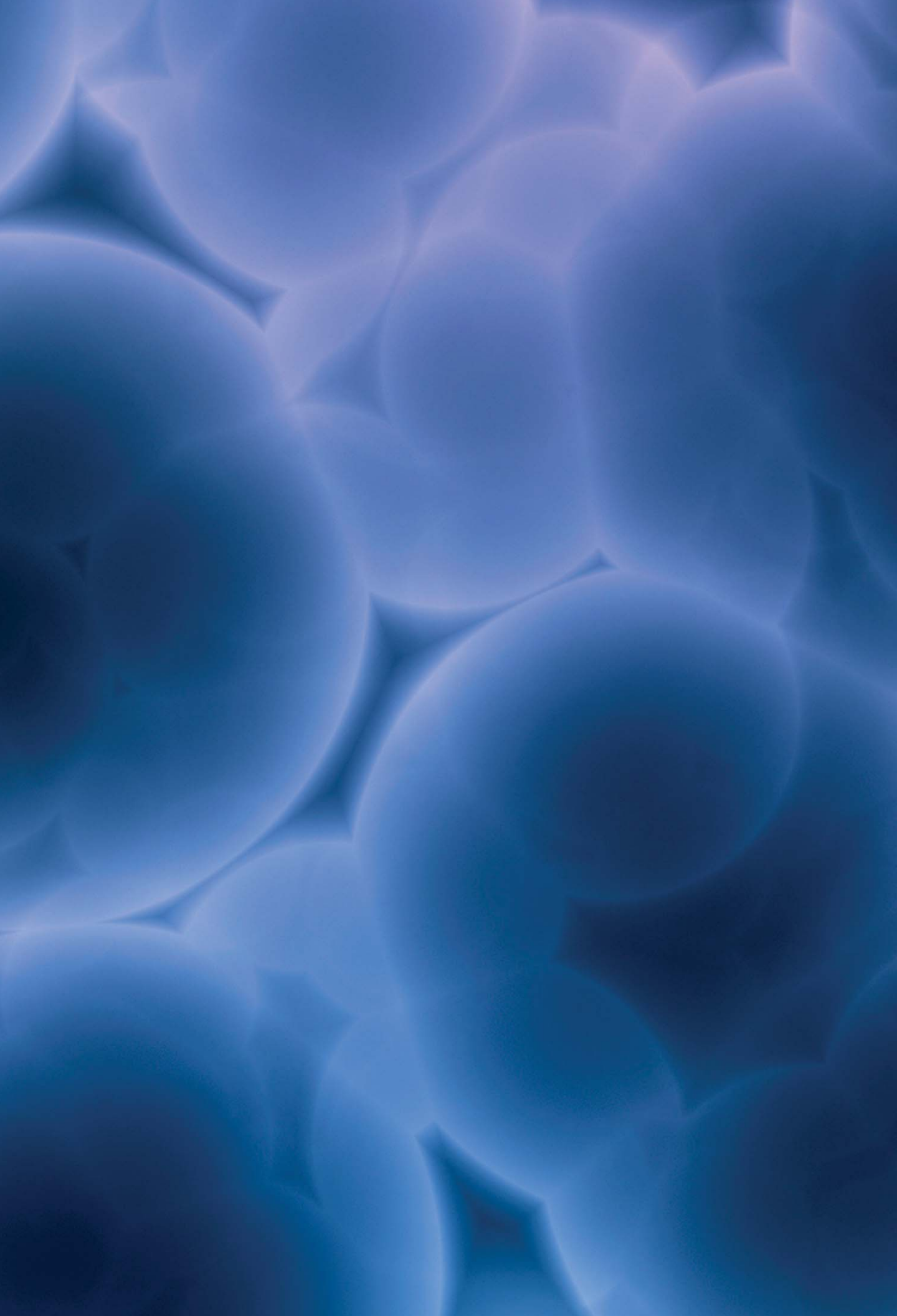




Growing Talent:

MEETING THE EVOLVING NEEDS OF THE
MASSACHUSETTS LIFE SCIENCES INDUSTRY



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Commissioned by:



Prepared by:



UMASS DONAHUE INSTITUTE
University of Massachusetts Office of the President



Dear Colleagues and Friends,

On behalf of the Massachusetts Life Sciences Center, I am pleased to present the findings of the Massachusetts Life Sciences Talent Initiative (LSTI) study, *Growing Talent*. The LSTI study was a yearlong project, co-sponsored by the Center and the Massachusetts Biotechnology Council, and conducted by the UMass Donahue Institute. Hundreds of business and academic leaders were engaged in the LSTI study. As a result, this research provides a comprehensive and quantitative assessment of the higher education and workforce challenges facing our life sciences super cluster.

The Life Sciences Talent Initiative is the first strategic investment undertaken by the Massachusetts Life Sciences Center, and with good logic: Massachusetts' world-class workforce is the number one reason that life sciences companies and research institutions grow or locate in the state. The Commonwealth needs to build upon its strengths if it is to remain the world leader in discoveries, patient care, and private sector investment in the life sciences. Growing our talented workforce is key to growing our super cluster.

