

**2022
Massachusetts
Life Sciences
Workforce Analysis
Report**

PRODUCED FOR THE MASSACHUSETTS BIOTECHNOLOGY COUNCIL (MASSBIO)

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Introduction

The Massachusetts Biotechnology Council (MassBio) commissioned BW Research Partnership to conduct primary and secondary research identifying the workforce needs and challenges within Massachusetts' life sciences industry. Released in August 2021, MassBio's report—The 2021 Industry Snapshot—highlights the significant growth anticipated in this industry over the next several years. Conservative estimates identify a near-term demand of up to 40,000 new workers by 2024.¹

Massachusetts' life sciences industry is a significant segment of the statewide economy, with marked revenue, wage, employment, and venture capital growth. Recent investments over the last couple years have propagated this growth trend, further expanding the life sciences footprint in Massachusetts. To meet the workforce demands of a rapidly growing industry, however, employers require access to a streamlined and connected talent pipeline. Investments, partnerships, and program development that ensure K-12 access and awareness, appropriate skills training, greater diversity, and regional equity, as well as on-the-job and other experience-based opportunities can help the state to meet these projected workforce demands.

The primary objectives of this research effort are as follows:

1. Understand hiring expectations and challenges for life sciences businesses in Massachusetts
2. Identify specific skillsets, certification, experience, and degree outcomes that are required and preferred by life sciences employers
3. Highlight opportunities for partnership or program development

The research presented here is a synthesis of surveys and interviews with life sciences employers in Massachusetts as well as a review of secondary data on current labor market trends, the life sciences training landscape, and federal and state workforce programs.

For more information on the employer survey methodology, please refer to Appendix A of this report.

Our sister organization, MassBioEd, produced the 6th Annual Massachusetts Life Sciences Employment Outlook. The report spotlights the full size of the Massachusetts Life Sciences sector like never before. It complements MassBio's Workforce Analysis Report by breaking down types of jobs that are growing and where talent is being produced using state and federal employment data for the booming Massachusetts Life Sciences workforce and comparing it to the Massachusetts labor market and Life Sciences in the United States. The report provides best practices and recommendations for industry and its workforce and talent development partners to diversify the short- and long-term talent pool of the sector. MassBioEd's 2022 Massachusetts Life Sciences Employment Outlook can be downloaded here: <https://www.massbioed.org/labor-market-information/>.

¹ Massachusetts Biotechnology Council. 2021 Industry Snapshot. August 2021. https://www.massbio.org/wp-content/uploads/2021/08/2021-INDUSTRY-SNAPSHOT_FINAL.pdf.

Executive Summary

Key Findings

INDUSTRY & EMPLOYMENT PROFILE

Main Takeaway

Overall, Massachusetts' life sciences industry is a strong and growing cluster. The data illustrate both historical and projected future growth as well as a significant competitive advantage in life sciences that is unique to the region.

Research and development (R&D), hospitals, and pharmaceutical manufacturing are central to Massachusetts' life sciences labor market.² Altogether, these sectors account for almost nine out of every 10 life sciences jobs in Massachusetts (87.0 percent). At the end of 2021, there were a total of almost 93,000 jobs across R&D firms, hospitals, and pharmaceutical manufacturing companies in the state. Biotechnology R&D tops the list, accounting for roughly 56,800 total jobs at the end of 2021, or just over half of all life sciences workers; this sector is also 9.4 times more concentrated in Massachusetts compared to the national average (see Table 1).

The life sciences labor market has more than doubled in size over the last decade and a half. Life sciences employment has grown by almost 60,500 jobs from 2006 through 2021—a growth rate of 131.1 percent in 15 years. To date, there are 106,600 life sciences employees across Massachusetts.

Job growth in the life sciences industry far outpaces other industry sectors and the statewide average. Between 2006

and 2021, Massachusetts' labor market grew by 6.9 percent, compared to a 131 percent growth rate for the life sciences industry. Growth in life sciences outpaces job growth in utilities, education, construction, retail trade, and finance and insurance. With the additional lab and manufacturing space set to come online by the end of 2024, employment projections estimate a near-term demand of up to 40,000 new workers by 2024.³

Of the top life sciences occupations, data science and biotech jobs have seen the greatest growth over the last several years. Specifically, the following occupations grew by 28 to 87 percent between 2015 and 2021: biological scientists, biochemists and biophysicists, natural sciences managers, medical scientists, biological technicians, software developers, and computer and information systems managers. Many of these jobs are also significantly more concentrated in Massachusetts compared to the national average (see Table 2).

Most surveyed life sciences firms expect to grow their workforce over the next 12 months with both entry- and non-entry-level new hires. More than three-quarters of firms indicated that they would be hiring more workers in the coming year (77.9 percent). Most companies are seeking to

² For a definition of the life sciences industry and employment percent contributions used for this report, please see Appendix D.

³ Massachusetts Biotechnology Council. 2021 Industry Snapshot. August 2021. https://www.massbio.org/wp-content/uploads/2021/08/2021-INDUSTRY-SNAPSHOT_FINAL.pdf. Conservatively, the projections assume two employees per 1,000 square foot.

fill both entry- and non-entry-level positions (81.9 percent), though a few respondents indicated that they are only hiring for entry-level (1.4 percent) or non-entry-level positions (16.7 percent).

HIRING CHALLENGES

Main Takeaway

Despite strong growth expectations, concerns regarding talent supply are creating bottlenecks in Massachusetts' life sciences industry. Employers report talent competition, up titling, wage inflation, and a skills and experience gap that is resulting in significant hiring difficulties.

Firms have had difficulty filling open entry- and non-entry-level positions over the last 12 months. In general, it has been more difficult to fill non-entry-level positions; 94.2 percent of businesses reported some level of hiring difficulty when trying to find qualified candidates for non-entry-level roles. At the same time, just under three-quarters of firms also indicated some level of hiring difficulty when trying to find qualified entry-level candidates (73.5 percent).

Insufficient supply and industry experience are the top reasons for reported hiring difficulty. In general, firms noted that a small applicant pool and lack of experience or industry-specific knowledge contributed to hiring difficulty for both entry- and non-entry-level positions. These two topped the list of reasons for hiring difficulty. Additionally, firms also noted that insufficient non-technical skills and competition from other life sciences companies was contributing to difficulties filling open positions.

Talent competition is high in Massachusetts' life sciences industry. Firms are facing competition from other life sciences companies in Massachusetts and out-of-state as well as competition from big tech for data science-related talent. Because of this, many firms are employing creative ways of attracting and retaining talent, including increasing wages, improving benefits packages, adding tuition and relocation assistance, and offering remote work options.

Up titling and wage inflation are major contributors to talent competition in Massachusetts' life sciences industry. Small and large firms indicated this as a major issue for recruitment and retention; the prevailing attitude is that there is always a company that is willing to pay more or offer a better title to potential candidates.

There is a skills and experience gap between firm expectations and available or prospective hires. Across both entry- and non-entry-level roles, firms indicated that the title and salary levels they are hiring for often do not match the skills prospective hires are able to confidently execute.

TRAINING, ASSETS, & RESOURCES

Main Takeaway

Life sciences firms benefit from an active training network and a number of federal and state-run programs and resources supportive of Massachusetts' life sciences cluster, including financial and employee recruitment support.

Training Landscape

This analysis focused on pathways that do not require a four-year degree and as such, does not include life sciences degree programs at universities in Massachusetts. The focus on non-four-year degree pathways is key for expanding the pipeline of available workers, especially those from underrepresented communities, while engaging community colleges in supporting life sciences workforce development initiatives. For more information, please refer to the Industry Assets & Resources section of this report.

Most non-four-year life sciences programs in Massachusetts aim to provide scientific background and training for careers in biotechnology and biomanufacturing, particularly for biological technicians. Both Quincy College and the Biomanufacturing Education and Training Center (BETC) at Worcester Polytechnic Institute (WPI) currently offer the most biomanufacturing programs, while Middlesex Community College (MCC) leads the charge in biotechnology training. Overall, community colleges currently have the highest number of non-four-year life sciences training programs. Associate degrees are the most popular outcome of Massachusetts' non-four-year life sciences training programs, with MCC and MassBay Community College being the top two institutions for associate degrees. Benjamin Franklin Institute of Technology (BFIT), the only private college on the list of community colleges, is still developing an associate program that would cover biotechnology and biomanufacturing.

Middlesex County currently leads the state in the total number of non-four-year life sciences training programs. Training in the county takes place in apprenticeship, internship, research, and academic settings leading to varied certificate, degree, and experience outcomes. In particular, Middlesex, Norfolk, and Suffolk—counties with the highest number of training programs and the most growth for research and development (R&D) jobs—are well-positioned to supply talent for biotechnology positions. At the same time, Worcester and Middlesex, the counties with the highest growth for biomanufacturing jobs, represent half of the identified biomanufacturing training programs.

State & Federal Workforce Development Resources

There are a variety of state and federal financial assets, programs, and resources to support the life sciences industry. Public tax credits, grants, tax exemptions, capital funding, wage reimbursement, and investments, including the suite of programs administered by the Massachusetts Life Sciences Center (MLSC), are available to support qualifying life sciences businesses in Massachusetts. Broadly, these mechanisms include supporting recruitment and workforce development, broadening equity and workforce diversity, supporting entrepreneurship, and creating jobs. For more detailed information, see Table 8 and Table 9. In addition, other states, including New Jersey, California, Pennsylvania, and Rhode Island also have strong life sciences support mechanism. For more information on these policies, please refer to Appendix E.

Programs offering “general support” are most common, though there are a significant number of federal and state programs that support recruitment, training, and employee retention. “General support” programs provide broad support to the life sciences industry through tax credits, tax exemptions, cost sharing benefits, and unemployment benefits. About a quarter of identified assets and resources (23.1 percent) support life sciences businesses with recruitment of employees and interns. These programs assist life sciences businesses in attracting new talent through sponsored internships and apprenticeships, wage reimbursement, and targeted grant programs.

There are also a number of programs focused on increasing equity and workforce diversity within Massachusetts’ life sciences industry. Equity-focused programs account for 11.5 percent of all programs; these programs sponsor internships targeting recruitment in underserved communities, wage reimbursement, and grants for female-led early-stage life sciences companies.

WORKFORCE DEVELOPMENT NEEDS

Main Takeaway

Traditional channels will be unable to meet the supply gap for Massachusetts’ life sciences industry. Increasing outreach and awareness, offering applied learning opportunities, new biotech modules, and non-four-year degree opportunities as well as expanding access to disadvantaged and underrepresented communities will be key to closing the supply gap and expanding the funnel of talent for life sciences employers.

Though the majority of employers prefer entry-level candidates with a Bachelor’s degree, many are willing to hire applicants with less than a Bachelor’s degree and have done so in the past. About seven in 10 surveyed firms indicated that they prefer entry-level applicants to have a Bachelor’s degree (70.6 percent), but only 58.8 percent actually require a Bachelor’s degree. In fact, about one-third of surveyed employers indicated that their required level of education for entry-level candidates is an Associate’s degree or less, which includes a certification or postsecondary nondegree award or a high school diploma/equivalent. Just over half of firms indicated that they would hire an entry-level applicant with less than a Bachelor’s degree (50.6 percent), and 62.4 percent have previously hired an applicant with less than a Bachelor’s degree for an entry-level position.

Unclear or unpredictable training pipelines and information gaps are resulting in a hiring bottleneck for entry-level talent. Low awareness or access to information among middle and high school students is contributing to fewer entrants into the life sciences labor market. Employers indicated the need to engage students early on in their educational careers, highlighting the employment options available in the life sciences industry. Educational partnerships and outreach are key to developing these long-term workforce pipelines.

Internships, co-ops, and apprenticeships are valuable models for bridging the information and experience gap in the industry. Many employers indicated their preference for entry-level candidates with on-the-job and experiential training. In particular, Northeastern graduates with co-op experience were identified as the most sought-after candidates; Worcester Polytechnic Institute graduates were also identified as well-prepared for their roles. Out of a list of potential

program and resource offerings which included mentorships, career days, and wage reimbursement, 43.2 percent of firms indicated interest in an apprenticeship-type program for their future employees.

Community colleges are valuable sites of potential investment for non-traditional workforce development (i.e., hiring for people without four-year degrees). While most job postings require at least a bachelor's degree for certain entry-level positions, companies are interested in reevaluating their hiring structure to include more candidates without four-year degrees. While some companies already work with community colleges, some of those which did not highlight their willingness and enthusiasm to partner with community colleges to hire candidates with associate degrees. One interviewee suggested that community colleges are valuable for the certification options they offer, as any employee could enroll in a certification course to upskill for future roles within the company.

Companies identified manufacturing and quality control functions as the most likely spaces for non-traditional training initiatives to be implemented successfully. Companies have already reevaluated the minimum qualifications for these positions. Hires without 4-year degrees can be successful in these roles, but employers noted that a scientific background is instrumental for their success in the training program. Certificates, lab experience, and associate degrees were identified as sources for people to develop a science foundation for these roles.

Certificates from two-year colleges are especially important for entry-level candidates. Seven in 10 employers indicated that certificates in specialized topics from two-year colleges covering topics such as cell culture or biomanufacturing are important for entry-level applicants (69.1 percent). Third-party certifications, including RAPS and Six Sigma, are also important to 48 percent of surveyed employers.

Life sciences firms largely partner with 4-year universities for recruitment efforts, but less so with community colleges, high schools, or vocational technical schools. Six in 10 employers reported partnering with 4-year universities such as Northeastern, Harvard, and the Massachusetts Institute of Technology to recruit talent for open positions (61.7 percent). Fewer than 20 percent of firms also indicated partnering with both in-state and out-of-state community colleges (19.8 percent), high schools (11.1 percent), and vocational technical schools (7.4 percent). About a quarter (25.9 percent) of firms do not partner with any training providers or educational institutions for recruitment.

Conclusions & Recommendations

There are several key themes that converge across the high-level data findings in this report to produce a number of strategic recommendations. Namely, Massachusetts is expected to see significant workforce demand in the life sciences industry—by some estimates, the industry will require 40,000 new workers over the next couple years⁴—and the industry must re-think the current workforce development pipeline for life sciences occupations to meet it, prioritizing regionalization and diversity.

Beyond the significant growth rate, life sciences firms are faced with labor market competition from out-of-state firms and other industries, such as information technology and data science. Given that employers project to see growth across several different entry- and non-entry-level positions over the next couple years as well as the significant hiring difficulties attributed to a small applicant pool and lack of experienced or qualified applicants, the life sciences industry will require significant workforce development support mechanisms from the state, educational institutions, and other workforce development stakeholders.

Short-Term Interventions

In the short-term, there are a number of interventions that can provide a relief valve for life sciences firms in Massachusetts:

Add contextualized biopharma-specific modules to existing four-year degree programs. Degree programs where a need exists in the sector, such as accounting and marketing, may consider adding additional courses or modules to their existing course frameworks specifically geared toward the life sciences industry. These could include the addition of biopharma-specific courses or modules into existing course frameworks that are geared towards skills in the life sciences industry, such as accounting with pharmacy or biotech applications.

Scale up short-term, customized certification programs that align with employer needs. Education providers can consider scaling customized certification programs, such as successful programs like MassBioEd's Life Sciences Apprenticeship Program, Gloucester Marine Genomics Institute (GMGI), and Just-A-Start, that are based on the specific skill, knowledge, and educational needs of different types of companies in Massachusetts' life sciences industry. These programs are short-term in nature, allowing workers to either transition into the life sciences industry with the appropriate skills or enter the industry with a minimum of the requirements to begin working on the job immediately.

Increase laboratory or hands-on experience in educational settings. Investment in physical space and programs to allow increased access to lab time would ensure that incoming life sciences workers have the hands-on training needed to enter a lab setting. Lab experience programs may be designed to include a core curriculum plus a one- to two-year apprenticeship where individuals may work part-time and spend the rest of their time in school or in lab modules. Such a learn-and-earn model would be similar to union apprenticeships for trade positions.

Expand internship programs with life sciences companies. To build on the success of the Massachusetts Life Science's Internship Challenge program and Project Onramp would require increased partnerships among high schools, community colleges, workforce development agencies, and life sciences firms. An active network of stakeholders could create a pipeline of

⁴ Massachusetts Biotechnology Council. 2021 Industry Snapshot. August 2021. https://www.massbio.org/wp-content/uploads/2021/08/2021-INDUSTRY-SNAPSHOT_FINAL.pdf.

diverse talent from high schools, community colleges, and workforce development organizations that connect jobseekers to internships at life sciences firms across the state. MassBio could seek out additional scalable internship programs and advocate for continued state funding.

Grow role-specific certification programs. These programs would be designed with region- and firm-specific needs in mind to meet industry needs focused on cell and gene technologies, manufacturing, regulatory, QA, QC, and other manufacturing roles. These types of certification programs should be developed in conjunction with community colleges to take advantage of regional resources and networks.

While the above recommendations can provide some short-term relief, there are larger workforce issues that must be recognized in order to meet industry needs over the coming years. Most importantly, employment growth in the life sciences industry presents a significant opportunity to advocate for inclusive workforce development planning that targets traditional disenfranchised or underrepresented communities. These types of workforce development efforts must meet residents where they are at, providing support mechanisms to alleviate the trauma of poverty and create pathways that include the ability to earn-and-learn in a true apprenticeship-style program.

Long-Term Strategy

To re-think the current workforce development pipeline for life sciences occupations as this report indicates, the ecosystem must move away from four-year degrees and more towards apprenticeship-style programs, particularly for the manufacturing sector. MassBio, along with other key stakeholders, must support and advance an earn-and-learn program that is focused on the “job” aspect, as opposed to the “training” aspect. This program would immediately support a living wage for individuals, providing them with the opportunity to build their skills and experience—similar to the construction and building trades—while simultaneously supporting themselves and their families. Such a program would likely include a combined effort of on-the-job and classroom or lab training. The following are some final key takeaways and recommendations that must be coupled with diversity-focused workforce development initiatives for Massachusetts’ life sciences industry:

1. Create partnerships with Minority Serving Institutions (MSIs). Throughout program development, concerted efforts must be made to ensure partnership with federally designated minority serving institutions, either through their specific program offerings or generally, ensuring adequate representation of MSIs in workforce planning efforts moving forward.
2. Develop a central organizing workforce institute run by MassBio. To ensure maximum efficiency and programmatic success, all activities—from the coordination and facilitation of discussions with industry and academia to the creation of new modules and short-term certification programs—must be run or managed under a single organizing body. MassBio can act as a leading convener, bringing together university, academia, workforce development, industry, and government agencies, creating alignment amongst stakeholders.
3. Enlist state support through financial resources. The above efforts will require significant investment, much of which can be provided through state programming and funds. The state can mobilize significant financial resources to support upward mobility for individuals from disenfranchised populations, transition them into long-term sustainable careers.

