for jobs data aggregation, parsing, extraction, and analysis, which translates free text job postings into actionable intelligence on the nature and content of employer demand.

Info USA

Info USA is a source for more than 23 million business records in the U.S. including geography, income, sales volume, and employee counts.

Supply Data

The SN/DSN team took the lead on generating both state and regional supply data from the 27 community colleges in the state with biotechnology courses or programs. Multiple data sources were used in this process as well, including:

1) **CCC Chancellor's Office MIS data** provided an overview of biotechnology programs in the state and the number of graduates – from both Associate degrees and Certificates of Achievement – that are recognized by the Chancellor's Office. It is important to note that local

certificates from a college are departmental awards and do not appear on student transcripts. Colleges that have no formal or informal program are those that only offer courses.

2) **College course offerings** were reviewed and categorized by the SN/DSN team to provide estimates of the **current annual capacity** of California Community Colleges to produce workforce ready students and the **current annual supply** of job ready students. A detailed description of the methodology used to generate these numbers is provided in the “Supply Data” section of this report.

3) **Surveys and interviews with the Biotechnology Program Directors** at each of the colleges were conducted by the SN/DSN team in order to validate the assumptions made in generating the current annual capacity and annual supply numbers for each college.

Finally the supply data includes other potential sources of supply, including the names of four-year universities and proprietary institutions in California with baccalaureate or undergraduate programs in biotechnology.

In the “Training Gap Analysis” section of the report, the research team analyzes the supply of job ready biotechnicians compared to the demand for these workers based on EMSI annual projected openings in California. A similar training gap analysis for the sub-regions of the San Francisco Bay, Los Angeles/Orange County/Ventura and San Diego can be found in Appendix E.

Finally, the “Summary of Findings and Recommendations” section provides an overview of key findings and makes recommendations to colleges about how to respond to the workforce needs of biotechnology employers as a result of the study.



Industry Overview

The life sciences/biotechnology sector is best understood as a group of diverse industries with a common link — the application of biological scientific knowledge. Biotechnology harnesses cellular and biomolecular processes to develop technologies and products that combat debilitating and rare diseases, reduce our environmental footprint, feed the hungry, use less and cleaner energy, and have safer, cleaner and more efficient industrial manufacturing processes.

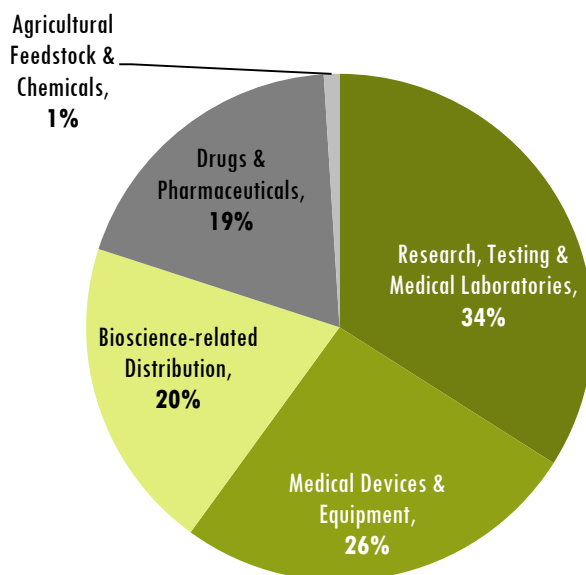
The sector represents a mix of five industry subsectors:

- Agricultural Feedstock & Chemicals
- Drugs & Pharmaceuticals
- Medical Devices & Equipment
- Research Testing & Medical Laboratories
- Bioscience-related Distribution

The life sciences/biotechnology sector has demonstrated that it is a strong and steady job generator, growing jobs over the past decade at a pace well above the national average. It also has fared much better than the overall economy through the recent U.S. recession and into the first few years of the recovery. A primary reason for the resiliency of biotechnology is the diverse set of markets it serves. These markets span: biomedical drugs; diagnostics and devices; agricultural products from animal health to seeds and crop protection; and bio-based industrial products such as enzymes for industry chemical processes and bio-remediation, bio-fuels, and bio-plastics.

Figure 1 demonstrates the five biotechnology subsectors by employment in California. Research, Testing & Medical Laboratories are responsible for the most jobs in this sector.

Figure 1 – Life Sciences/Biotechnology Subsectors by Employment (California, 2014)



Source: Battelle/BIO, 2014

Quick Facts about Life Sciences/Biotechnology:

- California has the largest life sciences/biotechnology employment base in the U.S. with more than 235,000 jobs, spanning over 8,000 individual business establishments.
- California's largest biotechnology subsector –Research, Testing, and Medical Labs –has increased employment by 19 percent between 2007 and 2012 and maintained strong job growth even during the recent recession years.
- The average California life sciences/biotechnology job paid \$107,335 in 2012, which is \$51,090 more than the average private sector job.
- Over \$19 billion in biotechnology-related venture capital (VC) investments were made in California between 2009 and 2013, accounting for over 38% of VC dollars invested in biosciences in the U.S. during that period.
- California's academic and research institutions lead the nation in National Institutes of Health (NIH) funding, receiving over \$3 billion in 2013.⁵

Within California, there are three geographic regions where the life sciences/biotechnology industries are concentrated and economically important. These regions are the Los Angeles/Orange County region, the San Francisco Bay region and the San Diego region. Table 1 shows the regional concentrations of firms, employment and annual sales revenue for the three regions.

Table 1 – Life Sciences/Biotechnology Sector by Macro Region

Macro Region	Number of Firms	Number of Employees	2012 Sales Volume
Los Angeles/Orange County	4,600	128,700	\$30.7 billion
San Francisco Bay	2,900	118,900	\$72.1 billion
San Diego	1,300	42,900	\$14.7 billion

Appendix C of this report contains a heat map of the biotechnology sector employment and revenue in California, broken out by the 15 economic regions defined by the Doing What Matters initiative of the CCCC.

⁵ 2014 California Biomedical Industry Report by California Healthcare Institute and PwC.

Labor Market Demand: Occupational Employment

The research team conducted the analysis of related occupations using the Standard Occupational Classification (SOC) codes and their descriptions as well as Occupational Information Network (O*NET) codes. As described in the methodology section, this analysis resulted in two sets of occupations: Group 1, “middle skills” occupations, i.e. those that require Bachelor’s degree or below to obtain employment; and Group 2 “pathway” occupations, i.e. those that require graduate level degrees and/or significant work experience.

The following 20 occupations were included in two groups:

Group 1: Entry Level Occupations

- Biological Technicians
- Chemical Technicians
- Medical and Clinical Laboratory Technicians
- Quality Control Analysts (*part of SOC 19-4099 Life, Physical, and Social Science Technicians, All Other*)
- Manufacturing Production Technicians (*part of SOC 17-3029 Engineering Technicians, Except Drafters, All Other*)
- Inspectors, Testers, Sorters, Samplers, Weighers

Group 2: Pathway Occupations

- Laboratory Managers (*part of SOC 11-9121 Natural Science Managers*)
- Clinical Research Coordinators (*part of SOC 11-9121 Natural Science Managers*)
- Compliance Officers
- Biostatisticians (*part of SOC 15-2041 Statisticians*)
- Clinical Data Managers (*part of SOC 15-2041 Statisticians*)
- Biomedical Engineers
- Biochemists and Biophysicists
- Microbiologists
- Medical Scientists , Except Epidemiologists
- Chemists
- Medical and Clinical Laboratory Technologists
- Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
- First-Line Supervisors/Managers of Production and Operating Workers
- Manufacturing Engineers (*part of SOC 17-2199 Engineers, All Other*)

To understand the demand for both groups of occupations and their share in the employment across Life Sciences/Biotechnology industries, the occupational employment projections were obtained for both groups within the specific industry NAICS codes included in Battelle’s Bioscience industry definition of 25 NAICS codes (see Appendix A for this Bioscience industry definition). Figure 2 represents the high level employment statistics related to the two groups of occupations.

Figure 2 – Employment Statistics for Two Groups of Biotechnology Occupations in California



Data source: EMSI

Both middle skills and pathway occupations are important for the biotechnology sector. The current number of people employed in the six middle skills occupations comprise almost one-third of the employment across all 20 occupations included in the analysis. Both groups are projected to grow at a relatively fast rate, with the middle skills occupations increasing 15% over the next five years and the pathway occupations increasing 13% over the same period.

Even though the pathway occupations are an important component of the demand in the biotechnology sector, community college programs primarily prepare students for jobs in middle skills occupations. Therefore, further analysis of the labor market demand focuses on the six occupations in Group 1. Their definitions are provided below.

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.
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. <i>Part of 17-3029 Engineering Technicians, Except Drafters, All Other</i>
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. <i>Part of 19-4099 Life, Physical, and Social Science Technicians, All Other</i>

Source: O*Net

Employment

Using EMSI data, projected labor market demand data for these six occupations in California is presented in Table 2.

The chart in Table 2 shows the projected growth (change) between 2013 and 2018 and that change represented as a percentage increase from 2013 to 2018. The chart also shows the projected number of workers for each occupation who will need to be replaced over the five-year period due to workers retiring or leaving for other reasons. In the “Openings” column the number of new workers from the “change column” and replacement workers have been added

together to create an Openings number for each occupation. Openings have been divided by 5 to create an “Annual Openings” number that is an average number of annual openings over the period.