This report comes to you at an exciting time for the Massachusetts life sciences community. On June 16, 2008, Governor Patrick signed into law the Life Sciences Act, which dedicates \$1 billion over ten years to reinforce Massachusetts' leading position in the life sciences. The success of this initiative is tied directly to our ability to create enduring public-private collaboration among industry, academia, research institutions and government in order to address such critical issues as workforce development.

The LSTI is itself an example of effective collaboration among these sectors. In addition to this research study, the LSTI produced the first Life Sciences Talent Summit that was convened in February 2008. Nearly 300 leaders participated in a thoughtful and productive dialogue about the super cluster's workforce challenges. Their expert opinions are included in this final research report, which provides insight and momentum for our work ahead as we endeavor to grow and protect the vital life sciences workforce in the Commonwealth.

Sincerely,

A handwritten signature in black ink that reads "Susan R. Windham-Bannister".

Susan R. Windham-Bannister, Ph.D.
President and CEO
Massachusetts Life Sciences Center

Dear Friends,



The life sciences industry, one of the fastest growing economic sectors of the Massachusetts economy, is a cornerstone of the Commonwealth's future prosperity, and so much more. Demonstrating significant growth in employment and exports, the impact of the life sciences sector does not stop at the state's borders. Every day in Massachusetts committed workers at all levels are making progress in developing new therapies, medicines, and medical instruments that save or improve the lives of millions throughout the world.

The life sciences cluster has grown in Massachusetts for many reasons, none more important than access to a highly talented workforce. However, in order to continue to enjoy strong growth, the industry's pipeline of workers — from skilled technicians, engineers, and scientists, to the many professional positions that support life sciences — needs to grow as well. We must work together to ensure that we are educating and preparing our future workforce for this vital industry.

Accordingly, the Massachusetts Biotechnology Council (MBC) teamed up with the Massachusetts Life Sciences Center to produce this Life Sciences Talent Initiative (LSTI) report, conducted by the University of Massachusetts Donahue Institute.

This study reflects a yearlong collaboration, highlighted by an impressive LSTI Summit in February 2008. This project was founded with two primary goals — to underscore the importance of talent to our member companies, and to generate renewed public and private investment in workforce training and higher education.

Moving forward, MBC and our member companies place high priority on continuing to work with the Massachusetts Life Sciences Center, the Massachusetts Biotechnology Education Foundation, and partners, like MassMEDIC and the Commonwealth's institutions of higher education, to build upon the momentum developed through this Initiative. This is a working document, including recommendations, goals and objectives that we are committed to achieving as a group.

It is with great pride that we present the Life Sciences Talent Initiative report.

Sincerely,

A handwritten signature in black ink that reads "Mark Leuchtenberger". The signature is fluid and cursive, with a large loop at the end.

Mark Leuchtenberger
Chairman



“Our business value resides in its intellectual capital. We established and grew our R&D presence in Massachusetts to access the area’s scientific talent in our effort to discover new medicines and increase the value of our business. The talent we have assembled has been a main driver of our success.”

*John Hennessy, Executive Director and General Manager
AstraZeneca Research & Development*

“The reason we made the decision to come here was talent. The quality and caliber of talent in the region, attracted by the unique combination of academic institutions and entrepreneurial companies attracted here by significant government funded NIH research and venture capital, was the critical element in our decision.”

*Jeffrey Elton, Senior Vice President of Strategy and Global Chief Operating Officer,
Novartis Institutes for BioMedical Research*



Introduction:

THE LIFE SCIENCES TALENT INITIATIVE

Massachusetts' ability to grow talent has been its greatest strength in developing a life sciences industry that is a global leader. Building upon that strength is essential to ensuring that the Commonwealth maintains its leadership in the life sciences.

Massachusetts is widely recognized as a science and technology leader and as home to the world's best universities, teaching hospitals and research institutions. While these extraordinary institutions have helped to make Massachusetts a global innovation powerhouse in the life sciences, the engine driving the Massachusetts innovation economy is the Commonwealth's world-class workforce. Highly educated and skilled Massachusetts workers have produced a steady stream of biomedical breakthroughs, and have transformed cutting edge research into commercial therapies, diagnostics, devices and products that are improving and saving lives.

Leaders in business, government and academia agree that the state's highly educated and innovative workforce has been vital to the development of Massachusetts leadership in the life sciences industry. It is why companies such as Genzyme, Biogen Idec and Boston Scientific started and have thrived here. And, it's why multi-national firms such as Abbott, AstraZeneca, Bristol-Myers Squibb, and Novartis have moved here.

However, difficulties meeting the growing and changing talent needs of the industry in Massachusetts represent a challenge in maintaining that leadership position in an increasingly competitive global economy. Industry leaders have reported talent shortages in key functional areas.