Current Labor Supply

Employment in Massachusetts' life sciences industry has seen continual growth dating back to 2006. Over the last 15 years, from 2006 through 2021, the industry grew by 131 percent, or about 60,500 workers. As of 2021, there were just under 106,600 life sciences jobs across the state.⁵

Life sciences employment growth has far outpaced other industries in Massachusetts as well as the statewide average. Between 2006 and 2021, Massachusetts' labor market overall grew by 6.9 percent, compared to a 131.1 percent growth rate for the life sciences industries. Job growth in the life sciences sector has outpaced employment growth in utilities, education, construction, retail trade, and finance and insurance.

FIGURE 1. EMPLOYMENT GROWTH BY INDUSTRY, 2006-2021⁶

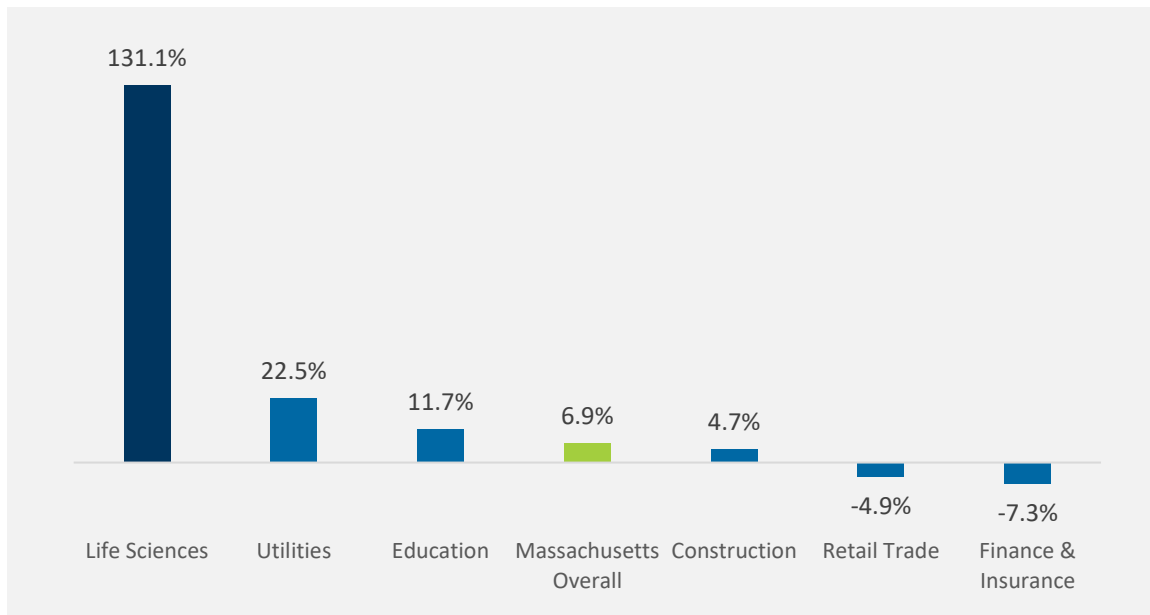


Table 1 highlights the specific industries that constitute Massachusetts' "life sciences industry cluster".⁷ In general, the state is a leader in both research and development (R&D), hospitals, and pharmaceutical manufacturing. These sectors alone account for almost nine out of every 10 life sciences jobs in Massachusetts (87.0 percent).

⁵ JobsEQ 2021 Q4. Accessed April 2022. JobsEQ extrapolates an extra quarter out in advance of the BLS QCEW data release. As such, this data may be slightly updated following the QCEW data release for 2021 Q4.

⁶ *Id.*

⁷ For a definition of the life sciences industry and employment percent contributions used for this report, please see Appendix D.

Biotechnology R&D tops the list, with more than 56,800 total jobs at the end of 2021—just over half of all life sciences jobs. This sector is also 9.4 times more concentrated in Massachusetts compared to the national average, indicating that biotechnology R&D is a significant economic specialty or strength for the state. Between 2016 and 2021, biotechnology R&D employment grew by 64.7 percent, or 22,300 net new jobs.

R&D firms in the physical, engineering, and life sciences sector accounted for about 22,100 jobs in 2021—20.7 percent of all life sciences jobs. Employment in this sector is 2.78 times more concentrated in Massachusetts compared to the U.S. average and has grown by 54.3 percent since 2016—roughly 7,800 new jobs.

General medical and surgical hospitals employed 8,100 workers at the end of 2021 for a growth rate of 1.9 percent or 150 new jobs. This industry is 1.27 more concentrated in Massachusetts. Lastly, pharmaceutical manufacturing firms employ almost 5,700 jobs across the state, with a concentration that is 1.09 times, or nine percent, above the national average.

TABLE 1. LIFE SCIENCES INDUSTRIES IN MASSACHUSETTS⁸

NAICS	Industry	Total Jobs, 2021	Location Quotient (LQ)	Growth, 2016 - 2021
541714	Research and Development in Biotechnology (except Nanobiotechnology)	56,816	9.36	64.7%
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	22,096	2.78	54.3%
622110	General Medical and Surgical Hospitals	8,100	1.27	1.9%
325412	Pharmaceutical Preparation Manufacturing	5,672	1.09	-25.2%
621511	Medical Laboratories	4,478	0.82	-2.5%
611310	Colleges, Universities, and Professional Schools	3,546	1.74	2.4%
325413	In-Vitro Diagnostic Substance Manufacturing	1,788	2.23	14.2%
325414	Biological Product (except Diagnostic) Manufacturing	1,438	1.48	57.6%
541713	Research and Development in Nanotechnology	1,064	2.65	17.4%
622310	Specialty (except Psychiatric and Substance Abuse) Hospitals	820	3.34	3.1%
541380	Testing Laboratories	396	0.81	-8.2%
325411	Medicinal and Botanical Manufacturing	335	0.37	29.0%
622210	Psychiatric and Substance Abuse Hospitals	45	1.32	-8.0%

⁸ *Id.*

Table 2 highlights the top 15 occupations that are found across the “majority” life sciences sectors in the preceding table.⁹ Overall, nearly all occupations, with the exception executive secretaries and administrative assistants, have seen job growth since 2015. Of these top life sciences occupations, data science and biotech jobs have seen particularly high growth in Massachusetts, including biological scientists (86.5 percent), biochemists and biophysicists (76.6 percent), natural sciences managers (74.9 percent), medical scientists (48.1 percent), biological technicians (43.6 percent), software developers (34.6 percent), and computer and information systems managers (28.1 percent).

TABLE 2. TOP 15 OCCUPATIONS IN MASSACHUSETTS’ LIFE SCIENCES INDUSTRY¹⁰

SOC	Occupation	Life Sciences-Specific Jobs, 2021	Life Sciences % of Overall Occupation	Total Jobs in MA, 2021	Total Occupational Growth, 2015-2021	Location Quotient (LQ)
19-1042	Medical Scientists, Except Epidemiologists	9,893	73.1%	13,527	48.1%	4.3
15-1256	Software Developers and Software Quality Assurance Analysts and Testers	4,229	6.0%	70,067	34.6%	1.53
19-4021	Biological Technicians	4,063	71.7%	5,666	43.6%	2.82
19-1021	Biochemists and Biophysicists	3,665	89.6%	4,092	76.6%	4.57
11-9121	Natural Sciences Managers	3,558	79.1%	4,500	74.9%	2.66
11-1021	General and Operations Managers	3,349	4.0%	84,170	15.3%	1.44
13-1198	Project Management Specialists and Business Operations Specialists, All Other	2,614	6.8%	38,239	33.6%	0.92
19-2031	Chemists	2,286	62.2%	3,674	15.2%	1.81
17-2141	Mechanical Engineers	1,981	22.8%	8,672	22.7%	1.19
19-1029	Biological Scientists, All Other	1,827	74.5%	2,451	86.5%	2.37
17-2112	Industrial Engineers	1,752	15.7%	11,129	19.1%	1.59
11-3021	Computer and Information Systems Managers	1,673	8.5%	19,749	28.1%	1.71
11-3031	Financial Managers	1,654	5.4%	30,572	12.7%	1.9
11-9041	Architectural and Engineering Managers	1,652	22.0%	7,503	14.5%	1.59

⁹ These occupations are based only on those industries or NAICS from Appendix D for which at least 50 percent of employment is considered part of the “life sciences” industry; for the purposes of this report, these are called “majority” life sciences sectors. These include the following: medicinal and botanical manufacturing; pharmaceutical preparation manufacturing; in-vitro diagnostic substance manufacturing; biological product (except diagnostic) manufacturing; research and development in nanotechnology; research and development in biotechnology; research and development in the physical, engineering, and life sciences; and medical laboratories.

¹⁰ *Id.*

43-6011	Executive Secretaries and Executive Administrative Assistants	1,574	7.9%	20,013	-46.5%	1.6
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Workforce Needs & Challenges

The Workforce Needs & Challenges section highlights the quantitative and qualitative research findings from both the quantitative employer survey and a series of qualitative interviews conducted with talent acquisition professionals, executives, and leaders in Massachusetts' life sciences industry. Their feedback and insights have been compiled here for analysis and understanding.

Business Survey Results

The following section details the results of the employer survey outreach. Through an iterative process, the research team developed a survey instrument tailored to meet the needs and inquiries of MassBio. The survey is meant to gather quantitative data and statistics to better understand employer perceptions of challenges, needs, and trends in the life sciences labor market. For more information on the survey research methodology, please refer to Appendix A.

Reporting of the survey results is broken out into the following sub-sections:

1. Firm profile
2. Employment Profile
3. Hiring Expectations & Challenges
4. Hiring Requirements & Preferences
5. Partnerships & Program Interest

FIRM PROFILE

The majority of surveyed firms indicated they are in the drug development industry (73.4 percent). Other surveyed industries include research products and instrumentation (11.7 percent), bioinformatics (9.4 percent), and human diagnostic development (7.8 percent).

Most surveyed firms were larger in size, with 25 employees or more (84.3 percent). About one in 10 (13.2 percent) survey respondents indicated that their firm has 10 to 24 employees. The remaining businesses have fewer than 10 workers.

FIGURE 2. SURVEYED INDUSTRIES

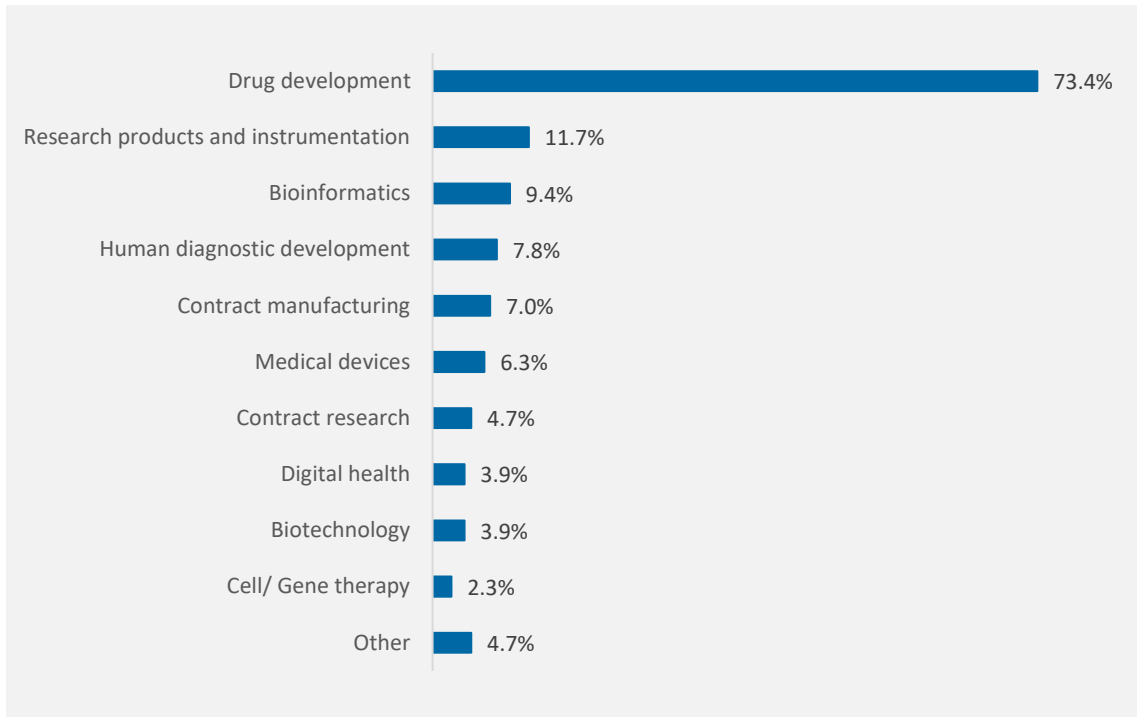
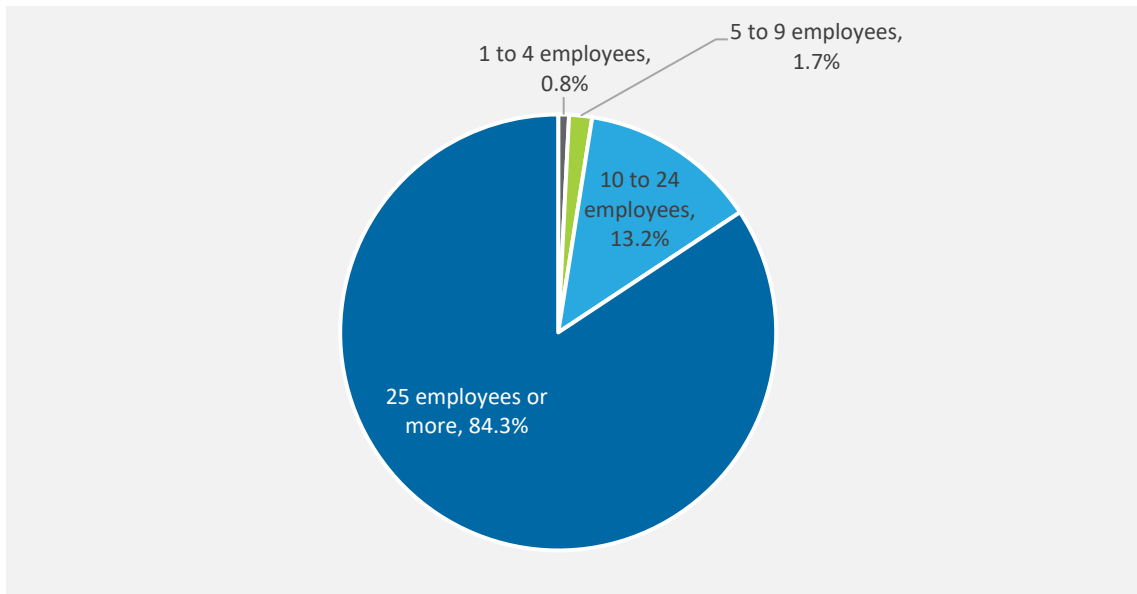
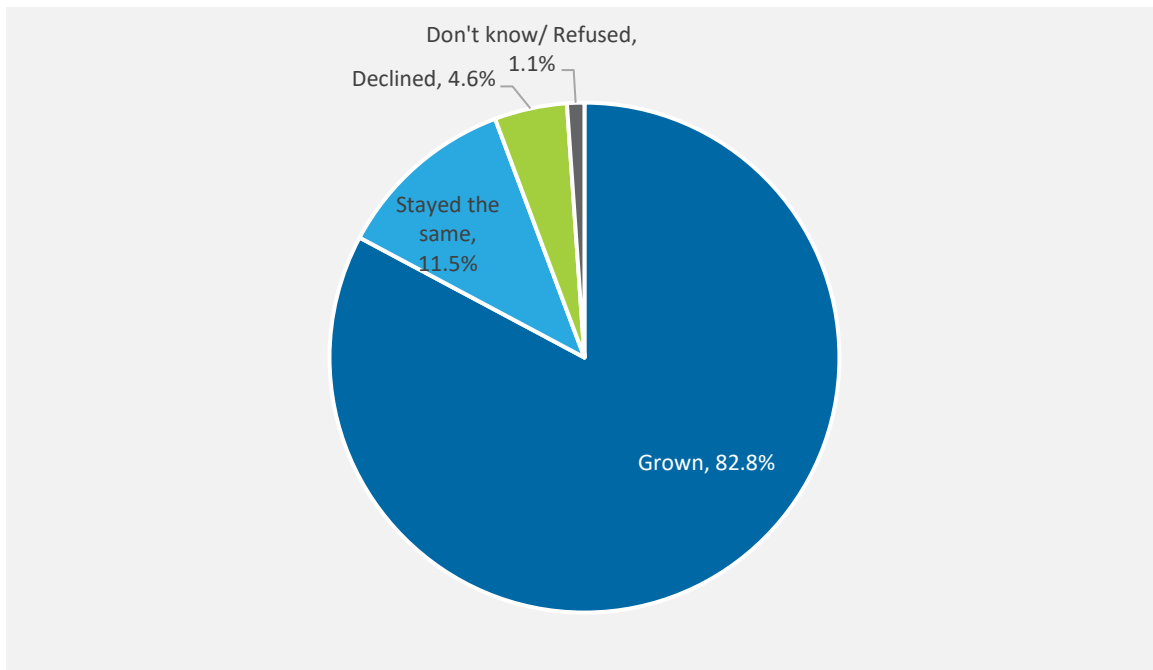


FIGURE 3. BUSINESS SIZE



Over the last three years, eight in 10 surveyed businesses indicated that their company has grown in terms of total employment (82.8 percent). About one in 10 firms indicated their workforce has stayed the same size (11.5 percent), and less than five percent noted that their labor force has decreased in size over the last three years.

FIGURE 4. EMPLOYMENT GROWTH OVER LAST THREE YEARS



EMPLOYMENT PROFILE

Across surveyed life sciences firms in Massachusetts, the majority of full- and part-time permanent employees have at least a Bachelor's degree. Four in 10 employees have a Bachelor's degree (40.8 percent) and another four in 10 have a Master's degree, Doctoral, or professional degree (43.1 percent). Sixteen percent of life sciences workers in Massachusetts have less than a Bachelor's degree.

The majority of the life sciences workforce is engaged in scientific or research roles (65.1 percent), with the remaining roughly one-third of workers engaged in non-scientific roles, such as office and administrative support (34.9 percent).