Table 2 – Employment Projection for Middle Skills Biotechnology Occupations in California

Occupation	2013 Jobs	2018 Jobs	2013-18 Change	2013-18 Replace- ments	% Change	Open- ings	Annual Openings
Manufacturing Production Technicians* (17-3029.09)	804	878	74	80	9%	154	31
Biological Technicians (19-4021)	2,962	3,210	248	533	8%	781	156
Chemical Technicians (19-4031)	2,475	2,912	437	223	18%	660	132
Quality Control Analysts** (19-4099.01)	745	818	64	164	8%	228	46
Medical and Clinical Laboratory Technicians (29-2012)	3,427	4,000	573	343	17%	916	183
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	6,632	7,769	1,137	862	17%	1,999	400
TOTAL	17,045	19,587	2,533	2,205	15%	4,738	948

*The data presented for this occupation is based on the broader 6 digit SOC code for Engineering technicians, except drafters, all other (17-3029)

**The data presented for this occupation is based on the broader 6 digit SOC code for Life, physical and social science technicians, all other (19-4099)

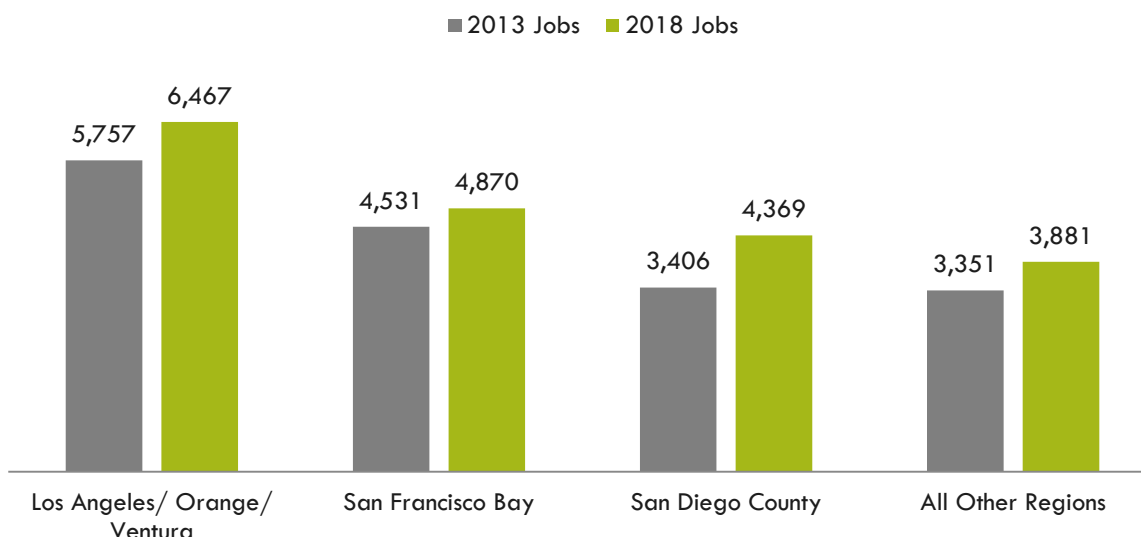
Source: EMSI

The demand data shows that current employment for the cluster of six middle skills occupations is 17,045. Over the 2013-2018 period it is projected that 2,533 new jobs will be added to this cluster of occupations to bring employment in 2018 to 19,587. There will also be 4,738 openings (new plus replacement jobs) for the cluster of six occupations over the five year period, with 948 openings annually. The growth rate projected for the cluster of six occupations is 15% over the five-year period, which if averaged is an annual growth rate of 3%.

The occupation that is projected to have the greatest number of openings in California over the next five years is Inspectors, Testers, Sorters, Samplers and Weighers (1,999) followed by Medical and Clinical Laboratory Technicians (916). The fastest growing occupation is Chemical Technicians, with 18% growth over the period, followed closely by Medical and Clinical Laboratory Technicians and Inspectors, Testers, Sorters, Samplers and Weighers, both with 17% growth over the period. The occupation with the largest current employment in the state is Inspectors, Testers, Sorters, Samplers and Weighers, with 6,632 workers.

The growth rate for the cluster of six occupations is 15% over the five-year period, which if averaged is an annual growth rate of 3%.

The chart in Figure 3 compares occupational employment data for the Los Angeles/Orange County region, the San Francisco Bay region and the San Diego region.

Figure 3 – Current and Projected Jobs for Middle Skills Biotechnology Occupations by Region

Source: EMSI, 2014

The San Diego region is projected to have the most openings - 1,414 new plus replacement jobs for the cluster of six occupations over the five year period, or 283 annually. The Los Angeles/Orange/Ventura region is projected to have the next highest number of openings (new plus replacement jobs) over the five year period, with 1,383 (276 annually). The San Francisco Bay region is projected to have 949 openings (new plus replacement jobs) over the five year period, or 188 annually. The San Diego region has the highest growth rate for the cluster of six occupations, at 28% over the five-year period, which if averaged is an annual growth rate of 5.6%. The Los Angeles/Orange/Ventura region has the next highest growth rate, at 12% over the five-year period, an average annual growth rate of 2.4%. The San Francisco Bay region is projected to have a growth rate of 7% over the five year period, an average annual growth rate of 1.4%.

Additional occupational data for the Los Angeles/Orange/Ventura, San Diego and San Francisco Bay regions can be found in the Appendix E.

The combined annual job openings for the six middle skills occupations in the Los Angeles, San Diego and the Bay Area regions (747) represents 79% of the total annual openings in California (948).

Occupational Wages

Table 3 shows data on wages for each of the six occupations that were studied. Median hourly earnings are provided along with 25th percentile and 75 percentile hourly earnings. Wage data at the 25th percentile for employees in an occupation is an indication of more entry-level wages and at the 75th percentile an indication of wages for employees with more experience in the occupation.

Table 3 – Wages for Middle Skills Biotechnology Occupations in California

Occupation	Median Hourly Earnings	25 Percentile Hourly Earnings	75 Percentile Hourly Earnings
Manufacturing Production Technicians* (17-3029.09)	\$31.36	\$24.20	\$38.66
Biological Technicians (19-4021)	\$21.89	\$16.93	\$18.14
Chemical Technicians (19-4031)	\$20.92	\$15.87	\$27.80
Quality Control Analysts** (19-4099.01)	\$22.84	\$18.13	\$28.65
Medical and Clinical Laboratory Technicians (29-2012)	\$19.69	\$16.53	\$24.08
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	\$17.34	\$13.24	\$22.90

*The data presented for this occupation is based on the broader 6 digit SOC code for Engineering technicians, except drafters, all other (17-3029)

**The data presented for this occupation is based on the broader 6 digit SOC code for Life, physical and social science technicians, all other (19-4099)

Source: EMSI

The occupation with the highest median wages is Manufacturing Production Technicians at \$31.36 per hour. The occupation with the lowest median wages is Inspectors, Testers, Sorters, Samplers and Weighers at \$17.34.

The San Francisco Bay Region has the highest median wages for five of the six middle skills occupations when compared to the other two regions. The San Diego region's median wages are higher than those in the Los Angeles/Orange County region for four of the six occupations. EMSI wage data for the six occupations by region can be found in Appendix E.

Employer Demand: Job Postings

Employer demand can also be quantified and qualified by analyzing online job postings. Using Burning Glass, the research team compiled job postings data for the same six middle skills occupations to look at the following: number of job postings by occupation, common job titles, top required skills, minimum education requirements, top certifications, postings by industry, and top employers advertising jobs.

For more information on the selection process and criteria utilized, refer to the methodology section and Appendix D.

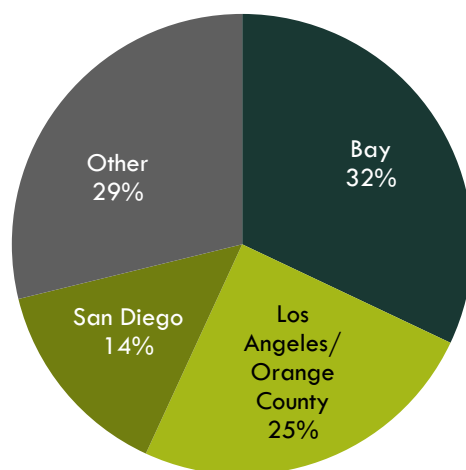
Table 4 below shows the results of the 'Top Occupations' data pull. For the calendar year 2013 in California, 3,297 job postings met the selection criteria. The occupation with the most openings was Medical and Clinical Laboratory Technicians (1,529) followed by Inspectors, Testers, Sorters, Samplers, and Weighers (617) and then Manufacturing Production Technicians (357). For the Los Angeles/Orange/Ventura, San Diego and Bay Area regions these same occupations were also the top three occupations with the most openings.

Table 4 – Number of Job Postings by Occupation in California, Full Year 2013

O*NET Code	Occupation	Number of Job Postings, Jan – Dec 2013
29-2012	Medical and Clinical Laboratory Technicians	1,529
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	617
17-3029.09	Manufacturing Production Technicians	357
19-4099.01	Quality Control Analysts	310
19-4021	Biological Technicians	402
19-4031	Chemical Technicians	82
Total		3,297

Source: Burning Glass, 2014

Figure 4 represents the distribution of the job postings across California regions. About one-third of all online advertisements were posted by employer in the Bay region, followed by Los Angeles/Orange County region (25% of job postings). Appendix E provides more detailed data for each of the three regions.

Figure 4 – Postings for Middle Skills Biotechnology Jobs by Region (n= 3,297)

Source: Burning Glass, 2014

Common Job Titles

Table 5 below shows the results of the “Top Job Titles” data pull, based on the selection criteria (see Appendix D). These are the actual titles that employers use in advertising jobs for the six occupations of study. For the calendar year 2013 in California, the top job titles for the 3,297 job postings were Laboratory Assistant (569), Manufacturing Technician (301) and Quality Assurance Specialist (254).

Table 5 – Top 15 Job Titles by Number of Job Postings in California, Full Year 2013

Title	Number of Job Postings, Jan – Dec 2013	Title	Number of Job Postings, Jan – Dec 2013
1. Laboratory Assistant	569	9. Research Associate	53
2. Manufacturing Technician	301	10. Production Technician	51
3. Quality Assurance Specialist	254	11. Quality Control Inspector	43
4. Laboratory Technician	246	12. Quality Specialist	42
5. Quality Control Analyst	136	13. Research Technician	40
6. Quality Control Technician	97	14. Clinical Technician	38
7. Medical Laboratory Technician	96	15. Quality Inspector	35
8. Specimen Accessioner	82		

Source: Burning Glass, 2014

Skills, Education, and Certification Requirements

Table 6 shows the results of the “Top Required Skills” data pull, based on the selection criteria. For the calendar year 2013 in California, 2,863 job postings listed technical and fundamental skills. The technical skill most frequently listed in job postings as a requirement was Chemistry (705), followed by Inspection (513) and then Good Manufacturing Practices (504). For fundamental skills, the most frequently listed skill was Quality Assurance and Control (1,100) followed by Communication Skills (1,027) and then Research (898).

Table 6 – Top Required Skills by Employer Job Postings in California (n=2,863)

Technical Skills (Specialized)		Fundamental Skills (Baseline)	
Skill	Number of Job Postings, Jan–Dec 2013	Skill	Number of Job Postings, Jan–Dec 2013
Chemistry*	705	Quality Assurance and Control**	1,100
Inspection	513	Communication Skills	1,027
Good Manufacturing Practices (GMP)	504	Research	898
Biology*	366	Organizational Skills	804
Experiments	352	Writing	749
Laboratory Equipment	346	Microsoft Excel	601
Validation	291	Detail-Oriented	587
Good Laboratory Practices (GLP)	262	Computer Skills	499
Biochemistry	244	Troubleshooting	468
Calibration	225	Problem Solving	345
Mathematics	220	Microsoft Office	336
High Performance Liquid Chromatography	202	Multi-Tasking	304
Manufacturing Processes	199	English	298
Record Keeping	199	Management	266
Molecular Biology	190	Microsoft Word	228
Laboratory Testing	168	Planning	160
Phlebotomy	168	Leadership	159
Cell Culturing	163	File Management	153
Laboratory Procedures	161	Time Management	149
Sample Preparation	158	Microsoft PowerPoint	144

* Labor Market Employer Forum in San Diego suggested that these are general subject areas. What employers are looking for in middle skills biotechnology workers is familiarity with applied chemistry and biology as it relates to routine laboratory work.

** Labor Market Employer Forum in San Diego suggested that Quality Assurance and Control should be listed as Technical Skill Area.

Source: Burning Glass, 2014

Table 7 shows the results of the “Distribution of Minimum Education Requirements” data pull, based on the selection criteria. For the calendar year 2013 in California, 3,544 job postings were listed.⁶ The data reveals that 34% of employers posted jobs requiring a Bachelor’s degree as the minimum education required, followed by 28% of employers posted jobs that required a High School degree. Nine percent of employers posted jobs that required a Post-Secondary or Associate degree and 2% of employers posted jobs that required a Graduate or Professional degree. About one-fourth of the postings did not list an educational requirement. Based on comments of the employers who participated in the San Diego region labor market forum, they often do not post education requirements to ensure that they are receiving a wider pool of candidates for a job.

Table 7 – Distribution of Minimum Education Requirements in Employer Job Postings in California (n=3,544*)

Education Level	% of Job Postings, Jan–Dec 2013
High School	28%
Post-Secondary or Associate Degree	9%
Bachelor’s Degree	34%
Graduate or Professional Degree	2%
Unspecified	27%

Source: Burning Glass, 2014

Table 8 shows the results of the “Top Certifications” data pull, based on the selection criteria. For the calendar year 2013 in California, 576 job postings listed a certification sought by employers, which means 82% of job postings did not list any certifications. Among those employers which mentioned certification requirement in the job ads, the top certifications they wanted were Phlebotomy certification (134 job ads), Certified medical laboratory technician (73) and First aid CPR AED (37).

Table 8 – Top Certifications by Employer Job Postings in California (n=576*)

**82% of job postings did not list any certification*

Certification	Number of Job Postings, Jan–Dec 2013
Phlebotomy certification	134
Certified medical laboratory technician	73
First aid CPR AED	37
Clinical laboratory scientist (CLS)	25
Biotechnology	21
Laboratory animal technician	21
Six sigma certification	15
American society for quality (ASQ) certification	11
Veterinary technician	11
American society of mechanical engineers (ASME) certified	9
Certified cardiovascular technologist	9
Registered vascular technologist	9

Source: Burning Glass, 2014

⁶ In order to pull education requirements and get 100%, data had to be pulled from the new Burning Glass interface. The old interface produced values that added up to over 100%; it included all education (minimum and preferred) rather than just minimum education. In the new interface, the skills clusters were not exactly the same and only went as far as “sciences: biotech” instead of “sciences: biotech: research/clinical trials”. This produced an increase in the number of job postings for pull 2. This is the only instance in which this data is used. All other data for pull 2 is from the original pulls.

Employers Posting Jobs

Table 9 shows the results of the “Top Industries” data pull, based on the selection criteria. This data pull helps us understand what types of establishments are posting online advertisements for middle skills biotechnology jobs. For the calendar year 2013 in California, 3,297 job postings were listed. The industry with the most job postings (over half) is Scientific Research and Development Services with 1,702 postings, followed by Pharmaceutical and Medicine Manufacturing with 665 postings.

Table 9 – Employer Job Advertisements by 4-digit NAICS Industry in California

NAICS	Industry Name	Number of Job Postings, Jan–Dec 2013
5417	Scientific Research and Development Services	1,702
3254	Pharmaceutical and Medicine Manufacturing	665
6215	Medical and Diagnostic Laboratories	270
3345	Navigational, Measuring, Electromedical & Control Instruments Mfg.	183
3391	Medical Equipment and Supplies Manufacturing	70
6113	Colleges, Universities, and Professional Schools	383
5613	Employment Services	24
Total		3,297

Source: Burning Glass, 2014

Among the largest employers (Table 10) that advertised biotechnology positions online in 2013 were University of California (196 job ads), Laboratory Corporation of America (131), Gilead Sciences (123) and Genentech (111). Table 9 lists the names of 15 top employers that post jobs for entry level biotechnology employment.

Table 10 – Top Employers by Number of Job Advertisements in California

Employer	Number of Job Postings, Jan–Dec 2013	Employer	Number of Job Postings, Jan–Dec 2013
University of California	196	Quest Diagnostics Inc.	54
Laboratory Corp. of America	131	Hoffmann-La Roche	53
Gilead Sciences	123	Grifols	44
Genentech, Inc.	111	Dianon Systems Inc.	41
Life Technologies	89	Palo Alto Medical Foundation	41
Baxter International Inc.	65	University of Southern California	38
Bayer Corporation	59	IDEXX Laboratories, Inc.	21
Novartis	59		

Source: Burning Glass, 2014

As research institutes and universities are important employers of middle skills biotechnology workforce, the research team looked at specific job titles and their descriptions which these employers were advertising in 2013. Table 11 demonstrates five specific examples of jobs that were posted by research universities. They include laboratory technicians and laboratory assistants of various levels. This confirms that traditional labor market data sources do not capture all biotechnology jobs because these positions appear in educational institutions rather than traditional biotechnology related industries. For this reason, it can be assumed that EMSI job projection numbers for occupations within biotechnology industries are underestimated.

Table 11 – Examples of Online Job Postings by Research Universities

Title	Institution	Location	Description
Lab Technician	Stanford University Medical Center	Palo Alto, CA	Processes/tests specimens, maintenance, archive lab samples.
Laboratory Assistant II	UC San Diego	La Jolla, CA	Assists with coordinating research with human subjects involving psychiatric disorders, HIV and substance dependence
Laboratory Assistant I	UCLA	Los Angeles, CA	Assists in experiments involving cell culture and virus production in School of Dentistry
Laboratory Assistant II	UC Santa Cruz	Santa Cruz, CA	Assists with field and lab research of salmonids (species of fish), endangered species
Hospital Lab Technician III	UC Irvine Health	Irvine, CA	Assists with patient care and performs tests related to ophthalmology (eye care)

Source: *Burning Glass, 2014*

Employer Needs: Biotech Recruiter Perspective

In tandem with this Gap Analysis study, California Life Sciences Initiative⁷ staff conducted face-to-face interviews with recruiters from eight staffing agencies across the state (Spring 2014). The interviews helped to refine and validate the demand for community college graduates. Recruiters were queried about which skills are hard to find, how many placements were done over a two-year period, and how many placements they project over the next two years. They were also asked about credentialing and whether micro-credentials or badges would be useful to them and potential employers.

The findings are as follows:

- About 65% of the companies that these agencies work with have over 100 employees. Collectively these agencies placed over 6,000 positions in the last two years and are predicting growth of placements to over 8,000 for the next two-year period.
- Fourteen percent of candidates are direct hire, and the rest are hired for temporary employment (38%) or temp to hire (51%), which allows a company to “test” a candidate before hiring. Working with these agencies is important for community college programs for transitioning students to entry-level jobs.

⁷ www.calbiotechcareers.org

- c. Students with less than a Bachelor's degree are considered for entry-level positions in general lab and manufacturing jobs, and are not placed into R&D.
- d. Staffing agency sentiment toward industry-vetted certification of job-skills is positive, indicating this would reduce training costs, reduce questions of consistency in job preparation between schools, reduce administrative burden and assist in hiring decisions.
- e. When asked the most common reasons for lack of "fit" with job seekers and new hires, the anecdotal information clustered around the following:
 - i. *Job seekers:* Lack of specific lab skills, inability to handle meeting and interviewing with hiring managers, resume skills not accurately portrayed.
 - ii. *New hires:* Misalignment of expectations and reality, lack of skills in communication, teamwork, skill level not meeting employer expectations.



Supply Side

This section of the report provides an overview of the biotechnology programs in the state as well as estimates of the **annual current capacity** of California Community Colleges to produce workforce ready students and the **current annual supply** of job ready students.

Background and Method

Consensus among faculty leaders of California Community Colleges (CCC) Life Sciences/Biotechnology programs is that the supply of individuals to the labor market cannot be determined by counting the number of awards (associate degrees and certificates granted to students). Not only do many ‘successful non-completers’ never finish a program to get the award, many who qualify never fill out the paperwork necessary to receive the credential. Thus, it was the consensus among faculty that there needs to be a better way to measure the number of students receiving necessary biotechnology skills and their success.

The concept of ‘skill builders’ put forth in a work called “*The Missing Piece*” by Kathy Booth and Peter Riley Bahr was used as the basis for developing a new metric for success. Booth and Bahr examined the course taking behavior of community college students and found that many students can be classified as ‘skill builders’ – students who take only the courses they need to gain employment or advancement and who do not seek degrees or certificates⁸. They propose that ‘skill builder’ students, known for years by biotechnology programs faculty as ‘successful non-completers’, be used in quantifying program success. This concept was utilized as the basis for assessing the supply of job ready students.