FIGURE 5. EMPLOYEE EDUCATIONAL ATTAINMENT

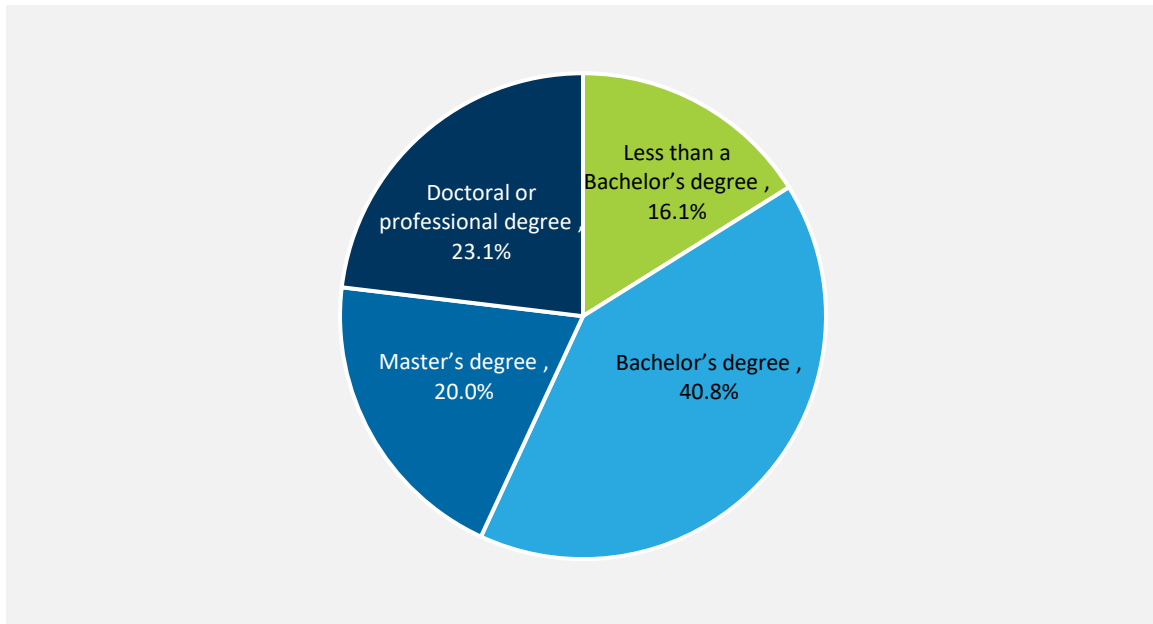


FIGURE 6. EMPLOYEE ROLES

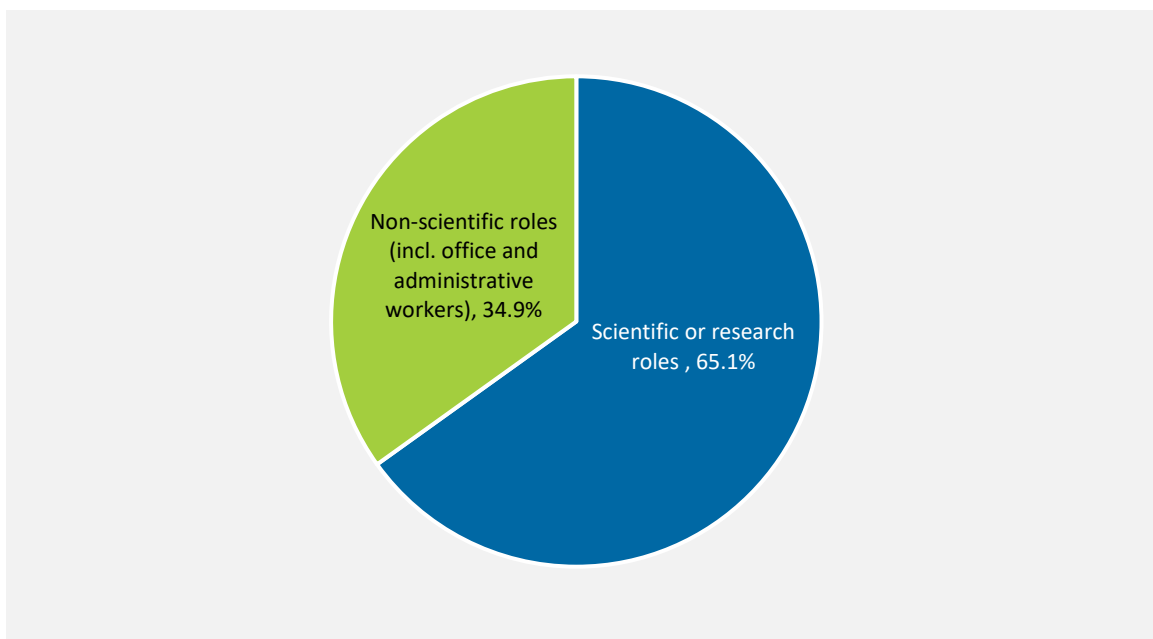
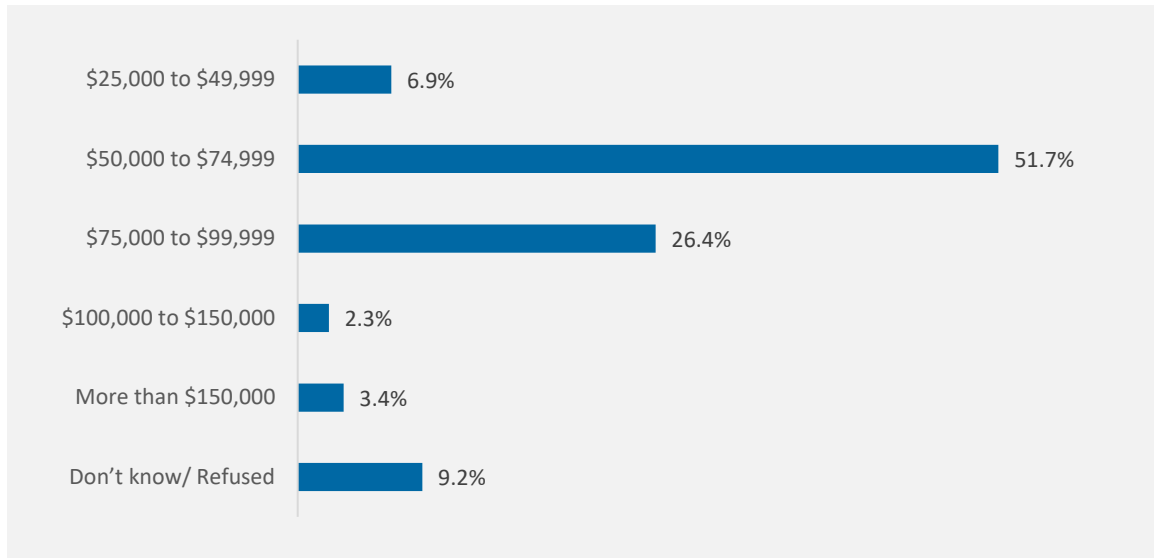


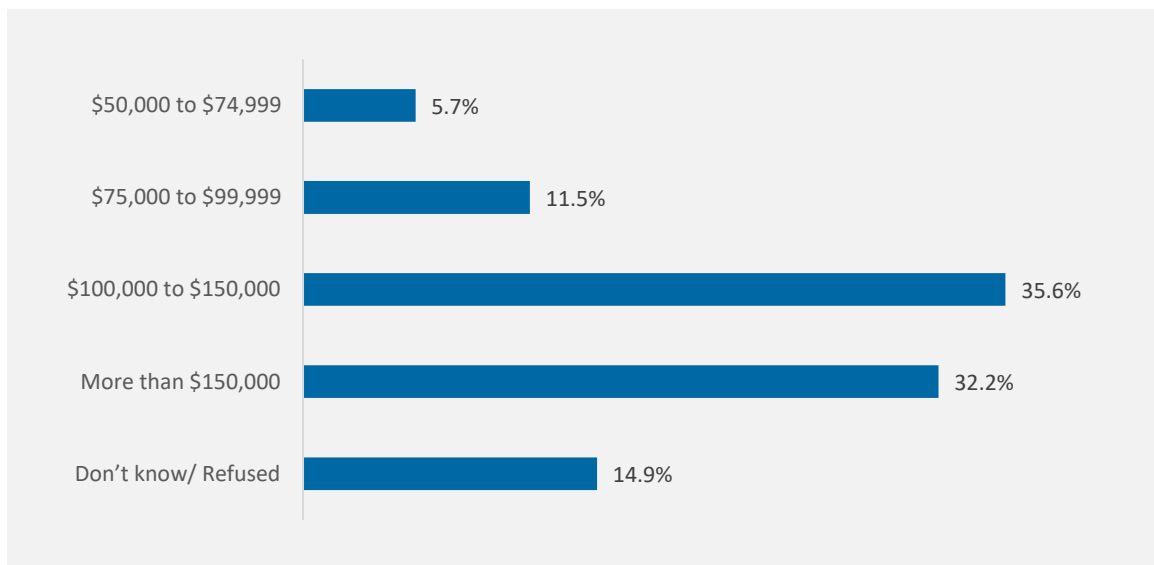
FIGURE 7. AVERAGE ENTRY-LEVEL WAGE



Entry-level wages for life sciences workers are largely concentrated in the \$50,000 to \$99,999 range; about eight in 10 survey respondents indicated that their firms offer an annual salary for entry-level positions somewhere within this range (78.1 percent). Only 6.9 percent provide entry-level salaries below \$50,000, while 5.7 percent reported entry-level wages \$100,000 or higher.

The average annual salary for non-entry-level positions is typically \$100,000 or greater; 67.8 percent of survey respondents indicated that their firm provides an average annual wage for non-entry-level positions that is at least \$100,000.

FIGURE 8. AVERAGE NON-ENTRY-LEVEL WAGE



HIRING EXPECTATIONS & CHALLENGES

Just over three-quarters of surveyed firms indicated that they expect to hire more employees over the next 12 months (77.9 percent). About one in 10 firms expect to maintain the same number of workers, and 2.6 percent of respondents expect their workforce to shrink over the next 12 months.

Firms that indicated they will be hiring for open positions are mostly looking for both entry- and non-entry-level workers (81.9 percent). About two in 10 firms (16.7 percent) are looking for only non-entry-level workers, while 1.4 percent of firms indicated that they are only hiring for entry-level positions.

Firms indicated hiring difficulty for both entry-level and non-entry-level positions, however, there was markedly greater hiring difficulty for non-entry-level positions compared to entry-level positions. Ninety-four percent of firms indicated difficulty (“very difficult” and “somewhat difficult”) filling non-entry-level positions over the last 12 months (94.2 percent). Just under three-quarters of firms reported difficulty filling entry-level positions (73.5 percent).

FIGURE 9. PROJECTED GROWTH OVER NEXT 12 MONTHS

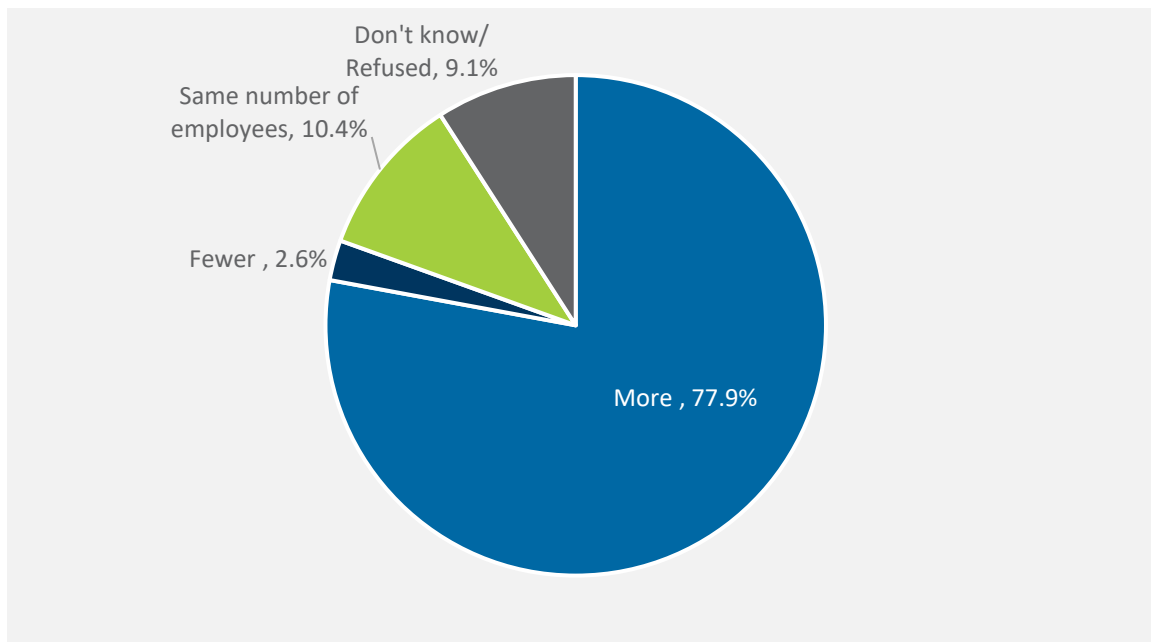


FIGURE 10. TYPES OF POSITIONS

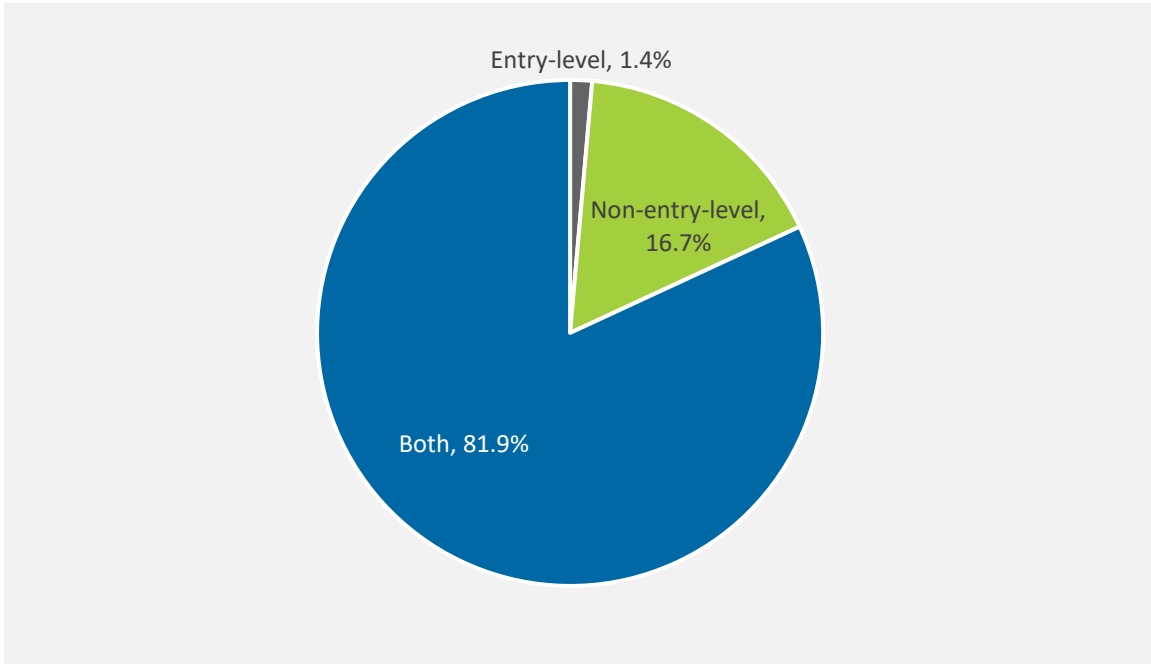
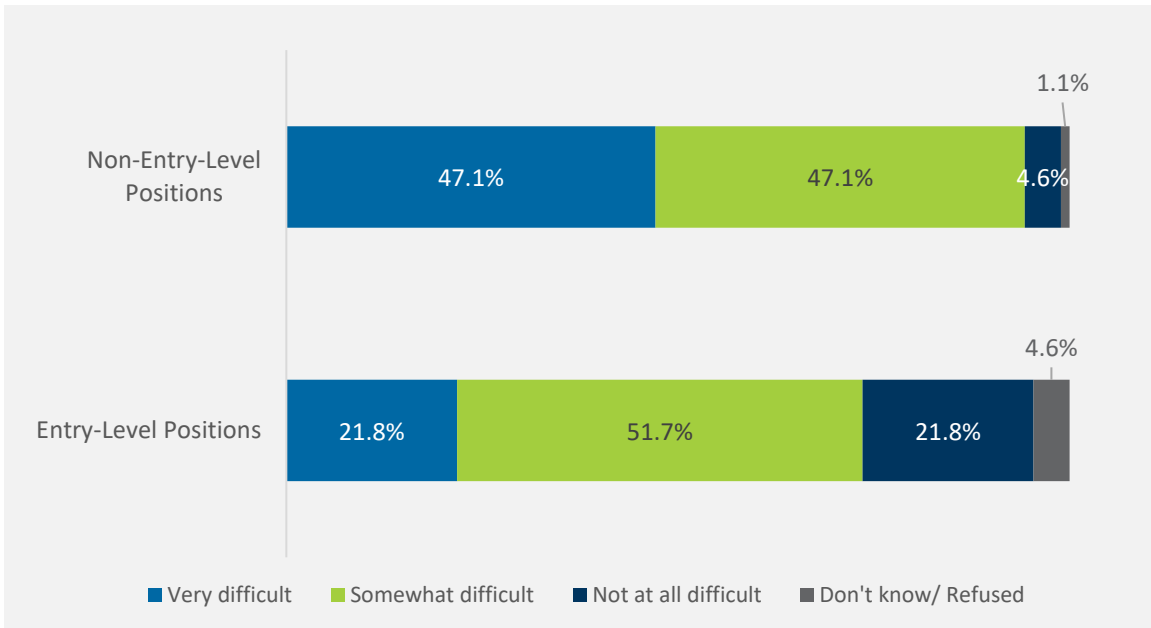


FIGURE 11. HIRING DIFFICULTY (ENTRY-LEVEL & NON-ENTRY-LEVEL POSITIONS)



Across both entry- and non-entry-level positions, firms indicated similar challenges and reasons for their reported hiring difficulty, including a small applicant pool, lack of experience or industry-specific knowledge, competition from other life sciences, and insufficient non-technical skills, such as problem-solving, critical thinking, communication, teamwork, and adaptability.