This study was limited to the programs classified under the Taxonomy of Programs (TOP) code 04.3000 *Biotechnology* as it directly prepares for the employment in biotechnology industries and occupations discussed in this report. For the years 2008-2009 through 2012-2013 data were obtained on student enrollment from the California Community Colleges Chancellor’s Office (CCCCO) Datamart and CCCCCO Curriculum Inventory. Additionally, program status (active or not) was determined by pulling information from the 2013-2014 college catalogs.

Estimated capacity and supply of trained workforce was determined using enrollment information and data from the interviews with faculty. A number of factors affect the accuracy of these figures including changes to the data in Datamart that may have occurred after this study was undertaken as well as the fact that some programs are grant funded and therefore do not report to Datamart. The data relies on average offerings over the 2011-2012 and 2012-2013 school years. Based on limited data sets, the numbers in this study must be considered rough estimates.

Community College Programs in California

Table 12 provides an overview of the existing Biotechnology programs in California by region. Associate level degrees and Certificates of Achievement are recognized by the CCC Chancellor’s Office and appear on the student’s transcript. Local certificates are departmental awards and do not appear on student transcripts. Colleges that have no formal or informal program are those that only offer courses. Appendix F provides a detailed list of programs. Appendix B has a detailed description of macro regions by sub-region and counties they are comprised of.

⁸ <http://www.wested.org/project/quantifying-non-completion-pathways-to-success>

Table 12 – Biotechnology Programs in California by Community College Region

Macro Regions	Colleges	# of programs			
		Associate Degree	Cert. of Achievement	Local Cert.	Courses Only
A: North Far North	American River, Lake Tahoe	1	1	-	1
B: Bay Region	Berkeley City, City College of San Francisco, Contra Costa, Gavilan, Laney, Merritt, Monterey Peninsula, Ohlone, San Mateo, Skyline, Solano	8	9	12	1
C: Central	Taft, San Joaquin Delta	-	-	-	2
D: South Central	Canyons, Moorpark, Ventura	3	4	-	-
E: San Diego & Imperial	Grossmont, Mira Costa, San Diego City, San Diego Miramar, Southwestern	4	3	4	1
F: Inland Empire/Desert	Mt. San Jacinto, San Bernardino Valley	-	-	-	2
G: Los Angeles & Orange County	Pasadena City, Mt. San Antonio	2	4	-	-
TOTAL		18	21	16	7

Sources: CCC Curriculum Inventory and 2013-2014 college catalogs

As Table 12 shows, there are 27 community colleges in the state that offer biotechnology programs and/or courses. There are a total of 39 Chancellor's Office approved programs, i.e. associate degree or certificate of achievement awarding programs. There are also 16 local certificates offered by community colleges. Seven of the 27 colleges only offer courses related to biotechnology, without granting an associate degree or any type of a certificate in this field.

The Bay region is leading the state in the number of colleges offering biotechnology programs (11) and the number of approved programs (17), followed by San Diego & Imperial Region with five colleges offering biotechnology programs and seven approved programs.

Analysis of Community College Courses

Using the skill builder concept, course information for community colleges was obtained from the college catalogs. Courses offered were analyzed and categorized as follows based on course description:

General Education or Career Exploration (GE/CE) classes are for career exploration. Generally these are classes of 3 units or less with *less than 48 hands-on instruction hours*. GE courses are *not* counted toward capacity or supply in this study.

Skill Builder-Basic (SBB) classes provide a broad set of foundational skills as preparation for entry level work in biotechnology fields. SBB classes provide *at least 96 hours hands-on instruction*, covering a broad array of basic lab techniques. A college with SBB courses is considered to be contributing to capacity and supply unless there has been no activity within the last year (2012-2013).

Skill Builder-Advanced (SBA) classes provide a broad set of more advanced skills to prepare students. SBA classes are usually aimed at the SBB class completer and/or incumbent worker. Fifty percent of students enrolled in SBA courses are also SBB completers. SBA classes have *at least 96 hours (2 units) of hands-on instruction on advanced techniques*. A college with SBA courses is

considered to be contributing to capacity and supply unless there has been no activity within the last year.

Specialty classes provide a limited skill-set. In general, the specialized classes focus on a single method or technique (for example, cell culture). When combined with shorter general skills classes, these can be considered to be a Skill Builder Basic equivalent.

Internship classes or Work Experience classes provide work based learning that enables a smooth transition to biotechnology industry employment. Since internship students are drawn from the pool of SBB and SBA students they are not counted toward capacity and supply figures.

Table 13 summarizes the frequency of colleges offering each type of courses by macro community college region. Detailed information about each course type by college and micro-region is provided in Appendix G.

Table 13 – Summary of Biotechnology Related Course Offerings by Region

Macro Regions	Colleges	Number of Colleges Offering Each Course Type				
		GE/CE	SBB	SBA	Specialty	Internship
A: North Far North	American River, Lake Tahoe	1	1	2	2	1
B: Bay Region	Berkeley City, City College of San Francisco, Contra Costa, Gavilan, Laney, Merritt, Monterey Peninsula, Ohlone, San Mateo, Skyline, Solano	4	8	2	8	5
C: Central	Taft, San Joaquin Delta	-	2	-	-	-
D: South Central	Canyons, Moorpark, Ventura	2	3	1	3	1
E: San Diego & Imperial	Grossmont, Mira Costa, San Diego City, San Diego Miramar, Southwestern	3	4	2	2	1
F: Inland Empire/Desert	Mt. San Jacinto, San Bernardino Valley	2	1	-	-	-
G: Los Angeles & Orange County	Pasadena City, Mt. San Antonio	-	1	1	2	1
TOTAL		12	20	7	18	9

Sources: CCC Curriculum Inventory and 2013-2014 college catalogs

Based on the information in Table 13, the state community college system offers a variety of biotechnology courses across regions, with the Bay region leading in each category. Overall, there are 20 colleges in the state offering Skill Builder-Basic courses in biotechnology and seven colleges offering Skill Builder-Advanced classes. Two-thirds of community colleges with biotechnology programs enroll students into specialty classes, while only about one-third of colleges provide internships or other work experience opportunities.

New Programs and Courses

Even though Los Angeles & Orange County Region currently has only two colleges offering programs and courses related to biotechnology, several other colleges in the region are planning to launch new programs or course (or revitalize previously offered ones) in the next two years.

Los Angeles County

- *Citrus College* is currently seeking program approval at the regional consortium level; curriculum development is in process; classes are set to start Fall 2015.
- *El Camino College* is reactivating existing classes that may not be offered as part of certificates; The college will offer SBB and SBA type of courses.
- *Los Angeles Trade Tech College* received program approval at the regional level; curriculum development is in process; classes are set to start Fall 2015.
- *Los Angeles Valley College* is designing new curriculum to bridge with a successful training program funded by the U.S. Department of Labor (DOL). The college will offer SBB and SBA courses program.

Orange County

- *Fullerton College* received a program approval at the Chancellor's Office and will start offering classes Fall 2014.
- *Irvine Valley College* is planning class offerings; classes are set to start Fall 2016.
- *Santiago Canyon College* received program approval at the Chancellor's Office; classes are set to start Fall 2014.
- *Santa Ana College* received program approval at the Chancellor's Office; classes are set to start Fall 2014.

Estimated Capacity & Supply

In order to estimate annual program capacity (i.e. the maximum number of unique students the community colleges could accommodate in their biotechnology programs) and annual supply of trained individuals (i.e. the number of workforce ready students produced by community college programs), the following analysis was conducted:

- 1) **Analysis of Active Programs:** 'Active' program was defined as such when a college offered biotechnology related courses that would qualify as Skill Builder Basic (SBB) and Skill Builder Advanced (SBA). Colleges offering only GE/CE or Specialty courses/programs were not included. However, a college can also score as having a capacity and producing a supply, if it had a sufficient number of Specialty classes to constitute a SBB course. Any college that had no offering in the previous school year was assumed to have no capacity or supply.
- 2) **Estimating Capacity:** Program capacity was estimated based on the course enrollment data for 'active' programs and interviews with faculty. To avoid double-counting students who enroll in SBB courses, finish them and then pursue SBA courses as well, the research team interviewed program faculty and determined that, on average, SBA courses enroll 50% of SBB course completers. This was factored in when estimating capacity.
- 3) **Estimating Supply:** Program supply, the actual number of **unique** students who are workforce ready was determined by interviewing relevant faculty or department heads. The estimated supply number *does not* include transfer students or incumbent workers, only those that are immediately ready to look for a job.

A number of factors affect the accuracy of these figures including changes to the data in the CCCCCO Datamart that may have occurred after this study was undertaken as well as the fact that some programs are grant funded and therefore do not report to Datamart. The data relies

on average offerings over the 2011-2012 and 2012-2013 school years. Based on the foregoing, the numbers in this study must be considered rough estimates.

Table 14 shows the capacity and supply of community college program across the state. The data is organized by macro region and micro (economic) region. Detailed capacity and supply data by college are provided in Appendix H.

Table 14 – Estimated Community College Supply of Trained Workforce in Biotechnology

Macro Region	Micro Region	College Contributing to Supply	Capacity	Supply
A: North Far North	Greater Sacramento	American River	40	18
B: Bay Region	East Bay	Berkeley City, Contra Costa, Laney, Merritt, Ohlone	200	114
	Mid-Peninsula	City College of San Francisco, San Mateo, Skyline	90	80
	North Bay	Solano	20	60*
	Silicon Valley	Gavilan	Unknown	Unknown
C: Central	Central Valley	None	-	-
D: South Central	South Central	Canyons, Moorpark, Ventura	100	5
E: San Diego & Imperial	San Diego & Imperial	Mira Costa, San Diego City, San Diego Miramar, Southwestern	120	95
F: Inland Empire/Desert	Inland Empire/Desert	Mt. San Jacinto, San Bernardino Valley	20	21
G: Los Angeles & Orange County	Los Angeles	Pasadena City, Mt. San Antonio	50	31
TOTAL			640	423

* Increased supply due to one-time grant funding

Estimated capacity of active community college biotechnology programs/courses across the state is about 640 and estimated supply of trained individuals is approximately 420. The East Bay micro region is leading the state with the largest capacity and supply – 200 and 114 respectively, followed by San Diego/Imperial colleges that are estimated to accommodate 120 students annually and produce about 95 job ready individuals.

While these estimates rely heavily on assumptions and individual reporting, subject matter experts working closely with biotechnology programs agree that this is a more accurate approximation than counting just the number of awards given.

Additional Supply of New/Revitalized Programs

Considering that there are a number of colleges in Los Angeles and Orange Counties that are planning to add new biotechnology related programs or courses or revitalize old ones, it is important to estimate potential future capacity and supply. With eight new/revitalized programs becoming operational, additional supply in the Los Angeles/Orange County region is estimated to be as high as 60 students annually.

Other Potential Sources of Supply

In addition to community college programs in biotechnology, there are other producers of supply for jobs within the state requiring no degree, an associate or bachelor's degree, and up to two years' experience.

A brief examination of four-year (both public and private) and proprietary institutions in California was done to find baccalaureate level degrees and undergraduate certification as well as short term (about 7 months) training programs related to biotechnology. Table 15 provides the names of each education institution and the type of degree or certificate in biotechnology offered.

Table 15 – Universities and proprietary institutions with baccalaureate or undergraduate programs in biotechnology

Institution	Degree or Certificate
Cal Poly Pomona	BS Biotechnology
CSU Bakersfield	BS Biology w/Biotechnology Concentration
CSU Long Beach	Biotechnology Certificate (Admits Undergrads)
CSU Northridge	BS Biotechnology/Medical Technology
CSU San Marcos	BS Biotechnology
UC Davis	BS Biotechnology
USC (Dornsife Campus)	Minor in Biotechnology
DeVry	BS in Biomedical Technology
Southern California Institute	Short-Term Entry Level Training Biomedical Technician
Biohealth Colleges	Short-Term Entry Level Training Biotechnology Technician

The analysis of the CSU courses in biotechnology programs revealed that these programs do not offer courses that are equivalent to the SBB and SBA coursework at community colleges. Appendix I provides a detailed listing of courses taught to biotechnology track students at CSUs.

Synopsis of Proprietary School Programs

- *DeVry University*: Biomedical Engineering Technology Program. Availability in California is limited to the Fremont, CA campus. Extensive baccalaureate of science degree program with both lecture and lab sections. Average time to complete is 4.5 years. Emphasis is on use of electronic equipment designed to be used for imaging, monitoring and telemedicine (wireless health applications). Pursues a biology track with six special emphasis courses including an internship. Graduates are expected to demonstrate competencies in bioengineering processes and tools.
- *Southern California Institute of Technology*: Located in Anaheim, CA. Short term program (7 months) emphasizes hands-on training in biomedical instrument operation, medical device troubleshooting and core electronic technologies. Certification as a Biomedical Equipment Technician is offered.
- *Biohealth College*: Located in San Jose, CA. Offers a 30 week course of instruction with two hands-on lab sections and basic biology foundation courses. Requires only a high school diploma or GED. Basic lab covers light microscopy, aseptic/sterile technique, calibration/use of pH meters, calibration/use of micropipettes, use of balances, preparation of reagents/buffers, measurement, centrifugation, spectrophotometry-vis, microbiology – plating, culturing, staining, enumeration, hemacytometer counting. Chromatography– paper/TLC/GC/HPLC (theory). Advanced lab covers electrophoresis -SDS PAGE/Agarose, protein detection and purification, protein assay using Bradford Assay, ELISA, DNA isolation and purification, restriction digestion, southern blot (theory), PCR, DNA fingerprinting, general skills, math skills, standard curves, dilutions, computer skills, spreadsheets, graphing, teamwork, ethics, oral presentation of data, safety practices, familiarity with SOPs/GMP's, proper documentation/laboratory records and notebook standards.

Training Gap Analysis

Demand for the group of six middle skills biotechnology occupations requiring up to a Bachelor's degree, when filtered by the biotechnology industry NAICS codes, totals 948 annual openings in California. The community college data analysis shows a supply estimate of approximately 420 job ready biotechnicians per year. This leads to the conclusion that based on the best available data, the community colleges in the state are under supplying the state's labor market for middle skills biotechnology workers by approximately 530 workers annually.

When considering supply, it has been difficult to determine how many Bachelor's degrees have been awarded to biotechnology students in the state. Specifically, it is unclear which graduates of these programs are qualified and competing for the same middle skills biotechnology jobs as community college graduates. Nevertheless, considering that some students from these institutions would compete for these jobs, the actual training gap might be smaller.

DEMAND		SUPPLY	
Annual projected job openings (EMSI)	948	Community College Trainees	420
Annual job advertisements (Burning Glass)	3,297	Bachelor's Degrees	Unknown
		Total job ready	420+

It should also be noted that the annual projected job openings provided by EMSI might be underestimated. The detailed analysis of the online job advertisements through Burning Glass suggests that there were approximately 3,000 unique postings for the middle skills biotechnology jobs. This could indicate that the actual training gap in the state might be larger.

A summary of the region-by-region gap analysis for the three key regions of the state is found below. Additional demand and supply data for each sub-region can be found in Appendix I.

In the Los Angeles region (Los Angeles, Orange and Ventura counties) the supply of workforce ready students is not currently meeting demand for projected job openings. The shortage of students supplied to the regional labor market may be as many as 245 per year. The good news is that in the coming year (2014-15), colleges in the region are projected to supply an additional 60 trained students to the regional labor market. Though this will not completely close the gap, it is a promising start to addressing the demand.

In the San Diego region, the supply of workforce ready students is not currently meeting demand for projected job openings. The shortage may be as many as 190 per year. Since no new biotechnology programs are being planned for the region, the four colleges with existing programs have an opportunity to expand capacity, in a coordinated way, to meet the regional labor market demand.

In the San Francisco Bay region, the supply of workforce ready students based on normal capacity is relatively balanced with demand. On the surface it may appear that colleges are over supplying the labor market by approximately 65 workers annually, however, two of the colleges in the region used grants funds to supply a combined total of 60 additional students to the labor market, beyond their regular capacity (using college general funds). Since these grant funds may not continue in the future, it is recommended that these additional students not be "counted" when decisions are made about the need to adjust program supply for the region.

Summary of Findings and Recommendations

This section provides a summary of the seven key findings from the study and the research team's recommendations for further labor market research as well as for community college program planning.

1) Job Titles

Employers advertise open positions using job titles that differ significantly from the standard occupational classification (SOC) titles used by the U.S. Bureau of Labor Statistics and California's EDD. Job titles that describe entry level biotechnology jobs include Laboratory Assistant/Technician, Research Assistant/Associate, Quality Control Technician/Assistant, Clinical Laboratory Scientist (CLS), Medical Laboratory Technician (MLT), Animal Technician, and others.

LMI Recommendations	Programmatic Recommendations
<ul style="list-style-type: none"> Use caution in this sector when applying SOC codes. 	<ul style="list-style-type: none"> Increase student awareness of real job titles and job opportunities in the labor market. Assess if programs are well aligned to job titles commonly used by employers.

2) Supply

The supply analysis suggests that community college supply is approximately two-thirds of the capacity of community college programs across the state. The estimated **annual capacity** of programs is approximately **600** students. Estimated **actual supply** of workforce ready students annually is **400**.

LMI Recommendations	Programmatic Recommendations
<ul style="list-style-type: none"> Determine if programs are full or if students are transitioning. Use actual supply of skill builders rather than awards when defining "supply." 	<ul style="list-style-type: none"> Each program should profile the "make up" of classes to better understand the needs of the diverse populations of students. Assess percentage of skill builders (both basic and advanced) seeking employment and percentage of students who are seeking degree/award/transfer. In each region, colleges should validate the workforce needs of employers in terms of meeting specific occupational and skill level requirements, to help guide how to build program capacity in a strategic manner.

3) Regional Gap Analysis

The region-by-region gap analysis for the three key regions of the state reveal that the Los Angeles/Orange and San Diego regions appear to be under-supplying their labor markets with work ready biotechnicians. The Bay Area is close to alignment between supply and demand.

LMI Recommendation

- Colleges in the Los Angeles/Orange County and San Diego regions should meet with employers to validate their workforce needs, since this study indicates that both regions may be under-supplying their labor markets. Even in the San Francisco Bay region, where there is closer alignment between supply of students and employer demand, more research may be needed to better understand if colleges are producing graduates with the right skills sets that employers need. This should be studied in all regions.

Programmatic Recommendation

- Colleges in the Los Angeles/Orange County and San Diego regions should coordinate efforts to expand the supply of workforce ready students, after employers validate the need for more workers. In all regions, work closely with employers to identify the skill sets they need in the workplace for entry-level occupations, so these skills can be added when missing from college courses/programs.

4) Industry Qualifications

This study begins to elucidate the qualifications employers seek and quantify the percentage seeking degrees versus those seeking skills. According to the official classification of the occupational titles considered, a Bachelor's degree is a minimum required credential for most jobs. However, employer feedback and the analysis of on-line job advertisements suggest that employers value community college students who receive certificates and/or Associate degrees and have hands-on laboratory training and skills more than a four-year credential.

LMI Recommendation

- Since employers confirmed and the data showed that students with CCC awards are desirable, continue to work with employers to fully understand the relative balance of training and education for the ideal candidates for different positions and career pathways.

Programmatic Recommendation

- Since employers confirmed that community college students with certificate or degree awards are desirable, do a better job marketing programs to students, including which programs are preparing job seekers for which positions.

5) Skills in Demand

Both employer feedback and Burning Glass data, suggest that Good Manufacturing Practices (GMP), Quality Control, fundamentals of scientific knowledge ("scientific common sense"), as well as workplace skills and abilities are important skills for job seekers to possess.

LMI Recommendation

- Continue to work with employers to understand the levels of understanding and job readiness they need.

Programmatic Recommendation

- Colleges should assess their curricula and where needed, add those elements that are missing to better prepare students with this knowledge set and skills.
- Determine best practices and methods of assessment.