FIGURE 12. REASONS FOR HIRING DIFFICULTY (ENTRY-LEVEL)

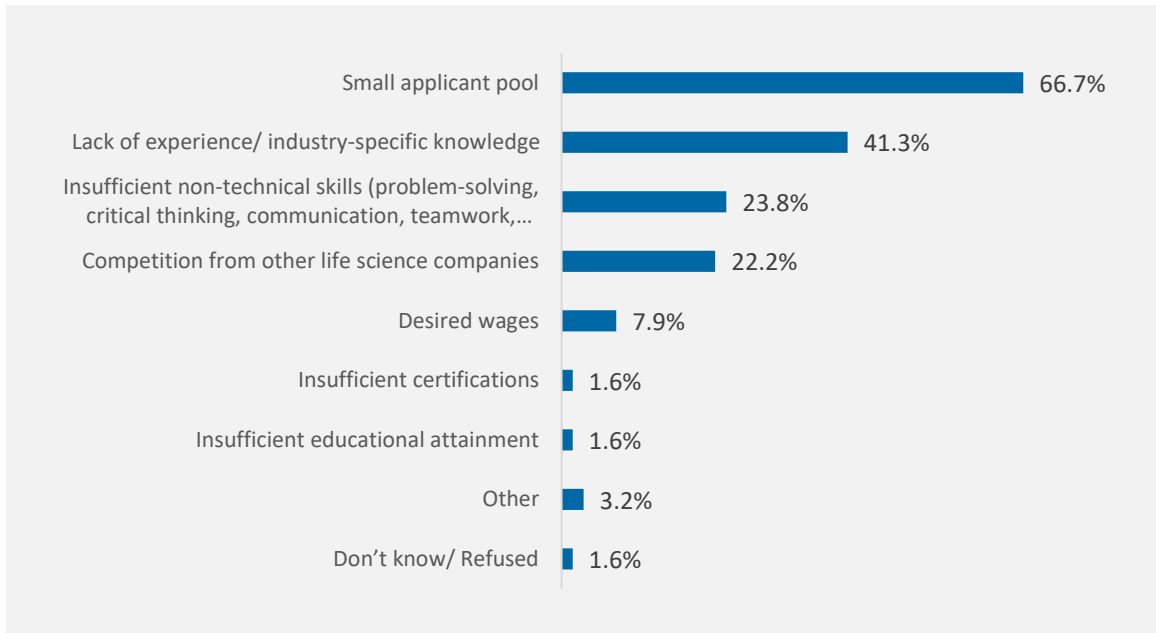
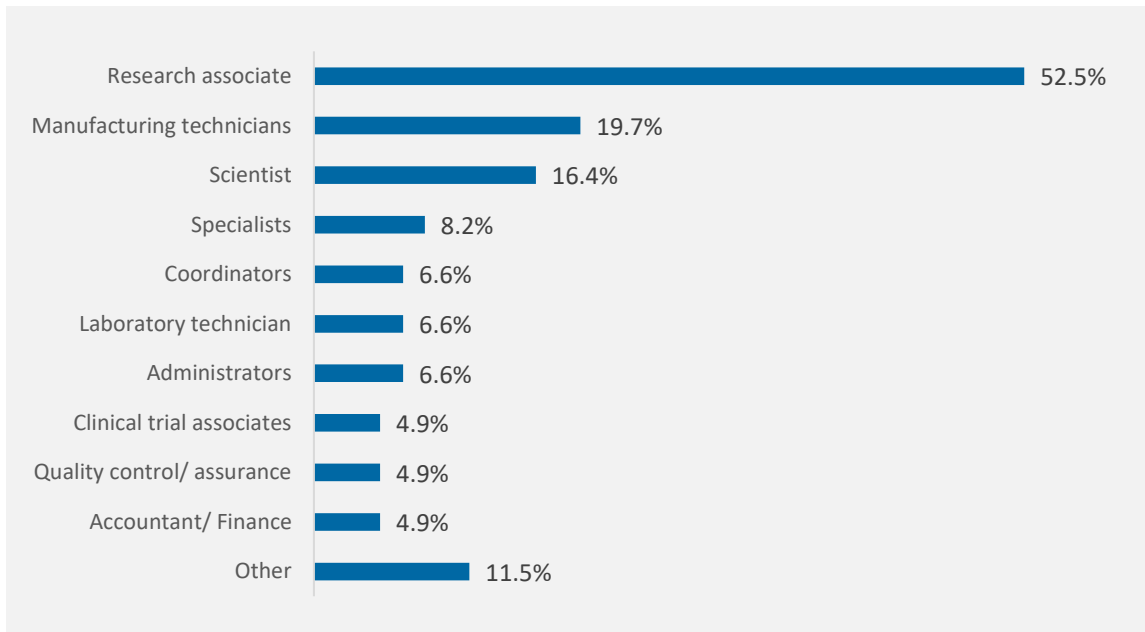


FIGURE 13. OCCUPATIONS WITH GREATEST HIRING DIFFICULTY (ENTRY-LEVEL)



The most difficult entry-level positions to fill include research associates (52.5 percent), followed by manufacturing technicians (19.7 percent). The most difficult non-entry-level roles to fill include senior scientists (34.2 percent) and direct level or higher managerial positions (26.6 percent).

FIGURE 14. REASONS FOR HIRING DIFFICULTY (NON-ENTRY-LEVEL)

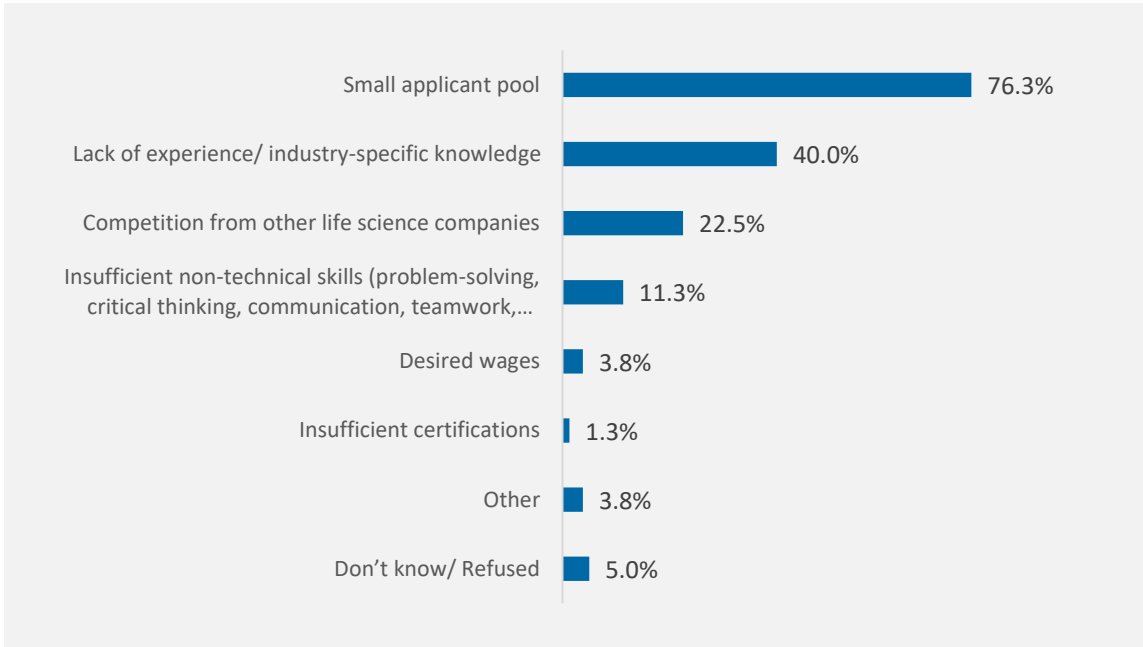
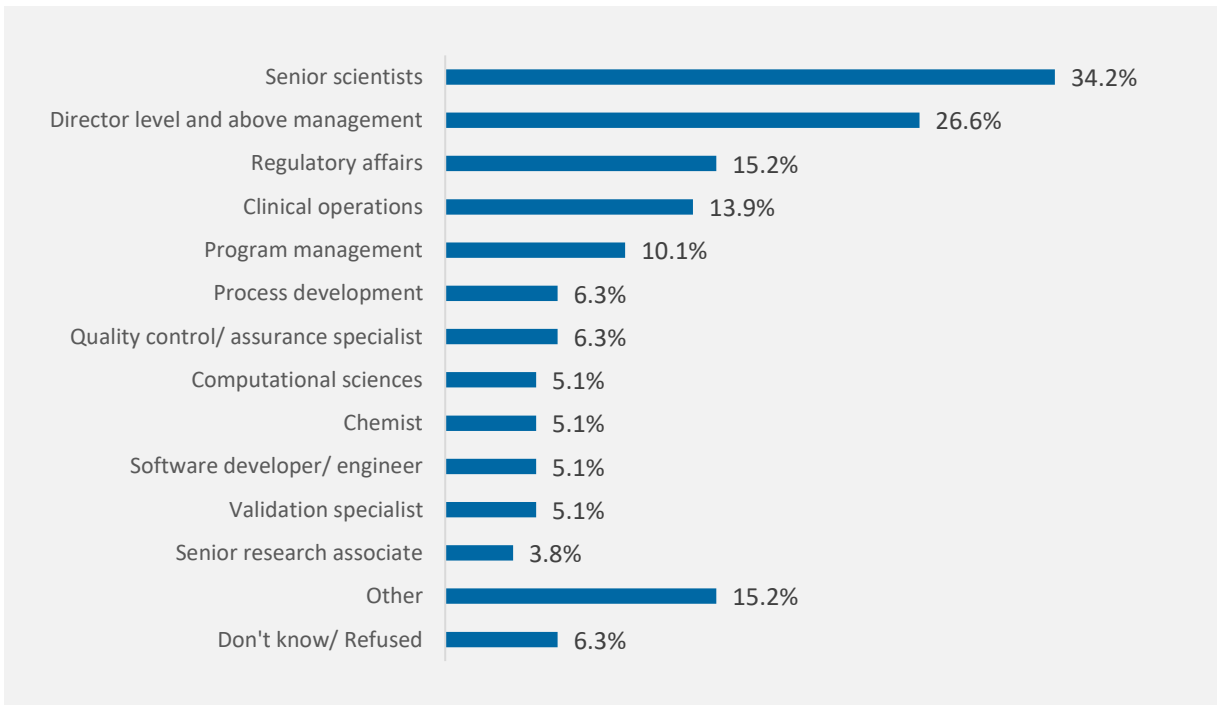


FIGURE 15. OCCUPATIONS WITH GREATEST HIRING DIFFICULTY (NON-ENTRY-LEVEL)

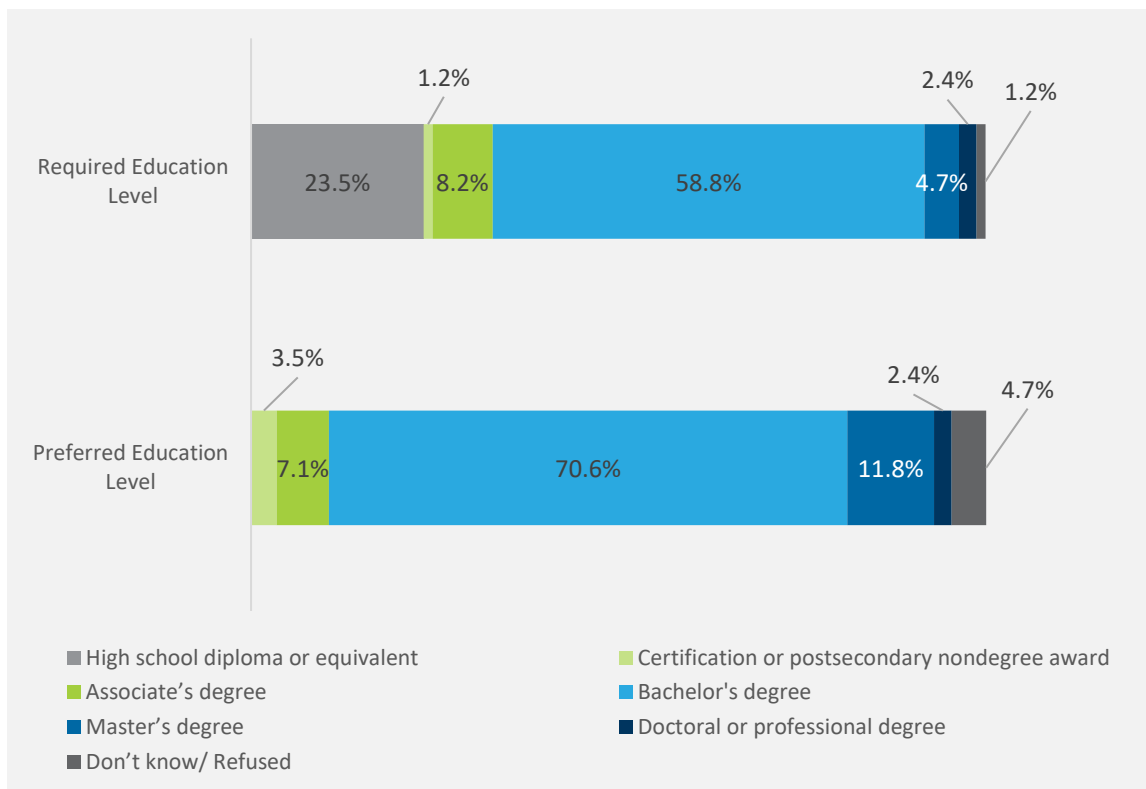


HIRING REQUIREMENTS & PREFERENCES

Required education levels are often lower compared to employers' preferred educational attainment for entry-level positions. Seven in 10 employers indicated that they would like their entry-level candidates to have a Bachelor's degree (70.6 percent), and 14.2 percent would prefer if their entry-level candidates have a Master's degree or higher. However, only 58.8 percent of employers actually require a Bachelor's degree of entry-level candidates, and 7.1 percent require a Master's degree or higher.

A third of surveyed employers reported that their required level of education for entry-level candidates is an Associate's degree or less, including a certification or postsecondary nondegree award or a high school diploma/equivalent (32.9 percent).

FIGURE 16. REQUIRED VS. PREFERRED EDUCATION LEVEL (ENTRY-LEVEL)



Just over half of firms indicated that they would hire an entry-level applicant with less than a Bachelor's degree; 50.6 percent of surveyed employers indicated they would either be "very likely" or "somewhat likely" to hire an entry-level worker with less than a Bachelor's.

Though 44.7 percent of firms reported that they are "not at all likely" to hire an applicant for an entry-level position with less than a Bachelor's degree, about six in 10 firms have done so in the past; 62.4 percent of firms reported that they have previously hired an applicant with less than a Bachelor's degree for an entry-level position.

For non-entry-level positions, firms are much less likely to hire applicants with less than a Bachelor's degree. About three-quarters of firms indicated that they are not likely to do so (72.9

percent), 22.4 percent indicated they'd be somewhat likely, and only 2.4 percent reported that they would be very likely to hire a non-entry-level candidate with less than a Bachelor's degree.

FIGURE 17. LIKELIHOOD OF HIRING LESS THAN A BACHELOR'S DEGREE (ENTRY-LEVEL)

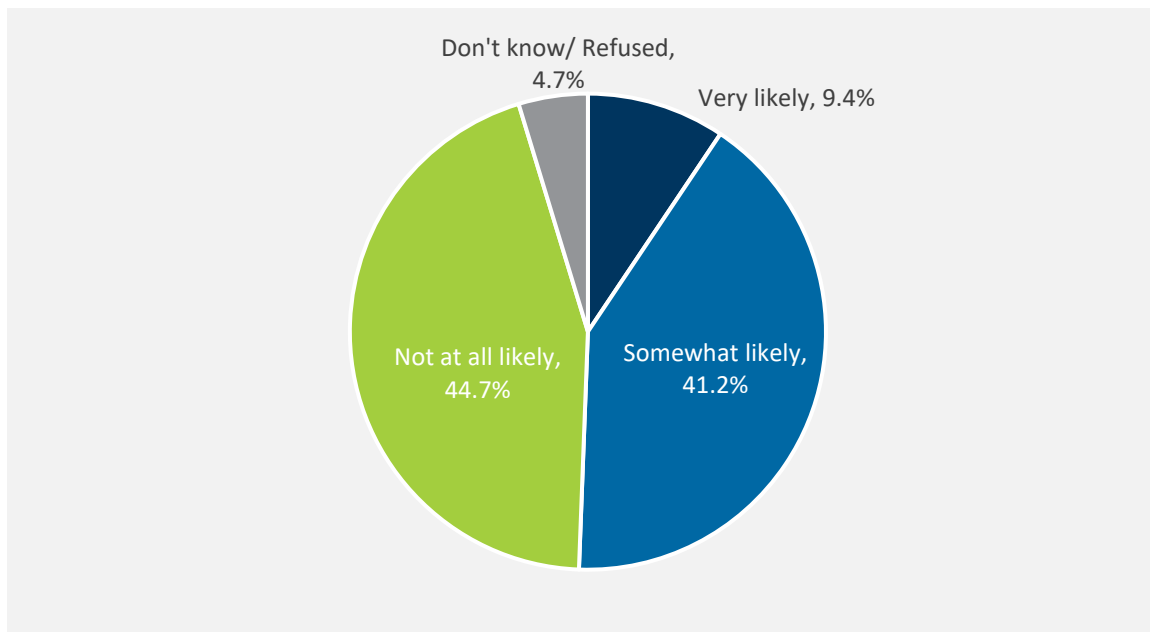


FIGURE 18. HISTORY OF HIRING LESS THAN A BACHELOR'S DEGREE (ENTRY-LEVEL)

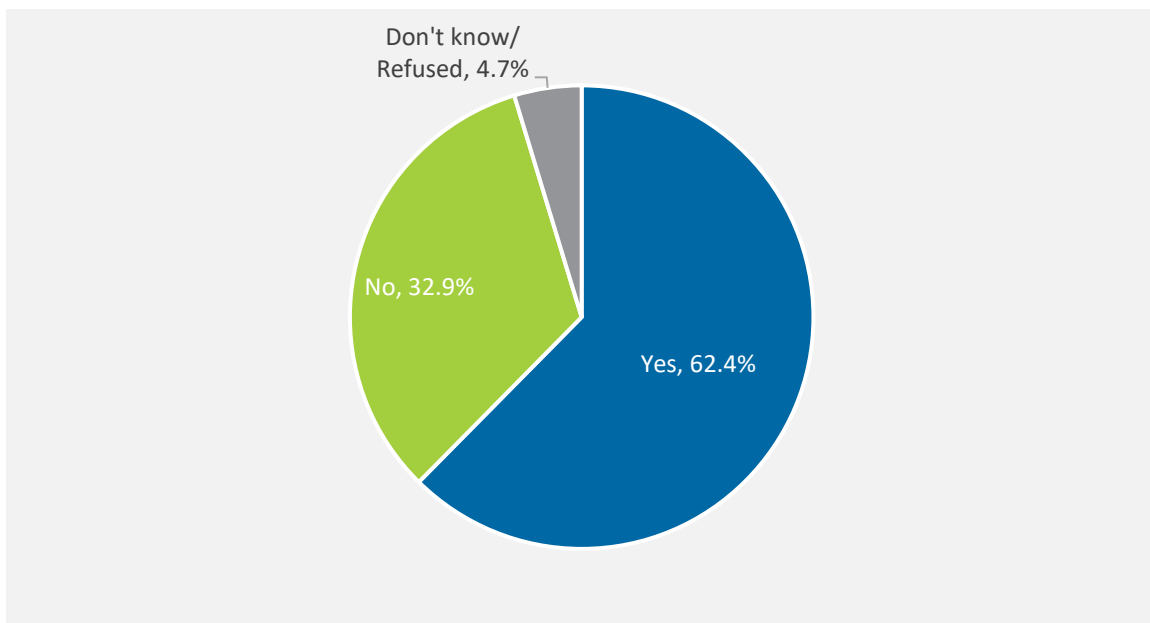
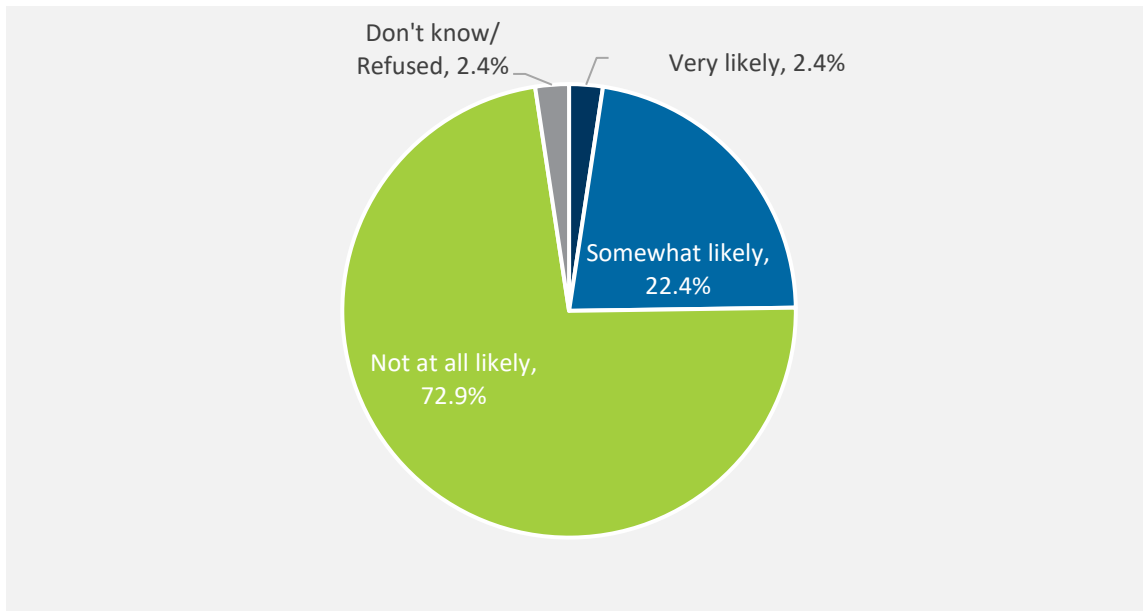


FIGURE 19. LIKELIHOOD OF HIRING LESS THAN A BACHELOR'S DEGREE (NON-ENTRY-LEVEL)



PARTNERSHIPS & PROGRAM INTEREST

For both entry- and non-entry-level positions, firms reported interest in more STEM program offerings in their region, as these types of programs and certificates would meet their firm’s skill requirements and hiring needs; 19.2 percent of firms reported they would like to see STEM programs for entry-level positions and 17.0 percent indicated they would like to see these programs for non-entry-level positions.