6) Certifications

Certifications are rarely required by employers (i.e. 81% of the on-line job postings considered did not list a certification requirement). However, based on employer comments at the San Diego regional forum, they prefer trainees with a relevant certification for a specific job over those without it when considering candidates during a selection process. Phlebotomy and medical lab technology are two of the most common certifications sought by employers.

LMI Recommendation	Programmatic Recommendation
<ul style="list-style-type: none"> Continue to monitor certifications that employers may be seeking from job candidates. 	<ul style="list-style-type: none"> Industry is open to certifications/badges as long as they are real measures of what students know and can do. Consider meaningful certifications/badges.

7) Building Pathways

Community college biotechnology programs across the state are structured very differently. This results in confusion to students and potential employers. For the purposes of inventory and gap analysis, courses were grouped into categories based on the skill builder philosophy of Kathy Booth and Peter Barr.⁹ Based on this harmonization of classes or courses, a statewide career pathways chart was created using the template for High Impact Pathways (HIP) promoted by the Career Ladders Project.¹⁰

LMI Recommendation	Programmatic Recommendation
<ul style="list-style-type: none"> Continue to monitor student pathways as they obtain education credentials. 	<ul style="list-style-type: none"> The strategy for harmonization should be included in future programmatic planning and analysis of community colleges. Colleges are encouraged to create latticed pathways based on skill-builder philosophy. Pathways should be structured to permit students to move into careers in a time efficient manner based on previous education and training. Appendix J provides HIP career pathways chart that could be utilized for planning purposes. A list of core skills in each 'Skill Builder' class category (Basic and Advanced) should be developed in an effort to explain to both students and industry what program completers know and can do.

⁹ "What's Completion Got to Do With It?: Using Course-taking Behavior to Understand Community College Success, 2012

¹⁰ See www.calbiotechcareers.org for inventory/categorization and <http://www.careerladdersproject.org/>

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Appendix A – Life Sciences/Biotechnology Sector in NAICS

NAICS Code	Description
AGRICULTURAL FEEDSTOCK & CHEMICALS	
311221	Wet Corn Milling
311222	Soybean Processing
311223	Other Oilseed Processing
325193	Ethyl Alcohol Manufacturing
325221	Cellulosic Organic Fiber 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
54171*	Research and Development in the Physical, Engineering, and Life Sciences
621511	Medical Laboratories
BIOSCIENCE-RELATED DISTRIBUTION	
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers
424210*	Drugs and Druggists' Sundries Merchant Wholesalers
424910*	Farm Supplies Merchant Wholesalers

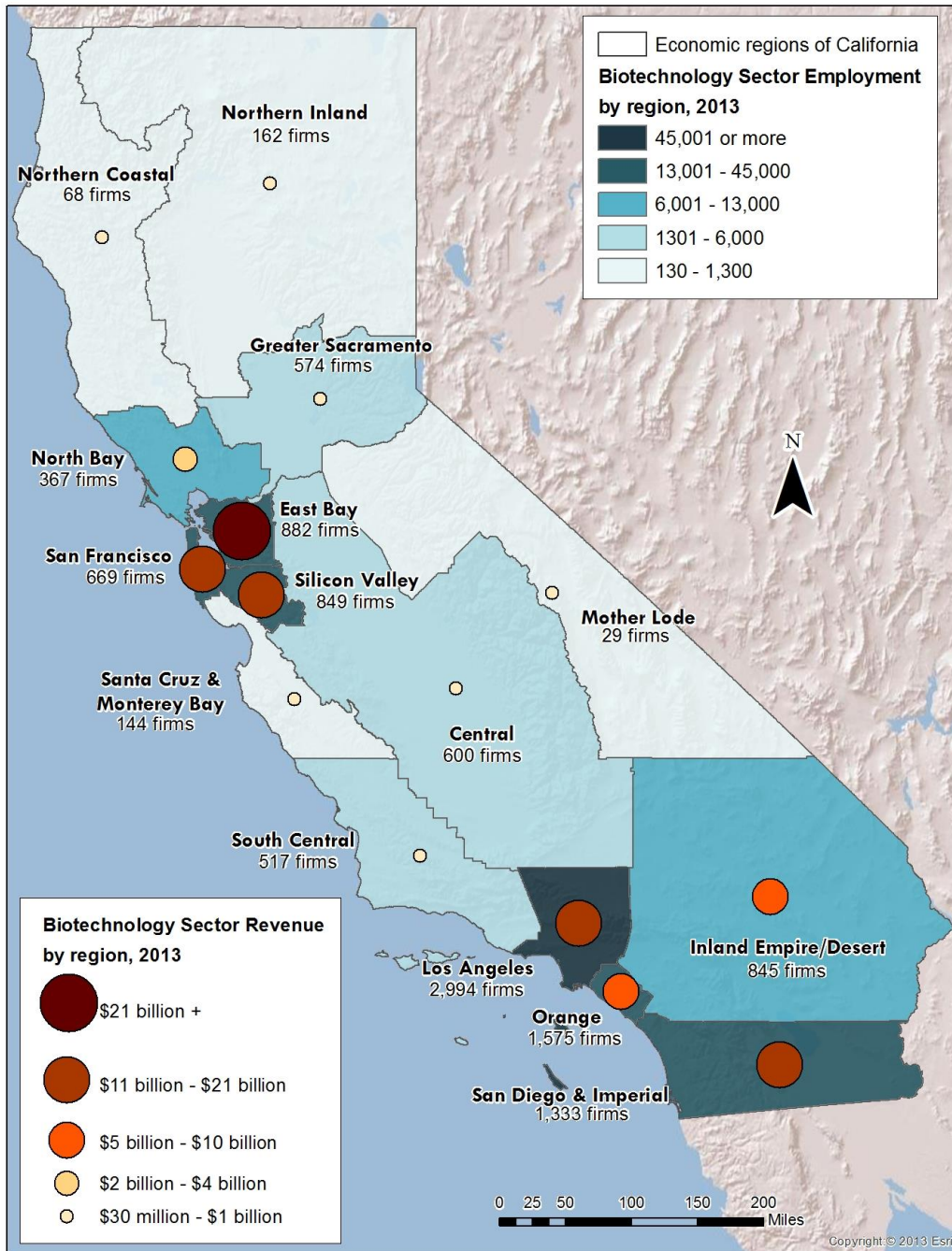
*Includes only portion of these industries engaged in relevant life sciences activities.

Source: Battelle, 2014

Appendix B – Economic Regions of California

Macro Regions	Micro Regions	Counties
A: North / Far North	Northern Coastal	Humboldt, Lake, Mendocino, Trinity, Del Norte, Butte, Colusa, Glenn, Lassen, Modoc, Plumas, Shasta, Sierra,
	Northern Inland	Siskiyou, Tehama
	Greater Sacramento	Sacramento, El Dorado, Placer, Yolo, Yuba, Sutter, Nevada
B: Bay	San Francisco / San Mateo	San Francisco, San Mateo
	East Bay	Alameda, Contra Costa
	Silicon Valley	Santa Clara, San Benito
	North Bay	Solano, Napa, Sonoma, Marin
	Santa Cruz / Monterey	Santa Cruz, Monterey
C: Central	Central Valley	Merced, San Joaquin, Stanislaus, Fresno, Kern, Kings, Madera, Tulare
	Mother Lode	Mariposa, Mono, Tuolumne, Alpine, Amador, Calaveras, Inyo
D: South Central	South Central Coast	San Luis Obispo, Santa Barbara, Ventura, plus Zip Code areas of Northern Los Angeles
E: San Diego & Imperial	San Diego / Imperial	San Diego, Imperial
F: Inland Empire / Desert	Inland Empire / Desert	Riverside, San Bernardino
G: Los Angeles / Orange	Los Angeles	Los Angeles
	Orange County	Orange

Appendix C – Map of Life Sciences/Biotechnology Employment & Revenue



Business Data Source: InfoUSA through ESRI ArcGIS Business Analyst.

Map design by CCC Centers of Excellence.

Appendix D – About Burning Glass Data and Selection Criteria

Burning Glass Labor/Insight™ is an interactive, report-generating application that gives users real-time access to a comprehensive database of job postings data. It is powered by Burning Glass's unique technology for demand data aggregation, parsing, extraction and analysis, which translates free text job postings into actionable intelligence on the nature and content of employer demand.¹¹

The COEs used the following selection criteria for the data pulls using the Burning Glass software:

Selected Occupations	Quality Control Analysts Manufacturing Production Technicians Chemical Technicians Inspectors, Testers, Sorters, Samplers And Weighers Biological Technicians Medical and Clinical Laboratory Technicians
Selected Industries (4-digit NAICS Codes)	Pull 1: <ul style="list-style-type: none"> - Medical Equipment and Supplies Manufacturing - Pharmaceutical and Medicine Manufacturing - Navigational, Measuring, Electromedical and Control Instruments Manufacturing - Scientific Research and Development Services - Medical and Diagnostic Laboratories Pull 2: <ul style="list-style-type: none"> - Colleges, Universities and Professional Schools - Employment Services
Words excluded from job titles	Head, Supervisor, President, Director, Mechanical Inspector, Scientist, Senior, Engineer
Skill Clusters*	Sciences, Biotech, Research, Clinical Trials
Location/Timeframe	California Full year 2013

*Included only in pull 2

¹¹ <http://www.burning-glass.com/products/laborinsight-market-analysis/>

Appendix E – Regional Demand and Supply Data

Los Angeles, Orange, and Ventura counties

Occupational data for Los Angeles/Orange/Ventura

Occupation (SOC)	2013 Jobs	2018 Jobs	13-18 Change	13-18 Replace- ments	% Change	Openings	Annual Openings
Manufacturing Production Technicians (17-3029.09)	188	206	18	19	10%	37	7
Biological Technicians (19-4021)	572	600	28	103	5%	131	26
Chemical Technicians (19-4031)	759	861	102	61	13%	163	33
Quality Control Analysts (19-4099.01)	157	173	19	35	12%	54	11
Medical and Clinical Laboratory Technicians (29-2012)	1,871	2,051	180	187	10%	367	73
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	2,210	2,576	366	265	17%	631	126
TOTAL	5,757	6,467	713	670	12%	1,383	276