Additional program offerings firms would like to see for entry-level positions include lab skills (17.3 percent) and biotechnology manufacturing (17.3 percent). For non-entry-level positions, firms would like to see some leadership training (12.3 percent) and manufacturing certificates (9.7 percent).

For entry-level applicants, it is especially important for these individuals to have certificates in specialized topics from two-year colleges, such as cell culture or biomanufacturing; seven in 10 firms indicated that this is either very or somewhat important for entry-level candidates (69.1 percent). Third-party certifications, including RAPS and Six Sigma, are also important to 48 percent of surveyed employers, while badges are not really important to the majority of employers.

FIGURE 20. PROGRAM OR CERTIFICATE INTEREST (ENTRY-LEVEL)

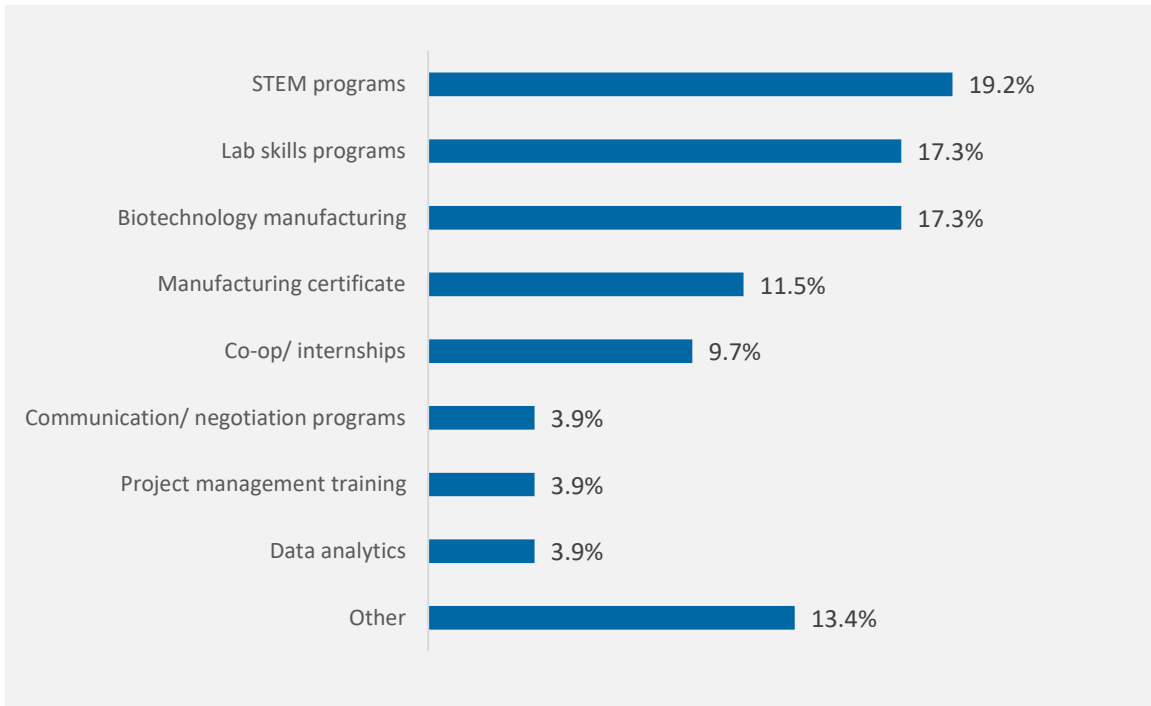


FIGURE 21. PROGRAM OR CERTIFICATE INTEREST (NON-ENTRY-LEVEL)

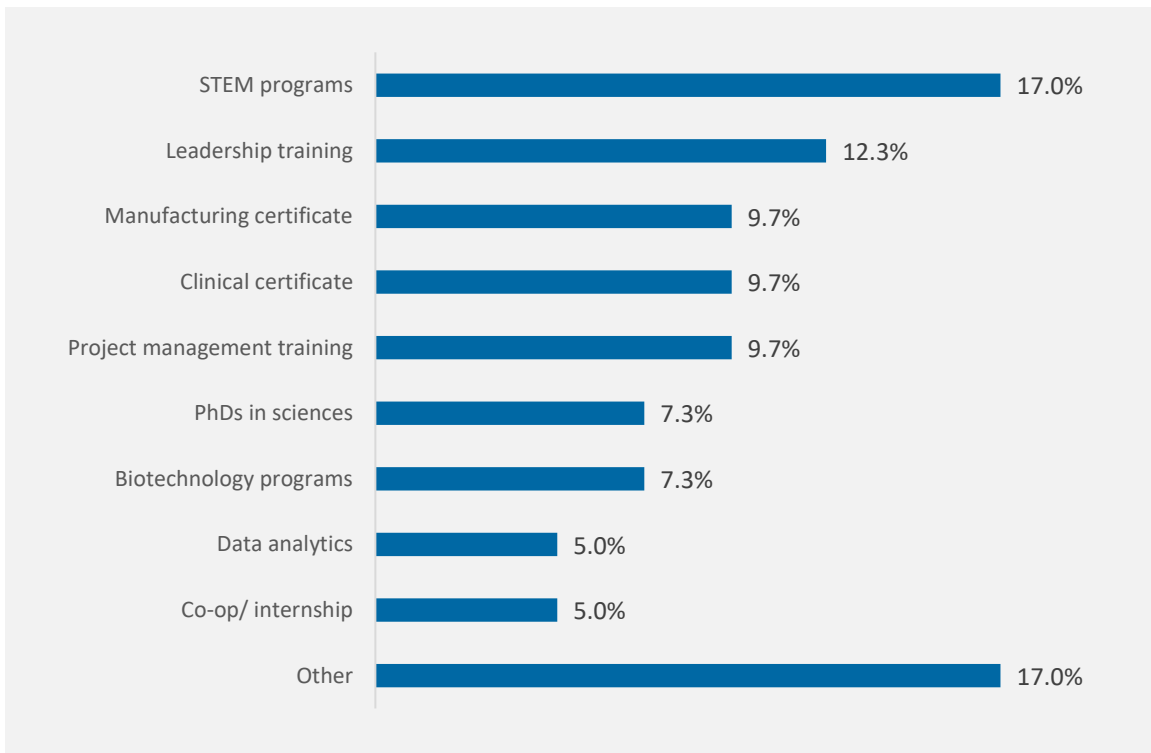
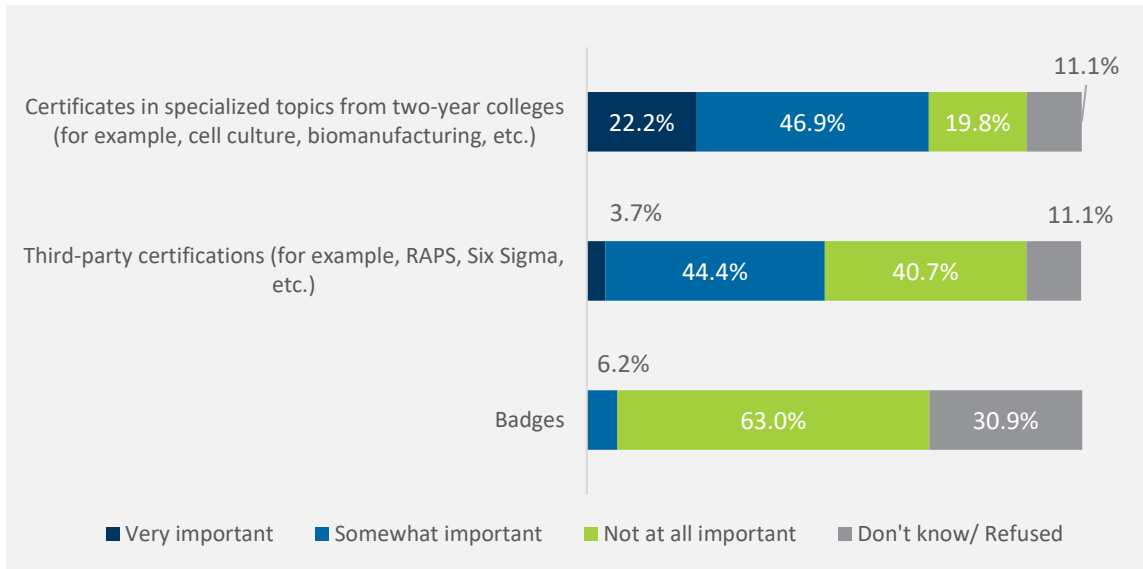


FIGURE 22. CERTIFICATION & BADGE IMPORTANCE LEVEL (ENTRY-LEVEL)

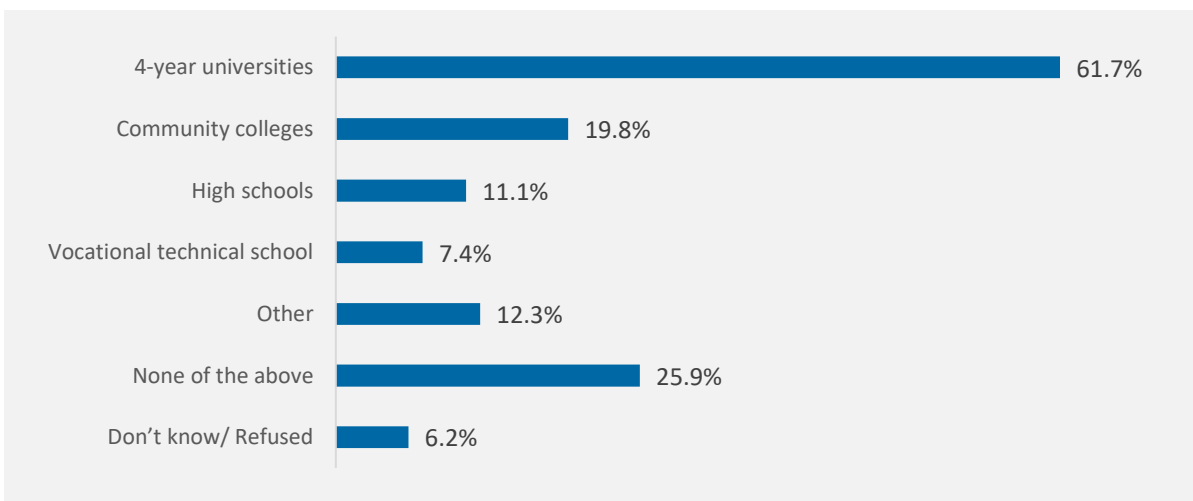


Most life sciences firms partner with 4-year universities to recruit talent for open positions; 61.7 percent of surveyed businesses indicated that they partner with 4-year universities, such as Northeastern, Harvard, and the Massachusetts Institute of Technology. About two in 10 firms (19.8 percent) also partner with community colleges on recruitment efforts, including Middlesex, Roxbury, North Shore, Bunker Hill, Bristol, and other out-of-state community colleges.

A few employers also partner with high schools (11.1 percent) and vocational technical schools (7.4 percent).

Just over a quarter of firms indicated that they do not partner with any educational institutions (25.9 percent).

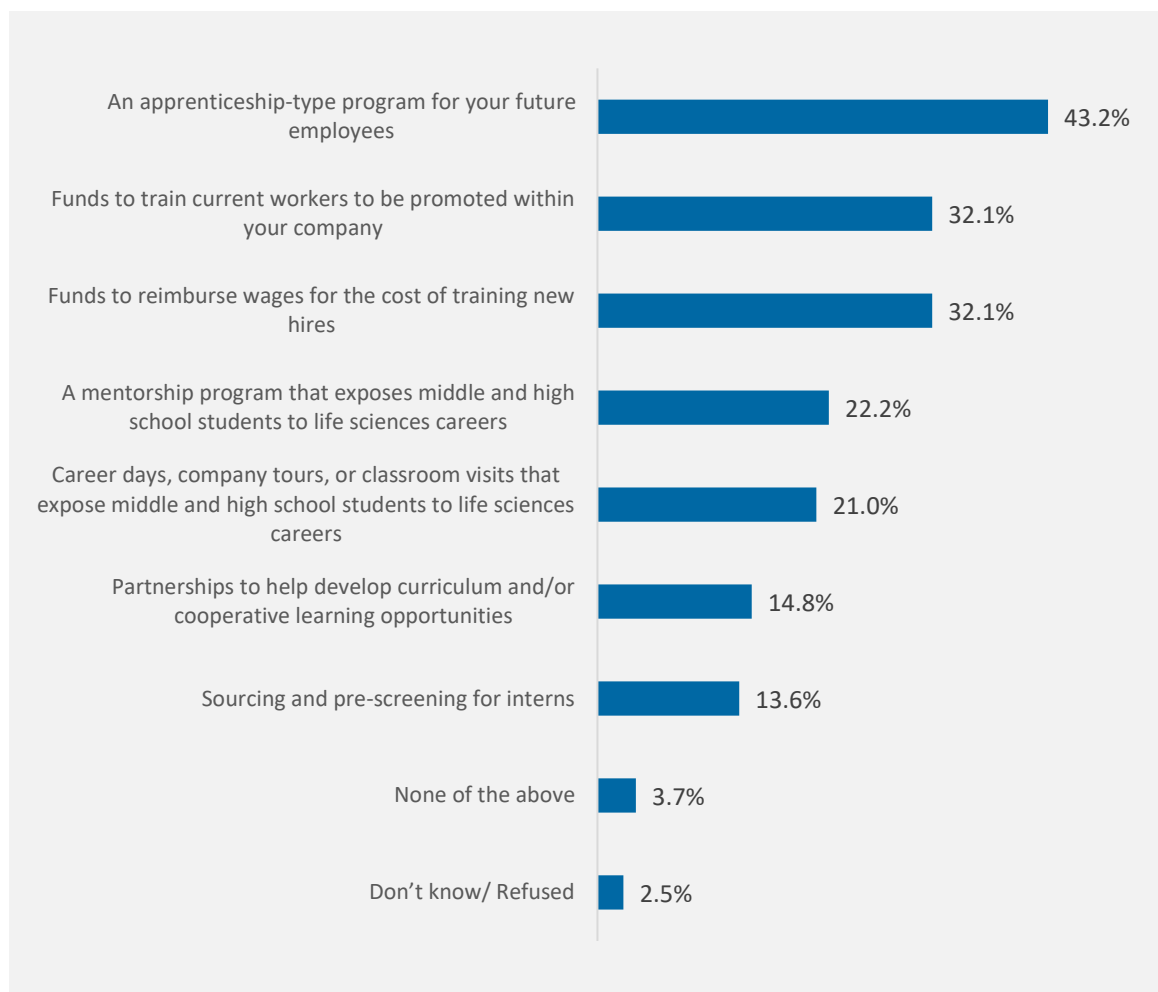
FIGURE 23. TRAINING PROVIDER PARTNERSHIPS



When offered the following list of potential programs or services, firms indicated the most interest in an apprenticeship-type program for their future employees (43.2 percent), followed by funds to train current workers (32.1 percent), funds to reimburse wages for the cost of training new hires (32.1 percent), a mentorship program that exposes middle and high school students to life sciences careers (22.2 percent), and career days, company tours, or classroom visits that expose middle and high school students to life sciences careers (21.0 percent).

Fewer than 15 percent of firms also indicated interest in partnerships to help develop curriculum and/or cooperative learning opportunities (14.8 percent) and sourcing and pre-screening for interns (13.6 percent).

FIGURE 24. PROGRAM INTEREST



Executive Interview Findings

The following section details findings from a series of interviews and a roundtable conducted between February and April 2022. The research team spoke with a total of 28 life sciences companies based in Boston, the MetroWest, and Central Massachusetts. Companies that participated include, but are not limited to, the following: Vertex, Lykan Bioscience, Mustang Bio, Alkermes, Thermo Fisher Scientific, Cyteir, Be Biopharma, and Blueprint Medicines.

BW Research sought to gather qualitative data on the perceptions of workforce needs and challenges for life sciences firms in Massachusetts. The key themes and findings from these interviews are broken out into the follow sub-sections:

1. Talent Competition & the Skills Gap
2. Industry Awareness & the Early Education Pipeline
3. Non-Traditional Training Pathways

TALENT COMPETITION & THE SKILLS GAP

Competition for talent is very high in the Life Sciences industry, and companies have had to get creative to attract and retain talent. There was a broad consensus that the life sciences industry, in Massachusetts and elsewhere, is facing high levels of competition and representatives noted how they have never experienced such a market. Life Sciences firms are facing competition from other life sciences companies in Massachusetts and out-of-state; however, the industry is also facing competition from big tech for data science-related talent.

Many firms are employing various methods to attract and retain talent, including higher wages, improved benefits, and hybrid work models. Large- and mid-sized firms indicated how biotech startups were attracting talent they could not afford to keep because their policies surrounding salaries and titles were more “old school” and not as fast-moving as startups. On the flip side, startups indicated financial considerations as the main source of their retention issues, citing immaturity as a company for their financial disadvantage. Firms also cited hybrid remote work models as one method they have used to retain talent while others have prioritized upskilling and reviewing benefits packages, offering tuition or relocation assistance.