Source: EMSI, 2014

Wage data for Los Angeles, Orange, and Ventura Region

Occupation	Median Hourly Earnings	25 Percentile Hourly Earnings	75 Percentile Hourly Earnings
Manufacturing Production Technicians (17-3029.09)	\$29.12	\$21.92	\$37.17
Biological Technicians (19-4021)	\$20.63	\$15.54	\$26.09
Chemical Technicians (19-4031)	\$19.94	\$14.77	\$26.53
Quality Control Analysts (19-4099.01)	\$21.56	\$17.18	\$27.12
Medical and Clinical Laboratory Technicians (29-2012)	\$17.96	\$14.96	\$22.26
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	\$17.01	\$12.70	\$22.26

Source: EMSI, 2014

Number of Job Postings by Occupation

O*NET Code	Occupation	Number of Job Postings, Jan – Dec 2013
29-2012	Medical And Clinical Laboratory Technicians	415
51-9061	Inspectors, Testers, Sorters, Samplers, And Weighers	202
17-3029.09	Manufacturing Production Technicians	75
19-4099.01	Quality Control Analysts	66
19-4021	Biological Technicians	47
19-4031	Chemical Technicians	14
Total		819

Source: Burning Glass, 2014

Top Job Titles by Number of Job Postings

Title	Number of Job Postings, Jan – Dec 2013
Laboratory Assistant	144
Manufacturing Technician	68
Laboratory Technician	47
Quality Assurance Specialist	43
Quality Control Technician	41
Quality Control Inspector	27
Specimen Accessioner	22
Quality Inspector	20
Quality Control Analyst	19
Chemist	18
Medical Laboratory Technician	16
Quality Assurance Inspector	14
Quality Assurance Technician	13
Quality Specialist	11
Laboratory Technician I	7

Source: Burning Glass, 2014

Los Angeles, Orange, and Ventura Gap Analysis**DEMAND**

Annual projected job openings (EMSI)	276
Annual job advertisements (Burning Glass)	819

SUPPLY

Community College Trainees	31
Bachelor's Degrees	???
Total job ready	31+

Demand for the group of six middle skills biotechnology occupations, when filtered by the biotechnology industry NAICS codes, totals 276 annual openings in the Los Angeles region. The college analysis shows a supply estimate of approximately 31 job ready biotechnicians are being produced by two community colleges in the region. This leads to the conclusion that based on the best available data, community colleges in the Los Angeles region are under supplying the labor market for middle skills biotechnology workers by approximately 245 workers. The Los Angeles region will have three more colleges offering Biotechnology programs starting in the fall of 2015. Orange County has three colleges offering programs starting in the fall of 2014. This should help address the under supply of biotechnicians to the regional labor market.

San Diego Region

Occupational Data for San Diego

Occupation	2013 Jobs	2018 Jobs	13-18 Change	13-18 Replacements	% Change	Openings	Annual Openings
Manufacturing Production Technicians (17-3029.09)	274	317	43	27	16%	70	14
Biological Technicians (19-4021)	756	863	107	136	14%	243	49
Chemical Technicians (19-4031)	376	572	196	34	52%	230	46
Quality Control Analysts (19-4099.01)	211	249	38	49	18%	87	17
Medical and Clinical Laboratory Technicians (29-2012)	471	595	124	47	26%	171	34
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	1,318	1,773	455	158	35%	613	123
TOTAL	3,406	4,369	963	451	28%	1,414	283

Source: EMSI, 2014

Wage data for San Diego

Occupation	Median Hourly Earnings	25 Percentile Hourly Earnings	75 Percentile Hourly Earnings
Manufacturing Production Technicians (17-3029.09)	\$31.39	\$22.74	\$38.31
Biological Technicians (19-4021)	\$20.53	\$15.91	\$27.34
Chemical Technicians (19-4031)	\$17.72	\$14.10	\$24.61
Quality Control Analysts (19-4099.01)	\$23.88	\$16.99	\$33.80
Medical and Clinical Laboratory Technicians (29-2012)	\$20.12	\$16.41	\$24.84
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	\$18.34	\$14.14	\$23.09

Source: EMSI, 2014

Number of Job Postings by Occupation

O*NET Code	Occupation	Number of Job Postings, Jan – Dec 2013
29-2012	Medical And Clinical Laboratory Technicians	217
51-9061	Inspectors, Testers, Sorters, Samplers, And Weighers	74
17-3029.09	Manufacturing Production Technicians	58
19-4099.01	Quality Control Analysts	64
19-4021	Biological Technicians	46
19-4031	Chemical Technicians	13
Total		472

Source: Burning Glass, 2014

Top Job Titles by Number of Job Postings

Title	Number of Job Postings, Jan – Dec 2013
Laboratory Assistant	68
Specimen Accessioner	60
Manufacturing Technician	52
Quality Assurance Specialist	38
Laboratory Technician	33
Quality Control Analyst	30
Medical Laboratory Technician	29
Research Technician	21
Research Associate	14
Clinical Technician	12
Quality Control Specialist	10
Quality Specialist	7
Quality Coordinator	7
Quality Control Technician	5
Quality Inspector	5

Source: Burning Glass, 2014

San Diego Gap Analysis**DEMAND**

Annual projected job openings (EMSI)	283
Annual job advertisements (Burning Glass)	472

SUPPLY

Community College Trainees	94
<u>Bachelor's Degrees</u>	<u>???</u>
Total job ready	94+

Demand for the group of six middle skills biotechnology occupations, when filtered by the biotechnology industry NAICS codes, totals 283 annual openings in the San Diego region. The college analysis shows a supply estimate of approximately 94 job ready biotechnicians being produced by four community colleges in the region. This leads to the conclusion that based on the best available data, community colleges in the San Diego region are under supplying the labor market for middle skills biotechnology workers by approximately 190 workers.

San Francisco Bay Area

Occupational Data for Bay Area

Occupation	2013 Jobs	2018 Jobs	13-18 Change	13-18 Replacements	% Change	Openings	Annual Openings
Manufacturing Production Technicians (17-3029.09)	195	190	(5)	21	-3%	16	3
Biological Technicians (19-4021)	1,018	1,067	49	183	5%	232	46
Chemical Technicians (19-4031)	708	746	38	78	5%	116	23
Quality Control Analysts (19-4099.01)	282	272	(10)	62	-4%	52	10
Medical and Clinical Laboratory Technicians (29-2012)	664	845	181	66	27%	247	49
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	1,664	1,750	86	200	5%	286	57
TOTAL	4,531	4,870	339	610	7%	949	188

Source: EMSI, 2014

Wage Data for Bay Area

Occupation	Median Hourly Earnings	25 Percentile Hourly Earnings	75 Percentile Hourly Earnings
Manufacturing Production Technicians (17-3029.09)	\$33.39	\$26.09	\$40.94
Biological Technicians (19-4021)	\$26.26	\$19.98	\$33.39
Chemical Technicians (19-4031)	\$23.86	\$18.76	\$30.67
Quality Control Analysts (19-4099.01)	\$22.65	\$18.69	\$27.91
Medical and Clinical Laboratory Technicians (29-2012)	\$24.54	\$20.95	\$29.42
Inspectors, Testers, Sorters, Samplers and Weighers (51-9061)	\$19.52	\$14.97	\$26.24

Source: EMSI, 2014

Number of Job Postings by Occupation

O*NET Code	Occupation	Number of Job Postings, Jan – Dec 2013
29-2012	Medical And Clinical Laboratory Technicians	339
51-9061	Inspectors, Testers, Sorters, Samplers, And Weighers	268
17-3029.09	Manufacturing Production Technicians	200
19-4099.01	Quality Control Analysts	124
19-4021	Biological Technicians	95
19-4031	Chemical Technicians	30
Total		1,056

Source: Burning Glass, 2014

Top Job Titles by Number of Job Postings

Title	Number of Job Postings, Jan – Dec 2013
Laboratory Assistant	178
Manufacturing Technician	162
Quality Assurance Specialist	150
Laboratory Technician	69
Quality Control Analyst	64
Quality Control Technician	42
Production Technician	33
Research Associate	22
Clinical Lab Assistant	20
Quality Control Specialist	16
Clinical Technician	16
Quality Specialist	15
Quality Assurance Inspector	15
Staff Research Associate II	11
Medical Laboratory Technician	11

Source: Burning Glass, 2014

Bay Area Gap Analysis**DEMAND**

Annual projected job openings (EMSI)	188
Annual job advertisements (Burning Glass)	1,056

SUPPLY

Community College Trainees	254
Bachelor's Degrees	???
Total job ready	254+

Demand for the group of six middle skills biotechnology occupations, when filtered by the biotechnology industry NAICS codes, totals 188 annual openings in the San Francisco Bay Area. The college analysis shows a supply estimate of approximately 254 job ready biotechnicians are being produced by nine community colleges in the region. This leads to the conclusion that based on the best available data, community colleges in the Bay Area are over supplying the labor market for middle skills biotechnology workers by approximately 65 workers.

Note: The combined annual job openings for the six middle skills occupations in the Los Angeles, San Diego and the Bay Area regions (747) represents 79% of the Total annual openings in California (948).