“It is tough out there these days, there has been an incredible flux. We know that we need to start getting creative and think differently about how to access talent and build it for the industry.”

“[It’s hard to find people in] IT/Data Science because we are always competing with the CS industry, and we need to convince people to come out of tech into our industry. [We’re] focusing on the data science side so we have to attract people with the experience...”

“Some of the roles can be hybrid in nature so that helps us expand in this competitive biotech market.”

“Big tech, and smaller biotech companies are the biggest competition. [We’re] very big, and sort of old school compared to the newer smaller biotech companies.”

“Most of our competition is in biotech and biopharma, not much in healthcare.”

"[For] manufacturing, lab-based researchers, some of the roles can be hybrid in nature so that helps us expand in this competitive biotech market."

"We have tuition assistance and we are working on reviewing our relocation package. Retention is up to us. We need help getting people in, but it is up to us to help people want to stay... we are losing people to the small guys and we are hiring from the big guys."

"The attrition rate has been pretty low for us, we're not in Cambridge or Boston, and we have benefitted because people figured out that they don't have to brave long commutes to do good science. We've had to add more benefits that aren't typical for people with less experience especially if you are attracting people from outside the state like we are."

Up titling and wage inflation are major contributors to talent competition in Massachusetts' life sciences industry. Small and large firms indicated this as a major retention and attraction issue as the prevailing attitude is that there is always a company that is willing to pay more or offer a higher salary to potential candidates.

"We have a lack of talent because there is a war for talent. With so much up titling and offering higher salaries... sometimes people come in for higher salaries and higher titles and we have had turnover because some do not stretch and grow in their titles as much as they should, and their skills do not match [the] title."

"This is nothing like I've seen before, we are competitive and seek high-level talent. There's a lot of small biotech everywhere, even entry-level people (little to no experience) go to those [small firms] for salaries and elevated titles (associate scientist I and II)."

"Small and large companies are running into the overtitling issue and it's everywhere, even from the hiring groups I am connected to, it seems this is a new thing that's happening."

"...it is very easy for a small startup to give [hires] an inflated title. We get beat out in total rewards (PTO, titles, promise of more [long-term incentives] than base salary, comp package flexibility), we lose a lot of our talent there. We are losing our underrepresented talent at a much faster rate because they are being targeted."

"We've had to loosen our standards in a way I have never seen before... most of the concessions we make are unheard of... and this is something we are seeing in the hiring communities I am connected to as well... we do pay higher scale but not off the scale for all levels including entry."

There is a mismatch in the experience and skills firms are willing to give certain titles and salaries for versus skills prospective hires and employees can confidently execute. Identified skills included bench skills for employees who need to work in labs, interpersonal skills (referred to as cultural fit by some interviewees), and professional skills (i.e., communication and punctuality). Firms have observed this across entry and non-entry level roles.

"The transition has been relatively recent for us, supply wasn't there for those roles (that had a bachelor's appended to them). There was a mismatch in the skills and goals... we've struggled to make connections with schools and some of those specialize in a way that is not compatible with the roles we need."

"It takes a lot of resources, investments, and a lot of communication and branding materials to [attract and retain people], it is not sustainable. [We] still have [the] difficulty once they are here,

they are not 100% qualified, we have to be creative and look at skills and capabilities in lieu of certain qualifications.”

“Yes, bench skills and lab experience in general... we had a potential hire who wanted to come in at a higher title but did not have the necessary skills... and like I said, we do oncology research and we cannot afford to hire people without the relevant skills... the person went with a higher title at a different company...”

“It comes down to getting people trained and the pipeline ready enough, so they come out of school informed and experienced

INDUSTRY AWARENESS & THE EARLY EDUCATION PIPELINE

Multiple employers cited unpredictable and unclear pipelines for hiring entry-level talent as a limiting factor and identified information gaps as a potential reason for this. Interviewees expressed frustration with the lack of credible information for students who are interested in life sciences careers and indicated a desire to communicate industry needs to students and educational institutions from as early as high school. Companies highlighted individual outreach and partnerships efforts with educational institutions and non-profit associations to develop clear entry points and pathways in the industry. Multiple firms indicated a desire for long-term pipeline development strategies. Interviewees expressed how they view such partnerships as instrumental for training the professionals and scientists needed not only for their own companies, but for the entirety of the life sciences industry.

“There isn’t much of a pipeline in Massachusetts, we’ve struggled to make connections with schools and some of those specialize in a way that is not compatible with the roles we need.”

“Sourcing is on LinkedIn primarily, but we need to put together a comprehensive recruitment plan that covers college grads, co-ops, and interns across the board. We are trying to establish that pipeline.”

“We would love to take advantage of interns in Mass Life Sciences. The challenge is education and attracting the talent because people are hard to find.”

“We’re not picky. I just haven’t had much luck with schools being responsive or having any kind of focus for trying to help people move into the workplace.”

“Quincy and Middlesex have been good... we sit on panels and do some resume reviews with connections from professors. One recent role had about 15 applicants from those schools in the space of two weeks.”

“We need to get into the high schools and earlier, educating about the industry early, also in more underprivileged areas, developing diversity early in the game, this is a long-term game.”

“People get into the industry and don’t have any idea what the roles are and what you’ll be doing in the role.”

“Kids in the Commonwealth cannot grasp the level of opportunity here, and we need to help them to stop seeing it as something for someone else. Looking at models around the world for centralized training centers (Ireland, North Carolina, Belgium), we need to have some investment [in these models].”

Internships, co-ops, and apprenticeships were cited as valuable models for covering the information and experience gap in the industry. For the employers who have developed or are developing internship programs, hiring manager buy in and involvement was identified as the most effective way to run an internship program. While some firms indicated their current limited ability to develop internship programs due to their current hiring needs, multiple employers indicated their preference for entry-level candidates with training from these experiences. Northeastern graduates with co-op experience were identified as the most sought-after candidates; Worcester Polytechnic Institute graduates were also identified as well-prepared for their roles.

“Co-ops and internships are the greatest opportunity for people to get experience and education, they are both important for the future of the industry because in most cases, 60-70% of hiring is coming from there.”

“We are currently working with Northeastern’s co-op program...”

“Northeastern grads are sought after, and we love them because they’ve had more work experience compared to the pale academic experience offered in other places.”

“Northeastern is the standard and a fabulous program and we are excited by what they have done so far.”

“...we are not super strict about experience. Any internship experience is huge.”

“The internship program we have is applicable to a few different places. The training aspect gets our hiring managers involved in the development of the program and that is a solid practice. The internship piece is great to see how individuals perform and for them to figure out if it’s for them. The continued check-ins and skill building (what I like to call scaffolding) is good too.”

“If we can strategically work with colleges and universities to get students into intern, co-op, and apprentice roles, that would benefit us.”

“We participate in an earn-and-learn program in which we have four interns who come from MCC every six months.”

“The types of jobs [at the new manufacturing plant] will be straight forward. We will have an apprenticeship program...”

“Apprenticeships are just one tool... we’re going to have about 20 apprentices joining us. In Cambridge, they work for people transitioning out of the military, meteorology in the Navy or nuclear energy because those people are stellar, they are the best.”

NON-TRADITIONAL TRAINING PATHWAYS

Community colleges were identified as being valuable sites of potential investment for non-traditional workforce development (i.e., hiring for people without four-year degrees). Interviewees mostly agreed that community colleges are underutilized resources that could fill the information and experience gap the industry is undergoing. While most job postings require at least a bachelor’s degree for certain entry-level positions, companies are interested in reevaluating their hiring structure to include more candidates without four-year degrees. While some companies already work with community colleges, some of those which did not

highlighted their willingness and enthusiasm to partner with community colleges to hire candidates with associate degrees. One interviewee suggested that community colleges are valuable for the certification options they offer, as any employee could enroll in a certification course to upskill for future roles within the company.

"Community colleges are an underutilized source of talent for us."

"We don't have a specific call out system to draw from Bunker Hill, we do hire people with associates. It's somewhat random still..."

"Once you have the core skills, how do you go back and get the new skills that you need to be competitive? Tech schools and community colleges play a key part in offering those certifications to people who want to get them."

"We are looking at community colleges as another source, and potentially as a longer-term investment. It's an opportunity for people to stay with us for a longer time if we hire them as an intern or grad and we train them for the long term."

"I think, too, that you don't always need a four-year degree in manufacturing (unlike QC or QA where the expectation is a bachelor's) and I have hired kids coming straight out of high school."

"The UMass system is very attractive; community colleges could be attractive and that's what we're trying to establish right now in Roxbury."

Companies identified manufacturing and quality control functions as the most likely spaces for non-traditional training initiatives to be implemented successfully. Companies have already reevaluated the minimum qualifications for these positions. Hires without 4-year degrees can be successful in these roles, but employers noted that a scientific background is instrumental for their success in the training program. Certificates, lab experience, and associate degrees were identified as sources for people to develop a science foundation for these roles.

"In manufacturing, I think the answer is yes [you do not need a four year degree], because we do train in the process, but I think it's important that some people have a foundational experience of working in the laboratory and understanding biology."

"I think someone who cares is number one. Attention to detail, ability to recognize when something doesn't work right, that's where that scientific background and experience and foundation really comes in here."

"QC is the entry-level steppingstone; you need to have scientific background/foundation though."

"I think in manufacturing it could work for sure. And in quality on the QA side it could work, but once you get beyond that QC analyst, we really look for people with GMP experience and you can really only get that in the lab. It's really important to us and we must have it in QC."

"A certificate in biotech is helpful because we find that it's easier to train for those folks. [They] do not need a degree which is related to the life sciences; we've had a variety of people with foreign language degrees, history degrees, medical assistants, [and] more recent applicants have not had a bachelor's."

"[Hiring folks without 4-year degrees for manufacturing, R&D, and IT activities] is one area where we have challenged ourselves and we have identified a number of roles that do not require it. We just saw to fruition 10 interns who are high school grads, interned in QC and supply chain for six months after biotech and business for six months and nine were offered full time roles. We'll be starting a new cohort in the fall."

Industry Assets & Resources

The Industry Assets & Resources section provides an overview of the life sciences training landscape in Massachusetts as well as available federal and state workforce development programs—both specific to life sciences and more generally available for businesses—that may be used by life sciences firms to augment and support their recruitment and hiring efforts.

Training Landscape

INTRODUCTION

The life sciences training landscape seeks to provide a greater understanding of the landscape of biotechnology and biomanufacturing training in Massachusetts. The training inventory focuses on pathways that do not require a four-year degree or lead to graduate certificates for baccalaureate holders with an interest in pivoting.¹¹

The research team augmented MassBio’s original list of biotechnology and biomanufacturing training programs by relying on publicly available information on program websites to supplement the original training inventory. The inventory, which contains 23 programs across 15 different institutions, provides a basic understanding of the distribution of existing non-four-year training programs by industry, geography, degree outcome, and program provider.

PROGRAM OFFERINGS

This section highlights the current training programs in Massachusetts that are presently involved in developing the state’s life sciences workforce. Only one program is brand new as of December 2021 and is still in development—the associate degree program in biotechnology manufacturing, which is a product of collaboration between the Benjamin Franklin Institute of Technology (BFIT) and Ginkgo Bioworks; the program will be hosted by the Nubian Square Life Sciences Training Center.

Life sciences workforce training in Massachusetts covers an array of industry sectors (Table 3). Identified programs prioritize providing students with a solid science foundation, as graduate certificates require a science background for students to take part in the programs. While all outlined programs train for careers in the life sciences, there emerged some distinction in the focus of these programs.

Biotechnology programs are designed to familiarize students with standard operating procedures (SOPs) in laboratories, strengthen their research skills, and teach them about the latest technologies. Most training programs (57.1 percent)—seven of which are hosted by community colleges—focus on biotechnology.

Biomanufacturing programs outlined the same foundations as biotechnology programs. In addition, biomanufacturing training includes activities that provide experience in quality control, process development, and current Good Manufacturing Practices (cGMP).¹² Overall, one-third of

¹¹ Northeastern’s A2M Program is an exception in this analysis as it is the next optional step for people who earn their credential through the program at Middlesex Community College.

¹² Mandated by the Food and Drug Administration (FDA)

identified programs focus on biomanufacturing; three of which are hosted by community colleges, two by private colleges or universities, and one by a community-based organization.

While data science accounted for one program (4.8 percent), the biomedical and general life sciences industry sectors accounted for two programs each (9.5 percent each). One of the biomedical programs, offered by Just-A-Start in partnership with Bunker Hill Community College (BHCC), provides an academic biomedical foundation that includes comprehensive laboratory skills training and leads to a variety of life sciences jobs. The data science and general life sciences programs, all offered by the Massachusetts Life Sciences Center (MLSC), are respectively geared towards data science and STEM internship opportunities in the life sciences industry.

TABLE 3. MASSACHUSETTS LIFE SCIENCES TRAINING PROGRAMS BY INDUSTRY SECTOR

Industry Sector	Number of Programs*	Percent of Programs
Biotechnology*	12	57.1%
Biomanufacturing*	7	33.3%
General Life Sciences	2	9.5%
Biomedical	2	9.5%
Data Science	1	4.8%

* BFIT's new program is expected to develop skills in biotechnology and biomanufacturing, among others; thus, it is counted for both categories. As such, the total number of programs will not equal 23 and the percentage will not sum to 100 percent.

Just over 60.0 percent (60.9 percent) of the identified in-state training programs focus on training biological technicians (Table 4). One of the fourteen programs is still in development, as mentioned above. Five of these programs—hosted by MassBay Community College (MassBay), MassBioEd, Quincy College, and Worcester Polytechnic Institute (WPI)—provide clear pathways into biomanufacturing roles. Approximately one-third (34.8 percent) of the programs train individuals for a variety of occupations within the life, physical, and social science category.¹³ Some programs include lab training while others focus on instruction broadly related to industry. One program, hosted by the Massachusetts Life Sciences Center (MLSC), develops data scientists for the life sciences industry.

TABLE 4. MASSACHUSETTS LIFE SCIENCES TRAINING PROGRAMS BY PROGRAM PROVIDER

Program Provider	Number of Programs	Percent of Programs
Community College	10	43.5%
Private College/University	5	21.7%
Community-Based/Non-Profit Organization	4	17.4%
Quasi-Public Agency	3	13.0%
Public College/University	1	4.3%

¹³ These programs outlined training opportunities for engineers, environmental scientists, chemists, biomedical professionals, and microbiologists among others.

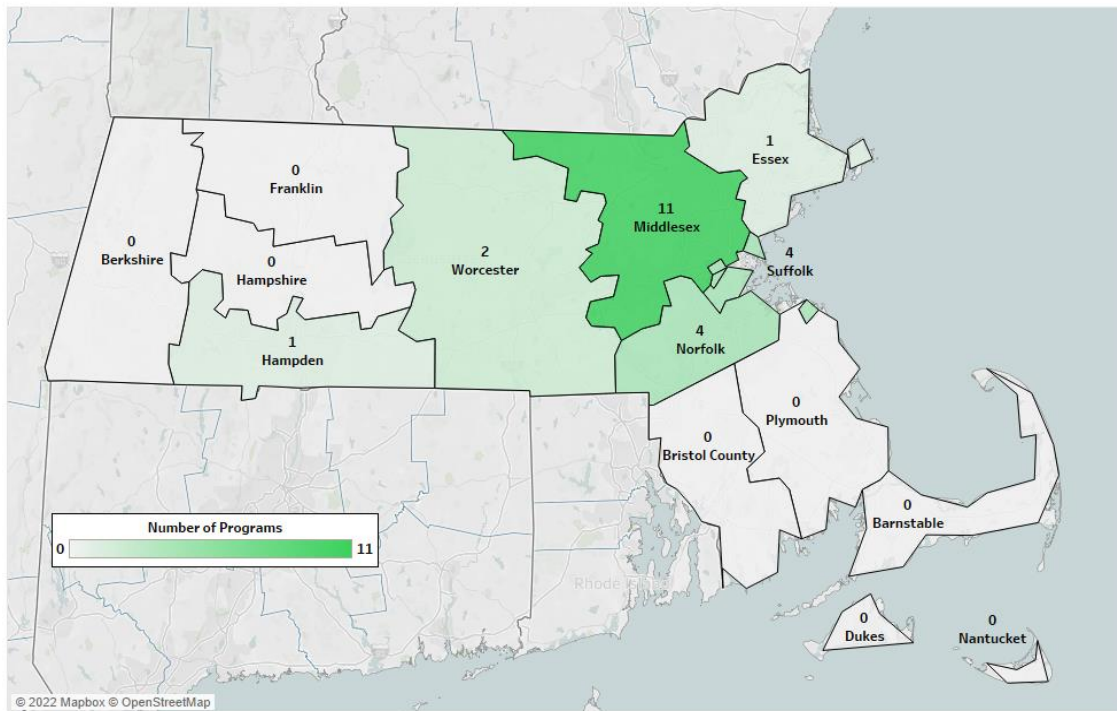
Middlesex County offers eleven training programs, accounting for 47.8 percent of programs (Table 5). Norfolk and Suffolk counties each have four programs (17.4 percent respectively). Worcester County has two programs which are offered by WPI and lead to certifications in biomanufacturing. Essex and Hampden counties each have one training program (4.3 percent each).

TABLE 5. MASSACHUSETTS LIFE SCIENCES TRAINING PROGRAMS BY COUNTY

County	Number of Programs	Percent of Programs
Middlesex	11	47.8%
Norfolk	4	17.4%
Suffolk	4	17.4%
Worcester	2	8.7%
Essex	1	4.3%
Hampden	1	4.3%

Of the eleven programs offered in Middlesex County, four are hosted by Middlesex Community College and three by MLSC; this means that six distinct institutions offer life sciences training in Middlesex County. Two institutions (MassBay Community College and Quincy College) offer training in Norfolk County and four institutions offer training in Suffolk County.

FIGURE 25. MASSACHUSETTS LIFE SCIENCES TRAINING PROGRAMS BY COUNTY



The concentration of life sciences training programs in Middlesex, Norfolk, and Suffolk counties is unsurprising given the general distribution of colleges and universities in Massachusetts.¹⁴ Given that Middlesex, Suffolk, and Norfolk also have the highest proportion of research and development (R&D) jobs¹⁵, the industry is well-poised to take advantage of the talent pipeline from schools in the area. Additionally, Middlesex County has the highest proportion of biomanufacturing jobs (45.2 percent) followed by Worcester County (20.4 percent).¹⁶ The two counties also have the highest biomanufacturing job growth of 7.9 percent for Worcester County and 4.8 percent for Middlesex County.¹⁷ However, there are only three biomanufacturing training programs between the two counties—two at WPI and one with MassBioEd.

One area of opportunity is leveraging talent from biomanufacturing programs adjacent to the county, which Middlesex and Suffolk companies are already doing with Northeastern’s programs. Another area of opportunity is increasing partnerships between industry and training hosts in Middlesex and Worcester counties. Regional economic development agencies, like Grafton’s Economic Development Council in Worcester County,¹⁸ are also keen to host biomanufacturing companies in their cities and towns.