Appendix F – Biotechnology Programs in California Community Colleges

Sources: CCC Curriculum Inventory and 2013-2014 college catalogs

Region	College	Program/s	Associate Degree	Cert. of Achievement	Local Cert.	Courses Only
A (Greater Sacramento)	American River	Biotechnology	x	x		
	Lake Tahoe	No Program				x
B (East Bay)	Berkeley City	Biotechnology	x	x		
		Biotechnology – Level One			x	
	Contra Costa	Biotechnology	x			
		Biotechnology Technician		x		
	Laney	Biomanufacturing Production	x			
		Biomanufacturing		x	x	
	Merritt	Fluorescence Bioscience Microscopy			x	
		Illumina HiSeq DNA Sequencing			x	
		Optical Microscopy			x	
	Ohlone	Biotechnology	x			
		Biotechnology: Biomanufacturing		x		
		Biotechnology: Biostatistics		x		
		Biotechnology: Quality Control/Research Associate		x		
B (Mid-Peninsula)	City College of San Francisco	Biotechnology	x		x	
		Biomanufacturing			x	
		Stem Cell Technology			x	
		Biotechnology Lab Assistant			x	
		Bioprocess Instrumentation & Control			x	
	Skyline	Biotechnology	x			
		Entry Level Biotechnology Manufacturing Certificate			x	
	San Mateo	Biology: Biotechnology (TOP 040100)	x		x	
B (North Bay)	Solano	Industrial Biotechnology	x	x		
		Applied Biotechnology		x		
B (Monterey)	Monterey Peninsula	No Program				x
B (Silicon Valley)	Gavilan	Biotechnology		x		
C (Central Valley)	Taft	No Program				x
	San Joaquin Delta	No Program				x
D (South Central)	Canyons	Biotechnology		x		
	Moorpark	Biotechnology	x	x		
		Biotechnology Manufacturing Operator		x		
	Ventura	Biotechnology	x			
		Plant Biotechnology	x			
		Biotechnician		x		

Region	College	Program/s	Associate Degree	Cert. of Achievement	Local Cert.	Courses Only
E (San Diego/Imperial)	MiraCosta	Biotechnology – Research and Development	x	x		
		Biotechnology – Laboratory Skills			x	
		Biotechnology – Bioprocess Technology		x		
	Grossmont	No Program(Grant Funded, no TOP)				x
	SD City	Applied Biology Track	x			
		Applied Biotechnology			x	
	SD Miramar	Applied Biology	x			
		Applied Biotechnology-Analytical Chemistry Track			x	
		Applied Biotechnology-Molecular Biology Track			x	
	Southwestern	Biotechnology	x	x		
F (Inland Empire/Desert)	Mt. San Jacinto	No Program				x
	San Bernardino Valley	No Program				x
G (Los Angeles)	Pasadena City	Biological Technology	x			
		Biological Tech: Computational Biology		x		
		Biological Tech: Lab Assistant Option		x		
		Biological Technology: Occupational Skills		x		
		Biological Technology: Stem Cell Culture		x		
	Mt. San Antonio	Histologic Technician Training	x			

Appendix G – Biotechnology Courses Organized by Region and College

Sources: Community College Catalogs

Macro Region	Region	College	GE/CE	SBB	SBA	Specialty	Internship
A: North Far North	Greater Sacramento Area	American River College	✓	✓	✓	✓	✓
		Lake Tahoe College			✓	✓	
B: Bay	East Bay	Berkeley City College		✓	✓	✓	✓
		Contra Costa College	✓	✓		✓	
		Laney College		✓	✓		✓
		Merritt College	✓			✓	
		Ohlone College	✓	✓		✓	✓
	Mid-Peninsula	San Francisco City College		✓		✓	✓
		San Mateo College				✓	
		Skyline College		✓			
	North Bay	Solano College	✓	✓		✓	
	Santa Cruz/Monterey	Monterey Peninsula College					✓
	Silicon Valley	Gavilan College		✓		✓	
C: Central Valley	Central Valley	San Joaquin Delta College		✓			
		Taft College		✓			
D: South Central	South Central	College of the Canyons		✓	✓	✓	
		Moorpark College	✓	✓		✓	✓
		Ventura College	✓	✓		✓	
E: San Diego & Imperial	San Diego/Imperial	Grossmont College	✓				
		MiraCosta College		✓		✓	✓
		San Diego City College		✓	✓		
		San Diego Miramar College	✓	✓	✓		
		Southwestern College	✓	✓		✓	
F: Inland Empire/Desert	Inland Empire/Desert	Mt. San Jacinto College	✓	✓			
		San Bernardino Valley College	✓				
G: Los Angeles & Orange County	Los Angeles	Mt. San Antonio College				✓	
		Pasadena City College		✓	✓	✓	✓

Appendix H – Estimated Capacity and Supply of Trained Students

Macro Region	Micro Region	College	Estimate of Capacity	Estimate of Supply	Comments
A: North Far North	Greater Sacramento	American River	40	18	
B: Bay	East Bay	Berkeley City	60	20	
		Contra Costa	20	10	
		Laney	40	25	
		Merritt	0	9	New Program (Emerging)
		Ohlone	80	50	
	Mid Peninsula	San Francisco	60	80	Some supply from Grant Funding
		San Mateo	0	0	Biology Degree w/Emphasis on Biotech (Not coded under 043000)
		Skyline	30	0	Program Revitalization Planned for Fall 2014
		North Bay	Solano	20	60
	Silicon Valley	Gavilan	0	-	Data Not Provided
D: South Central	South Central	Canyons	20	-	Data Not Provided
		Moorpark	60	5	
		Ventura	20	-	Data Not Provided
E: San Diego & Imperial	San Diego/Imperial	MiraCosta	30	26	
		San Diego City	30	23	
		San Diego Miramar	30	25	
		Southwestern	30	20	
F: Inland Empire/Desert	Inland Empire/Desert	Mt. San Jacinto	20	21	
		San Bernardino	0	0	General Education/Continuing Education
G: Los Angeles & Orange County	Los Angeles	El Camino	0	0	2 Biotech Courses Planned for Fall 2015
		Citrus	0	0	Biotech Program Planned for Fall 2015
		LA Trade Technical	0	0	New Biotech Program Started Fall 2014
		LA Valley	0	0	Biotech Program Planned for Fall 2015
		Mt. San Antonio	20	21	
		Pasadena	30	10	
	Orange County	Fullerton	0	0	Biotech Program Planned for Fall 2014 (Collaborative Effort between Fullerton, Santa Ana and Santiago Canyon)
		Santa Ana	0	0	
		Santiago Canyon	0	0	
Totals			640	423	

Appendix I – Biotechnology Programs of Study at California State University Locations

Source: Statewide Academic Senate C-ID Project

Biotechnology Major	CSU Campuses				
Course	Channel Islands	Fullerton	Northridge	Pomona	San Marcos
Intro to Biotechnology				1 qtr unit	
Fresh/Soph Biology sequence: Cellular, Molecular, Evolutionary and Organismal w labs	2 course sequence – 8 semester units	4 courses – 20 semester units	2 sets of courses – 8 semester units	3 sets of courses – 15 quarter units	2 courses – 8 semester units
Microbiology				4 qtr units	
General Chem w lab 1	4 sem units	5 sem units	4 sem units	6 qtr units	5 sem units
General Chem w lab 2	4 sem units	5 sem units	5 sem units	6 qtr units	3 sem units
Organic Chem w lab 1		5 sem units			5 sem units
Organic Chem w lab 2		5 sem units			5 sem units
Chem Quantitative Analysis				4 qtr units	x
Trig Based Physics w lab 1	4 sem units*	4 sem units	4 sem units	8 qtr units – 1 st 2 courses	
Trig Based Physics w lab2	4 sem units*	4 sem units	4 sem units	4 qtr units – 3 rd course	
Calc Based Physics w lab 1	4 sem units*				4 sem units
Calc Based Physics w lab 2	4 sem units*				4 sem units
Calculus for Life Science majors 1		Option** 4 sem units		4 qtr units	x
Calculus for Life Science Majors 2					x
Engineering Calculus 1	4 sem units	Option** 4 sem units			5 sem units
Engineering Calculus 2		Option** 4 sem units			
Statistics		Option** 3 sem units			Bio stats 4 sem units
Biol Quantitative Methods/Biometrics	3 sem units			4 qtr units	
College Algebra or Trig or Pre Calculus		X	3 -5 sem units		
Health, Nutrition & Integrated Being or Intro to Psy or Mind, Brain and Behavior or Soc				4 qtr units	3 sem units
Financial Acct					3 sem units
Managerial Acct					3 sem units

*students can choose trig or calc based physics

**student can choose between 'soft' or 'hard' calculus

Appendix J – Life Sciences/Biotechnology Career Pathways



Life Sciences/Biotechnology Sector Overview of Career Pathways for State of California

	INDUSTRY CERTIFICATION	ACADEMIC PROGRAM OF STUDY	JOB AND WAGES
ADVANCED LEVEL	Certificates and Degrees approved by local industry advisories, skills panels and CCCC	+ A.A./A.S. Degree/ Transfer + Advanced Level Certificate <u>Biotechnology/Bioprocessing Awards</u> AA/AS: ~60 units including GE, Biotech Skill Builder* Basic and Advanced courses Certificate of Achievement: ~18 units with General Chemistry, General Biology, Algebra and Skill Builder* Basic and Advanced	Advanced Level Employment Research Assistant or Associate Production Technician Degree: ~\$44,000-\$55,000** Certificate: ~\$26,000-\$43,000** ** Source is Wage Tracker (http://datamart.cccco.edu/Outcomes/College_Wage_Tracker.aspx)
MID LEVEL	Mid level 'local' Certificates approved by local industry advisories, skills panels and CCCC	+ Mid Level Certificate Local Certificates: 8-12 Units with Skill Builder* Basic and Skill Builder *Advanced classes (a broad set of advanced skills for prepared students with at least 96 hours of hands-on training)	Intermediate Level Employment Manufacturing Technician Laboratory Technician Quality Control Technician Mid-Level Local Certificate: ~\$15-\$20*** per hour
ENTRY LEVEL	Skill Builder* Basic classes approved by the Academic Senate of each college <small>*Skill Builder and Alignment based on Booth and Barr "The Missing Piece" (http://www.learningworksca.org/wp-content/uploads/2013/10/MissingPiece_05.pdf)</small>	+ Entry Level Certificate None Skill Builder* Basic classes provide foundational employment skills with at least 48 hours of hands-on training.	Entry Level Employment Glass Washing Technician Packaging Technician Laboratory Assistant ~\$10-\$17*** per hour ***Source is EMSI Economic Analyst, 2014
		<div style="border: 1px solid black; padding: 5px;"> College Biotechnology Bridge Readiness Programs to Transition H.S. Graduates </div>	

hiP Career Ladders Project "High Impact Pathways" (<http://www.careerladdersproject.org/initiatives-programs/hip/>)