The analysis shows an almost equal number of associate degrees (39.1 percent) and certificates (34.8 percent) as outcomes of life sciences training programs in Massachusetts (Table 6). While a total of five programs (21.7 percent) had no discernible outcomes, four identified the importance of internship experience gained through the program, and one hailed the eligibility to gain college credit for BHCC. MCC and Northeastern’s A2M program leads to various outcomes, and individuals may get the opportunity to pursue their studies up to the associate level at MCC or continue at Northeastern to earn their bachelor’s or master’s degrees.

TABLE 6. MASSACHUSETTS LIFE SCIENCES TRAINING PROGRAMS BY DEGREE OR OUTCOME

Degree/Outcomes	Number of Programs*	Percent of Programs
Associate*	9	39.1%
Certificate	8	34.8%
Internship Experience	4	17.4%
Bachelor's*	1	4.3%
Master's*	1	4.3%
College Credit Eligibility	1	4.3%

* The A2M program is counted for each outcome, i.e., associate degrees from MCC and either bachelor’s or master’s degrees from Northeastern University. As such, the number of programs will not total 23 and the percentage will not sum to 100 percent.

¹⁴ National Center for Education Statistics (NCES), College Map.

¹⁵ Massachusetts Biotechnology Council. 2021 Industry Snapshot. August 2021. https://www.massbio.org/wp-content/uploads/2021/08/2021-INDUSTRY-SNAPSHOT_FINAL.pdf.

¹⁶ *Id.*

¹⁷ *Id.*

¹⁸ Grafton Economic Development. Biomanufacturing Brochure. 2018. <https://massecon.com/wp-content/uploads/Grafton-MA-Biomanufacturing-Brochure-2018.pdf>.

Federal & State Workforce Development Resources

INTRODUCTION

The research team assembled an extensive life sciences asset inventory using a review of publicly available listings and government websites. The inventory includes 26 programs, covering grants, tax credits, wage reimbursement, capital funding, and cost share programs. This asset inventory provides a basic understanding of the existing programs and financial resources available to life sciences businesses in Massachusetts.

OVERVIEW

Three in ten (30.8%) life sciences assets are general support programs, the largest proportion of all programs. These programs provide broad support to life sciences businesses through various tax credits, tax exemptions, cost sharing benefits, and unemployment benefits. The general support programs have targeted goals of assisting life sciences businesses with research costs, drug development costs, purchases of property, improving manufacturing process, and unemployment assistance.

Recruitment programs accounted for the second largest share (23.1%) and consists of programs that support life sciences businesses with recruitment of employees and interns. These programs provide support to life sciences businesses by sponsoring internships and apprenticeships while offering wage reimbursement of interns and employees, targeted grant programs to attract life sciences businesses not located in the state to relocate to Massachusetts, and grant programs targeted to attract data scientists to the life sciences industry.

Research and development programs accounted for 19.2% of assets and consists of programs that assist life sciences businesses with research and development expenses. These programs provide support to life sciences businesses by providing tax credits that ease the burden of research and clinical testing expenses, and funding targeted to foster the development of novel technologies and techniques of existing or innovative therapies.

Equity-focused programs accounted for 11.5% of the assets and consist of programs that support life sciences businesses in creating a diverse workforce. These programs support life sciences businesses by sponsoring internships while offering wage reimbursement for interns, and grant programs to support early-stage life sciences companies that have women leadership.

The three remaining programs each accounted for less than 10.0% of the assets and include programs that support life sciences businesses with expanding their workforce through tax credits that stimulate job creation, improve the skills of their workforce through a grant that targets workforce development, and entrepreneurial support through a convertible note targeting life sciences startups (Table 7).

TABLE 7. ASSET PROGRAMS BY PROGRAM TYPE

Program Type	Number of Programs	Percentage of Programs
General Support	8	30.8%
Recruitment	6	23.1%

Research & Development	5	19.2%
Equity	3	11.5%
Job Creation	2	7.7%
Workforce Development	1	3.8%
Entrepreneurial Support	1	3.8%

FEDERAL PROGRAMS

Just under one quarter (23.1%) of the twenty-six identified asset programs are federal programs. There are two federal general support programs. The Trade Adjustment Assistance program is not life sciences specific but assists manufacturing companies affected by import competition with a 50/50 cost sharing of up to \$75,000 to projects aimed at improving a manufacturer's competitive position. For businesses to receive the trade adjustment assistance, they must be a manufacturer that is facing direct foreign competition (Table 8).

The WorkShare program is another federal general support program that is not life sciences specific. The WorkShare program aims to offer businesses who are experiencing temporary slowdowns an alternative to layoffs by allowing employers to reduce hours of employees while allowing employees to collect unemployment benefits to partially offset reduced hours. For businesses to receive the WorkShare assistance they must be covered by the unemployment insurance system.

There are two federal research and development tax credits—the Orphan Drug Tax Credit and the R&D Payroll Tax Credit. The Orphan Drug Tax Credit incentivizes pharmaceutical companies to develop treatments for rare diseases by offering a tax credit equivalent to 25.0% of qualified clinical testing expenses. The R&D Payroll Tax Credit provides a federal tax credit of 10.0% of research and development expenses up to \$250,000 to offset payroll taxes.

The on-the-job training (OJT) program is a recruitment program that is not life sciences specific. The OJT program assists employers with the cost of hiring and training new employees through wage reimbursements between 50.0% to 90.0% of an employee's wages during training. The wage reimbursement is only available for up to six months of training, and employers must commit to continued employment upon completion of the training.

The Work Opportunity Tax Credit (WOTC) program aims to enable targeted employees¹⁹ who have consistently faced barriers to employment move from economic dependency into self-sufficiency by providing employers tax credits ranging from \$2,400 to \$9,600 who hire individuals from these targeted groups.

¹⁹ The Internal Revenue Service defines this as veterans, ex-felons, TANF recipients, designated community residents, vocational rehabilitation referrals, summer youth employees, SNAP recipients, SSI recipients, long-term family assistance recipients, and long-term unemployment recipients.

TABLE 8. FEDERAL PROGRAMS

Program type	Program Name	Goals	Funder	Financial Resource	Eligibility
General support	Trade Adjustment Assistance	Provides financial assistance to manufacturers affected by import competition	U.S Department of Commerce	Cost sharing	Must be a manufacturer that faces direct foreign competition
General support	WorkShare	Offers an alternative to layoffs for businesses experiencing temporary slowdowns, while allowing to call back furloughed workers and hire new employees	Department of Unemployment Assistance, Executive office of Labor and Workforce Development	Unemployment insurance	Must be covered by the unemployment insurance system
R&D	R&D Payroll Tax Credit	Offset up to \$250,000 in payroll taxes each year for up to five years	Federal Tax Credit	Federal tax credit	Must be a company engaged in research and development
R&D	Orphan Drug Tax Credit	Incentivize pharmaceutical companies to develop medications and treatments for rare diseases that affect small populations	Federal Tax Credit	Federal tax credit	Must be a pharmaceutical company developing a treatment for rare diseases
Recruitment	On-the-Job Training	Assist employers with the cost of hiring and training a new employee	Federal Workforce Innovation and Opportunity Act (WIOA), administered through the MassHire Career Centers	Wage reimbursement for new employees	Employer must commit to continued employment upon completion of training
Equity	Work Opportunity Tax Credit (WOTC)	Enable targeted employees to gradually move from economic dependency into self-sufficiency	US DOL	Federal Tax Credit	Employers must hire veterans and other targeted groups

STATE-RUN PROGRAMS

Just over three quarters (76.9%) of the twenty-six identified asset programs are state programs. Included into the asset inventory are two job creation programs, six general support programs, five recruitment programs, three research and development programs, two equity programs, one workforce development program, and one entrepreneurial support program (Table 9).

Massachusetts Life Sciences Tax Incentives program creates new long-term employment in the life sciences industry through six tax credits and a tax exemption. The seven asset programs include one job creation tax credit, five general support tax credits, and a general support tax

exemption. The Life Sciences Refundable Job Tax Credit provides a tax credit to life sciences businesses that commit to the creation of a minimum of fifty net new permanent full-time positions in Massachusetts. Three of the tax credits - Life Sciences Research Tax Credit, Life Sciences Refundable Investment Tax Credit, and Life Sciences Refundable FDA User Fees Tax Credit – provide life sciences businesses support by easing administrative compliance and tax burdens. The Angel Investor Tax Credit increases investment in life sciences businesses by providing a tax credit to investors. The Corporate Excise Deduction and Sales and Use Tax Exemption also aim to ease tax and administrative compliance burdens through a tax credit and tax exemption.

The state offers five recruitment programs in the form of two internships, one apprenticeship, and two grant programs. The programs aim to connect employers with prospective interns and provide opportunities to gain experience in the life sciences industry. The state offers wage reimbursement to life sciences Businesses in Massachusetts who hire interns and apprentices through the Data Science Internship Program, High School Apprenticeship Challenge/ Lab Training Program, and Internship Challenge. The Bits to Bytes Program provides a grant for capital projects that targets data analytics and or machine learning techniques to attract, train, and retain data scientists to the life sciences industry. The project teams must be comprised of not-for-profit applicants collaborating with at least one for-profit Massachusetts life sciences company to be eligible for the grant. The Massachusetts Transition and Growth Program targets out-of-state life sciences companies considering locating in Massachusetts by providing a grant on a per-job basis to companies that commit to creating more than ten but fewer than forty-nine jobs in the first twelve months of in-state operations.

There are three research and development asset programs offered by the state, including one grant program, one tax credit, and a capital funding program. The Building Breakthroughs program provides grants for capital projects that support biomanufacturing innovation in the state, the Research Credit program offers a tax credit to support employers with research related expenses, and the Novel Therapeutics Delivery program offers capital funding to foster the development of novel technologies and therapies.

The state offers two equity programs aimed at improving the diversity of the workforce in the life sciences industry through the Project OnRamp program and Massachusetts Next Generation Initiative. Project OnRamp helps underserved students start their careers in life sciences by offering employers the reimbursement of wages for interns hired through the program. The Next Generation Initiative aims to increase gender parity for the next generation of life sciences entrepreneurs by providing grants to women-led early-stage life sciences companies.

There is one workforce development program the state offers through the Workforce Training Fund Program. The program is not life sciences specific and aims to address business productivity and competitiveness by providing grants to businesses to improve the skills of new or incumbent workers.

The state also offers entrepreneurial support for life sciences firms through the Seed Fund program. The program advances innovative life sciences companies in the state by offering a convertible note of up to \$250,000 to life sciences start-up companies in Amherst, Beverly, Lowell, Mansfield, North Adams, Springfield, Pittsfield, and Worcester.

TABLE 9. STATE-RUN PROGRAMS²⁰

Program Type: Job Creation

Program Name	Goals	Funder	Type	Eligibility
Life Sciences Tax Incentives Program	Provide incentives to promote companies of all sizes to expand their efforts in creating new long-term jobs in Massachusetts	Massachusetts Life Sciences Center	Tax credit	Massachusetts life sciences business
Life Sciences Refundable Jobs Tax Credit	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax credit	Massachusetts life sciences business, must commit to the creation of a minimum of fifty net new permanent full-time positions in Massachusetts

Program Type: General Support

Program Name	Goals	Funder	Type	Eligibility
Life Sciences Research Tax Credit	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax credit	Massachusetts life sciences business
Life Sciences Refundable Investment Tax Credit	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax Credit	Massachusetts life science business
Life Sciences Refundable FDA User Fees Tax Credit	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax Credit	Massachusetts life sciences business with more than 50% of the research and development costs for the drug incurred in Massachusetts
Angel Investor Tax Credit	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax credit	**
Corporate Excise Deduction - Qualified Clinical Testing Expenses for Orphan Drugs	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Tax credit	Massachusetts life sciences company, engaged in the development of medications and treatments for rare diseases that affect small populations

²⁰ The resources highlighted in blue in Table 9 are all offered under one program from the Massachusetts Life Sciences Center.

Sales and Use Tax Exemption	Foster the life sciences industry in Massachusetts by encouraging job creation and investment in the sector while easing tax and administrative compliance burdens	Massachusetts Life Sciences Center	Sales and Use Tax exemption on purchases of tangible personal property made on behalf of a life sciences company	Personal property purchase must be made on behalf of a life sciences company
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Program Type: Recruitment

Program Name	Goals	Funder	Type	Eligibility
Data Science Internship Program	Connects employers with prospective interns and provide opportunities that introduce interns to applications of advanced data analytics and data science to the life sciences	Massachusetts Life Sciences Center	Internship program with subsidized/reimbursement for intern wages	Bachelor's, Master's, and Doctoral students
High School Apprenticeship Challenge/ Lab Training Program	Place underrepresented and low-income H.S students in a paid worked based setting, supplement life science education with rigorous OST training.	Massachusetts Life Sciences Center	Internship program with subsidized/reimbursement for intern wages	High school students 16+,
Internship Challenge	Provide practical experiences, increase internship opportunities & provide the opportunity to explore careers in the life sciences industry	Massachusetts Life Sciences Center	Internship program with subsidized/reimbursement for intern wages	Current/Recent (graduated within the past calendar year) college student
Bits to Bytes	Provide grants to employ data analytics and/or machine learning techniques to attract, train, and retain data scientist to the life sciences	Massachusetts Life Sciences Center	State grant	Project teams must be comprised of not-for-profit applicants collaborating with at least one for-profit MA life sciences company
Massachusetts Transition and Growth Program	Recruitment tool targeting out of state life sciences companies considering locating in Massachusetts	Massachusetts Life Sciences Center	State grant	No current presence in Massachusetts, commit to creating more than ten but fewer than forty-nine jobs in the first 12 months of Massachusetts operations

Program Type: R & D

Program Name	Goals	Funder	Type	Eligibility
Building Breakthroughs	Provides grants for capital projects that support biomanufacturing innovation	Massachusetts Life Sciences Center	State grant	**
Research Credit	Assist employer with research expenses such as wages paid to employees, a portion of wages paid to contractors, and amounts paid for supplies	State of Massachusetts	Tax credit	Services must be performed for research purposes and supplies were used to conduct research in MA
Novel Therapeutics Delivery	Foster the development of novel technologies and techniques for the delivery of existing or innovative therapies.	Massachusetts Life Sciences Center	Capital funding	Must be a Massachusetts non-profit institution

Program Type: Equity

Program Name	Goals	Funder	Type	Eligibility
Project OnRamp	Develop a diverse workforce talent pipeline for the life sciences industry	Massachusetts Life Sciences Center, MassBio, MassBioEd, Life Sciences Cares, and Bottom-Line	Internship program with subsidized/reimbursement for intern wages	College student
Massachusetts Next Generation Initiative	The program is a five year, more than \$2M commitment to ensure greater gender parity for the next generation of life sciences entrepreneurs.	Massachusetts Life Sciences Center, Takeda, King Street Properties, Sanofi, Johnson & Johnson Innovation, Mintz, Mission BioCapital	State grant program	Women led Company

Program Type: Workforce Development

Program Name	Goals	Funder	Type	Eligibility
Workforce Training Fund Program	Helps address business productivity and competitiveness by providing resources to MA businesses to fund training for current and newly hired employees	Commonwealth Corporation, State Grant	Provides grants up to \$250,000 to improve the skills of new or incumbent workers. Also, a Workforce Training Fund Express program that offers grants of up to \$30,000 for "off-the-shelf" worker training programs approved by the state	Massachusetts companies of any size

Program Type: Entrepreneurial Support

Program Name	Goals	Funder	Type	Eligibility
Seed Fund	Advanced innovative life sciences companies in MA	Massachusetts Life Sciences Center through a federal award from the Department of Commerce's Regional Innovative Strategies Program	Convertible note, investments up to \$250,000 in a convertible note to life sciences start-ups.	Start-ups in Amherst, Beverly, Lowell, Mansfield, North Adams, Springfield Pittsfield, and Worcester

Appendix A: Survey Methodology

BW Research conducted an online employer survey of life sciences firms in Massachusetts. The survey was programmed and tested in-house by BW Research. Respondents were recruited through employer email samples and emails from MassBio to its membership.

In total, 684 emailed invites were distributed to life sciences firms in Massachusetts. Potential respondents were contacted up to 10 times via reminders. To qualify for the survey, respondents were required to be knowledgeable about hiring or staffing at their firm.

The survey was fielded between January 27th and April 15th, 2022. There were 119 respondents in total for the employer survey. The average length for the survey was 13 minutes. There is no reported margin of error for this survey as this was not a representative survey effort. The target survey population was generally MassBio membership, with some additional random outreach to other life sciences firms in Massachusetts.

Appendix B: Employer Survey Toplines

MassBio
Employer Survey
April 2022
n=121

Introduction/ Landing Page:

The following survey is being conducted on behalf of MassBio, who would value your participation in a brief survey about your firm's employment and hiring needs.

The survey is being conducted by BW Research, an independent research organization, and should take approximately 10 – 12 minutes of your time.

Your individual responses will not be published; only aggregate information will be used in the reporting of the survey results.

Section 1. Screener Questions

- A. Are you involved in staffing or hiring decisions at your firm or organization? (If not, could you please connect me to the appropriate person?) (n=129)

100.0% Yes
0.0% No
0.0% Not sure

- B. How many business locations does your company or organization have in Massachusetts? (n=129)

96.9% Record # of locations
3.1% Don't know/ Refused

Record # of locations (n=125)

63.2% 1 location
24.8% 2 to 3 locations
8.8% 4 to 5 locations
3.2% More than 5 locations

- C. What sector of the life sciences industry best describes your organization's? [ALLOW MULTIPLE RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100%* (n=128)

73.4% Drug development
11.7% Research products and instrumentation
9.4% Bioinformatics
7.8% Human diagnostic development
7.0% Contract manufacturing
6.3% Medical devices
4.7% Contract research
3.9% Biotechnology
3.9% Digital health
2.3% Cell/ Gene therapy
0.0% Agricultural biotech
4.7% Other
0.0% Don't know/ Refused

Section 2. Employment & Hiring Profile

1. Including all full-time and part-time employees, how many permanent employees work at your current location? [DO NOT ACCEPT 0 AS A RESPONSE]

Average	Median
288.0	95.0

- 0.8%** 1 to 4 employees
- 1.7%** 5 to 9 employees
- 13.2%** 10 to 24 employees
- 84.3%** 25 employees or more

2. Of these [INSERT Q1#] full-time and part-time permanent employees at your current business location, how many have: (n=71-87)

- 16.1%** **Less than a Bachelor's degree**
- 40.8%** **Bachelor's degree**
- 20.0%** **Master's degree**
- 23.1%** **Doctoral or professional degree**

3. Of these [INSERT Q1#] full-time and part-time permanent employees at your current business location, how many are in: (n=85-87)

- 65.1%** **Scientific or research roles**
- 34.9%** **Non-scientific roles, including office and administrative workers**

4. Please indicate the average annual wage for entry-level positions at your firm. (n=87)

- 0.0%** Below \$25,000
- 6.9%** \$25,000 to \$49,999
- 51.7%** \$50,000 to \$74,999
- 26.4%** \$75,000 to \$99,999
- 2.3%** \$100,000 to \$150,000
- 3.4%** More than \$150,000
- 9.2%** Don't know/ Refused

5. Please indicate the average annual wage for non-entry-level positions at your firm. (n=87)

- 0.0%** Below \$25,000
- 0.0%** \$25,000 to \$49,999
- 5.7%** \$50,000 to \$74,999
- 11.5%** \$75,000 to \$99,999
- 35.6%** \$100,000 to \$150,000
- 32.2%** More than \$150,000

14.9% Don't know/ Refused

6. Over the last three years, has your company grown, declined, or stayed about the same in terms of total employment at your current location? (n=87)

82.8% Grown

11.5% Stayed the same

4.6% Declined

1.1% Don't know/ Refused

7. If you currently have [INSERT Q1#] full-time and part-time permanent employees at your location, how many more or fewer employees do you expect to have at your location 12 months from now? (n=77)

77.9% **More (record #)**

2.6% **Fewer (record #)**

10.4% **Don't know/ Refused**

9.1% **Same number of employees**

More (record #) (n=60)

6.7% 1 to 4 employees

11.7% 5 to 9 employees

31.7% 10 to 24 employees

50.0% 25 employees or more

Fewer (record #) (n=2)

0.0% 1 to 4 employees

50.0% 5 to 9 employees

0.0% 10 to 24 employees

50.0% 25 employees or more

Employer Projected Growth = 10.8%

[IF Q7 = "More", ASK Q8, OTHERWISE SKIP]

8. Are you expecting to hire entry-level positions, non-entry-level positions, or a mix of both over the next 12 months? (n=72)

1.4% Entry-level

16.7% Non-entry-level

81.9% Both

0.0% Don't know/ Refused

9. Thinking of the applicants for open positions over the last 12 months, please indicate your level of difficulty finding qualified entry-level applicants to fill these positions. (n=87)

- 21.8% Very difficult
- 51.7% Somewhat difficult
- 21.8% Not at all difficult
- 4.6% Don't know/ Refused

10. Thinking of the applicants for open positions over the last 12 months, please indicate your level of difficulty finding qualified non-entry-level applicants to fill these positions. (n=87)

- 47.1% Very difficult
- 47.1% Somewhat difficult
- 4.6% Not at all difficult
- 1.1% Don't know/ Refused

[IF Q9 = "Very difficult" OR "Somewhat difficult", ASK Q11 AND Q12, OTHERWISE SKIP]

11. What are the two most difficult entry-level positions to fill at your location? [PLEASE PROVIDE UP TO 2 RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100%* (n=61)

- 52.5% **Research associate**
- 19.7% **Manufacturing technicians**
- 16.4% **Scientist**
- 8.2% **Specialists**
- 6.6% **Administrators**
- 6.6% **Laboratory technician**
- 6.6% **Coordinators**
- 4.9% **Accountant/ Finance**
- 4.9% **Quality control/ assurance**
- 4.9% **Clinical trial associates**
- 11.5% **Other**

12. What are the two most significant reasons for the reported hiring difficulty for entry-level positions? [DO NOT READ, ALLOW UP TO TWO RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100%* (n=63)

- 66.7% Small applicant pool
- 41.3% Lack of experience/ industry-specific knowledge
- 23.8% Insufficient non-technical skills (problem-solving, critical thinking, communication, teamwork, adaptability, etc.)
- 22.2% Competition from other life sciences companies
- 7.9% Desired wages
- 1.6% Insufficient educational attainment

- 1.6% Insufficient certifications
- 3.2% Other
- 1.6% Don't know/ Refused

[IF Q10 = "Very difficult" OR "Somewhat difficult", ASK Q13 AND Q14, OTHERWISE SKIP]

13. What are the two most difficult non-entry-level positions to fill at your location? [PLEASE PROVIDE UP TO 2 RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100% (n=80)*

- 34.2% Senior scientists
- 26.6% Director level and above management
- 15.2% Regulatory affairs
- 13.9% Clinical operations
- 10.1% Program management
- 6.3% Quality control/ assurance specialist
- 6.3% Process development
- 5.1% Validation specialist
- 5.1% Software developer/ engineer
- 5.1% Chemist
- 5.1% Computational sciences
- 3.8% Senior research associate
- 6.3% Don't know/ Refused
- 15.2% Other

14. What are the two most significant reasons for the reported hiring difficulty for non-entry-level positions? [DO NOT READ, ALLOW UP TO TWO RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100% (n=80)*

- 76.3% Small applicant pool
- 40.0% Lack of experience/ industry-specific knowledge
- 22.5% Competition from other life sciences companies
- 11.3% Insufficient non-technical skills (problem-solving, critical thinking, communication, teamwork, adaptability, etc.)
- 3.8% Desired wages
- 1.3% Insufficient certifications
- 0.0% Insufficient educational attainment
- 3.8% Other
- 5.0% Don't know/ Refused

Section 3. Workforce Needs & Preferences

15. What is your *preferred* level of education when hiring for entry-level positions? (n=85)

- 3.5%** Certification or postsecondary nondegree award
- 7.1%** Associate's degree
- 70.6%** Bachelor's degree
- 11.8%** Master's degree
- 2.4%** Doctoral or professional degree
- 4.7%** Don't know/ Refused

16. What is your *required* level of education when hiring for entry-level positions? (n=85)

- 23.5%** High school diploma or equivalent
- 1.2%** Certification or postsecondary nondegree award
- 8.2%** Associate's degree
- 58.8%** Bachelor's degree
- 4.7%** Master's degree
- 2.4%** Doctoral or professional degree
- 1.2%** Don't know/ Refused

17. Please indicate your likelihood of hiring an applicant with less than a Bachelor's degree for an entry-level position? (n=85)

- 9.4%** Very likely
- 41.2%** Somewhat likely
- 44.7%** Not at all likely
- 4.7%** Don't know/ Refused

18. Has your firm previously hired an applicant with less than a Bachelor's degree for an entry-level position? (n=85)

- 62.4%** Yes
- 32.9%** No
- 4.7%** Don't know/ Refused

19. Please indicate your likelihood of hiring an applicant with less than a Bachelor's degree for a non-entry-level position? (n=85)

- 2.4%** Very likely
- 22.4%** Somewhat likely
- 72.9%** Not at all likely
- 2.4%** Don't know/ Refused

20. What programs or certificates would you like to see offered in your region for entry-level positions that would relate to your firm's skill requirements and hiring needs? (n=81)

- 12.3% STEM programs
- 11.1% Biotechnology manufacturing
- 11.1% Lab skills programs
- 7.4% Manufacturing certificate
- 6.2% Co-op/ internships
- 2.5% Data analytics
- 2.5% Project management training
- 2.5% Communication/ negotiation programs
- 8.6% Other
- 35.8% Don't know/ Refused

21. What programs or certificates would you like to see offered in your region for non-entry-level positions that would relate to your firm's skill requirements and hiring needs? (n=81)

- 8.6% STEM programs
- 6.2% Leadership training
- 4.9% Project management training
- 4.9% Clinical certificate
- 4.9% Manufacturing certificate
- 3.7% Biotechnology programs
- 3.7% PhDs in sciences
- 2.5% Co-op/ internship
- 2.5% Data analytics
- 8.6% Other
- 49.4% Don't know/ Refused

22. How important are each of the following credentials for entry-level applicants to possess? (n=81)

RANDOMIZE

	<u>Very important</u>	<u>Somewhat important</u>	<u>Not at all important</u>	<u>Don't know/ Refused</u>
A. Certificates in specialized topics from two-year colleges (for example, cell culture, biomanufacturing, etc.)	22.2%	46.9%	19.8%	11.1%
B. Third-party certifications (for example, RAPS, Six Sigma, etc.)	3.7%	44.4%	40.7%	11.1%
C. Badges	0.0%	6.2%	63.0%	30.9%

Section 4. Partnerships & Program Needs

23. Does your company partner with any of the following training providers to recruit talent for open positions? [SPECIFY UP TO 3 RESPONSES FOR EACH SELECTION] (n=81)

- 11.1% High schools
- 7.4% Vocational technical school
- 19.8% Community colleges
- 61.7% 4-year universities
- 12.3% Other
- 25.9% None of the above
- 6.2% Don't know/ Refused

High schools

- 16.7% Boston Public High Schools
- 16.7% Cristo Rey Boston High School
- 16.7% Watertown High School
- 16.7% Project Onramp
- 16.7% Students to Science
- 16.7% Other

Community colleges

- 33.3% Middlesex Community College
- 22.2% Out of State Community Colleges
- 11.1% Roxbury Community College
- 11.1% North Shore Community College
- 11.1% Bunker Hill Community College
- 11.1% Bristol Community College

4-year universities

- 76.2% Northeastern University
- 14.3% Harvard University
- 11.9% Massachusetts Institute of Technology
- 9.5% Worcester Polytechnic Institute
- 7.1% The University of Massachusetts Amherst
- 7.1% Worcester State University
- 4.8% HBCUs
- 4.8% Tufts University
- 2.4% The University of Massachusetts Boston
- 11.9% Other

24. Of the following potential program and service offerings, which would your company be most interested? Please select up to two responses. [MULTIPLE CHOICE – SELECT UP TO 2 RESPONSES] – *Multiple responses permitted; percentages may sum to more than 100%* (n=81)

RANDOMIZE

- 43.2%** An apprenticeship-type program for your future employees
- 32.1%** Funds to reimburse wages for the cost of training new hires
- 32.1%** Funds to train current workers to be promoted within your company
- 22.2%** A mentorship program that exposes middle and high school students to life sciences careers
- 21.0%** Career days, company tours, or classroom visits that expose middle and high school students to life sciences careers
- 14.8%** Partnerships to help develop curriculum and/or cooperative learning opportunities
- 13.6%** Sourcing and pre-screening for interns
- 3.7%** None of the above
- 2.5%** Don't know/ Refused

Appendix C: Massachusetts Life Sciences Training Inventory

The below training inventory provides an overview of life sciences-related educational programs in Massachusetts. The inventory is focused on training programs and pathways that do not require a four-year degree, though Northeastern's A2M program is included in this analysis as it begins with an associate's credential and then provides pathways for participants to move into a bachelor's or master's program following completion.

Name of Organization	Name of Program	Program Type	Degree/ Outcome	General Technology Sector	County	Related SOC Code
Ben Franklin Institute of Technology	Associate Degree in Biotechnology Manufacturing	Private College/ University	Associate	Biotechnology/ Biomanufacturing	Suffolk	19-4021
Bunker Hill Community College	AS in Biological Sciences: Biotechnology	Community College	Associate	Biotechnology	Suffolk	19-1000
Gloucester Biotechnology Academy	Biotechnology Certificate Program and Summer STEM Program	Community Based/ Non-Profit Organization	Certificate	Biotechnology	Essex	19-4021
Health Resources in Action	LEAH Knox Scholars Biomedical Research	Community Based/ Non-Profit Organization	Internship Experience	Biomedical	Suffolk	19-4021
Holyoke Community College	AA in Arts and Science: Biotechnology Option	Community College	Associate	Biotechnology	Hampden	19-1000
Just A Start (in partnership with Bunker Hill Community College)	Biomedical Careers Training Program	Community Based/ Non-Profit Organization	College Credit Eligibility	Biomedical	Middlesex	19-1000
MassBay Community College	Associate in Science: Biotechnology	Community College	Associate	Biotechnology	Norfolk	19-4021
MassBay Community College	Associate in Science: Biotechnology with focus on Genomics and Biomanufacturing	Community College	Associate	Biomanufacturing	Norfolk	19-4021
Massachusetts Life Sciences Center	High School Apprenticeship Challenge	Quasi-Public Agency	Internship Experience	General Life Sciences	Middlesex	19-0000
Massachusetts Life Sciences Center	Data Science Internship Program	Quasi-Public Agency	Internship Experience	Data Science	Middlesex	15-2051
Massachusetts Life Sciences Center	Ernest E. Just Postgraduate Fellowship Program: Internship Challenge	Quasi-Public Agency	Internship Experience	General Life Sciences	Middlesex	19-0000

MassBioEd	Biomanufacturing Technician Apprenticeship Program	Community Based/ Non-Profit Organization	Certificate	Biomanufacturing	Middlesex/Worcester	19-4021
MassBioEd	Clinical Trial Associate Apprenticeship Program	Community Based/ Non-Profit Organization	Certificate	Clinical Trials	Online	19-1000
Middlesex Community College	Associate in Science: Biotechnology Technician	Community College	Associate	Biotechnology	Middlesex	19-4021
Middlesex Community College	Biotechnology Technician Program: Learn & Earn	Community College	Associate	Biotechnology	Middlesex	19-4021
Middlesex Community College	A2M with Northeastern	Community College	Associate	Biotechnology	Middlesex	19-4021
Middlesex Community College	Biotechnology Technician Certificate	Community College	Certificate	Biotechnology	Middlesex	19-4021
MIT	Professional Certificate Program in Biotechnology & Life Sciences	Private College/ University	Certificate	Biotechnology	Middlesex	19-0000
Northeastern University	A2M with Middlesex Community College	Private College/ University	Bachelor's, Master's	Biotechnology	Suffolk	19-4021
Quincy College	Certificate in Biotechnology and Good Manufacturing Practice	Community College	Certificate	Biomanufacturing	Norfolk	19-4021
Quincy College	Associate in Biotechnology and Good Manufacturing Practice	Community College	Associate	Biomanufacturing	Norfolk	19-4021
UMass Lowell	Graduate Certificate in Biotechnology and Bioprocessing	Public College/ University	Certificate	Biotechnology	Middlesex	19-1000
Worcester Polytechnic Institute	Fundamentals of Biomanufacturing	Private College/ University	Certificate	Biomanufacturing	Worcester	19-4021
Worcester Polytechnic Institute	Graduate Certificate in Biomanufacturing	Private College/ University	Certificate	Biomanufacturing	Worcester	19-4021

Appendix D: Life Sciences NAICS Codes

NAICS	Industry	Employment Percent Contribution
325411	Medicinal and Botanical Manufacturing	100.0%
325412	Pharmaceutical Preparation Manufacturing	100.0%
325413	In-Vitro Diagnostic Substance Manufacturing	100.0%
325414	Biological Product (except Diagnostic) Manufacturing	100.0%
541380	Testing Laboratories	11.6%
541713	Research and Development in Nanotechnology	59.7%
541714	Research and Development in Biotechnology (except Nanobiotechnology)	100.0%
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	66.0%
611310	Colleges & Universities	2.9%
621511	Medical Laboratories	100.0%
622110	General Medical and Surgical Hospitals	4.5%
622210	Psychiatric and Substance Abuse Hospitals	0.6%
622310	Specialty (except Psychiatric and Substance Abuse) Hospitals	3.8%

Appendix E: Life Sciences Regional Assets

New Jersey, California, Pennsylvania, and North Carolina are leaders in the Life Sciences industry. Their governments have all created various programs and incentives to help their life sciences businesses continue to grow. The four states have their own targeted focuses ranging from diversity, equity, and inclusion, early-stage business support, and workforce development. There is one targeted focus that the four states each had in common, access to capital, which can be a major barrier to a life sciences business' ability to grow.

New Jersey

The state of New Jersey supports their life sciences industry through various programs and incentives offered by the New Jersey Economic Development Authority (NJEDA). New Jersey has recognized that access to capital is a major barrier to life sciences business's ability to grow. The NJEDA is combating this through their angel investor tax credit program, which offers investors a tax credit of 20 percent of the qualified investment made in a New Jersey emerging technology or life sciences businesses.

The state of New Jersey is also targeting underserved communities by increasing the angel investor tax credit from 20 to 25 percent if the investment is made to a certified minority- or women-owned business enterprise or if the business is located in an opportunity zone or new markets tax credit census tract.

Another key focal point that New Jersey is supporting is early-stage companies. The NJEDA is supporting early-stage companies with seed capital programs like the NJ CoVest Fund and rent support grants through the NJ Ignite program, where bonus months of rent support are given to companies that are minority- or women-owned business enterprises or are located in an opportunity zone.²¹

California

The state of California assists their life sciences businesses through the California Life Sciences (CLS) organization. The CLS organization has targeted entrepreneurship, workforce development, and racial and social equity as principal areas of assistance for the life sciences industry. The state aims to build a pipeline of diverse talent through the racial and social equity initiative which includes the NexGeneGirls program that provides firsthand learning, leadership development and career mentoring for high school females of color, and the Racial & Social Equity Career Connections Summit that supports Black, Indigenous, and other People of Color (BIPOC) students in their career journey. The CLS supports workforce development through various skills training resources and professional development conferences held throughout the year.

The state of California also offers the employment training panel which provides funding to employers to assist in upgrading the skills of their workers through training that leads to good paying, long-term jobs.²²

²¹ New Jersey Economic Development Authority. Life Sciences Programs. <https://www.njeda.com/life-science/#:~:text=New%20Jersey%20is%20the%20medicine,therapy%20and%203D%20printed%20drug.>

²² California Life Sciences. <https://www.califesciences.org/>.

Pennsylvania

The state of Pennsylvania supports its life sciences industry through Life Sciences Pennsylvania (LSPA). LSPA has placed a focus on supporting life sciences business' access to capital and early-stage life sciences businesses support. LSPA supports access to capital and early-stage life sciences businesses with the Life Sciences Greenhouse Initiative which provides an appropriation fund to promote early-stage risk capital and catalyst development and creation of new life sciences related products and companies.

The state also offers the Keystone Innovation Program that creates innovation zones where tax credits are available for start-up life sciences firms. The state supports access to capital with the Ben Franklin Technology Development Authority Fund which provides funding to early-stage and established companies to promote an entrepreneurial business environment, advance technology innovation, and create a technology-ready workforce.²³

North Carolina

The state of North Carolina supports its life sciences industry through the North Carolina Biotechnology Center (NCBioTech). NCBioTech has placed a focus on supporting university technology development and company startup and growth. NCBioTech supports university technology development through various grants and loans including the Flash Grants, which provide up to \$20,000 to creative ideas that exhibit early indications of commercial potential, Innovation Impact Grants, which provide up to \$150,000 for the purchase of research equipment for academic or nonprofit institutions, and the Translational Research Grants that provide up to \$100,000 to fund programs that explore commercial applications or initiate the early commercial development of university-held life sciences inventions.

NCBioTech also supports company startups and growth with the Small Business Research Loan which provides a loan of up to \$250,000 for innovative early-stage life sciences companies and the Strategic Growth loan which provides a loan of up to \$500,000 to help North Carolina life sciences product companies reach milestones that will enable them to obtain further funding from investors and/or to commercialize their products.²⁴

²³ Life Sciences Pennsylvania. State Policy Priorities. <https://lifesciencespa.org/advocate-4/state-policy-priorities/>.

²⁴ North Carolina Biotechnology Center. Funding Programs. <https://www.ncbiotech.org/funding>.