That is why, in 2007, the Massachusetts Life Sciences Center and the Massachusetts Biotechnology Council engaged the UMass Donahue Institute to identify current and emerging workforce trends in the state's life sciences super

cluster and assess the capacity of the state's public and private higher education institutions to meet the industry's demand for talent. This study will inform the development of a comprehensive strategy to ensure that life sciences employers have the talent they need to succeed and grow in Massachusetts and that our students and workers have the education and training necessary to excel in high-quality, competitive careers.

Growing Talent is the result of a year of intensive research and extensive engagement of leaders in the Commonwealth's biopharmaceutical and medical device firms, research institutions, academic medical centers, public and private higher education institutions, workforce training organizations and state government officials about meeting the need for human capital in the Massachusetts life sciences industry. This effort has been informed by examination of industry trends, analysis of labor market data, a survey of life sciences employers, study of literature on life sciences education, research on higher education and workforce training programs in the Commonwealth, and review of talent strategies in selected states. The Life Sciences Talent Summit, held at UMass Boston, attracted nearly 300 leaders from industry, government, higher education and training organizations. The interest, commitment, and concern of these leaders about the talent needs in Massachusetts are captured in this report.

The good news is that Massachusetts life sciences employers are optimistic about the future of their companies in the state. More than 85% stated that they expected to expand within the

next two years. Industry executives report that their Massachusetts workforce is highly productive, and the strong economic performance of the sector supports their perspective. Labor market analysis suggests continued expansion of employment in the cluster, which is growing faster than the Massachusetts economy as a whole.

However, sustained growth in the life sciences in Massachusetts is not a foregone conclusion. Research conducted by the UMass Donahue Institute indicates that the Commonwealth's talent advantage in the industry could erode unless state government, employers and educators work together to maintain it.

One early warning sign is a shortage of workers in essential functional areas. Ninety percent of employers surveyed for this project reported difficulty hiring clinical research staff. More than 75 percent of respondents also said they had difficulty finding engineers and employees with regulatory and marketing experience. The concentration and expansion of biopharmaceutical firms, medical device companies and medical research institutions in the Commonwealth have produced a highly competitive marketplace for talent, with salaries higher than industry averages across the full range of available jobs and skill levels.

Life sciences research, development, manufacturing and sales are global industries, and business leaders are keenly aware of the relative advantages of Mas-

sachusetts in the international marketplace. So far, the brainpower available in the Commonwealth has outweighed lower costs of doing business elsewhere. Other states and nations, however, are increasing investments in research and education, making themselves very attractive in the global competition for talent. North Carolina has made talent development a strategic priority to support the growth of its life sciences industry cluster. Ireland has developed a national education and training strategy to produce workers for the biomanufacturing facilities that global companies have built there. Singapore is investing billions of dollars in state-of-the-art biomedical science research and teaching facilities, and is aggressively recruiting the world's leading scientists.

While the UMass Donahue Institute did not study issues related to science, technology, engineering and math education at the primary and secondary school levels, Massachusetts industry executives interviewed for this study expressed concern about the pipeline of domestic K-12 students motivated and prepared to enter higher education and careers in science. China and India are producing legions of ambitious young scientists and engineers every year, fueling growth of new life sciences companies and expansion of international firms in Asia.

While industry leaders are highly satisfied with the qualifications of scientists graduating from Harvard, MIT, UMass, WPI, Northeastern, Tufts, BU and other leading higher education institutions, they also emphasize that





the Commonwealth needs more formal strategies to develop a deep and wide spectrum of life sciences talent. Without a concerted, coordinated effort to produce the next generation of scientists, engineers, medical professionals, entrepreneurs and supporting workers, Massachusetts will fall behind its global competitors in attracting and growing companies in the biomedical sciences.

Over the past year, the Life Sciences Talent Initiative has engaged key stakeholders in a study to guide the development of a life sciences talent strategy. This collaborative effort has resulted in a new understanding of industry needs and the emergence of initiatives to meet them. This report, developed by the UMass Donahue Institute for the Massachusetts Life Sciences Center and the Massachusetts Biotechnology Council, presents findings from the research.

About the Life Sciences Talent Initiative: A Collaborative Effort of Industry, Government, and Academia

The Life Sciences Talent Initiative (LSTI) is the first comprehensive analysis of the growing and changing talent needs of the life sciences industry in Massachusetts and how to ensure that those needs are met in the years ahead.

The study was commissioned by the Massachusetts Life Sciences Center in partnership with the Massachusetts Biotechnology Council, representing a true public-private approach to these complex issues. The analysis was performed by the UMass Donahue Institute, the research and outreach arm of the President's Office of the University of Massachusetts.

The specific goals of LSTI were to:

- analyze current and prospective trends affecting the life sciences workforce and the capacity of higher education to respond
- describe existing life sciences education and training programs and best practices
- recommend strategies to ensure that life sciences employers have the talent they need to thrive and grow in Massachusetts

The study encompassed both quantitative and qualitative research and analysis. This included review of current research and analysis of the life sciences super cluster; analysis of the current and future life sciences workforce using federal and state occupational and employment data; investigation of industry needs through focus groups engaging more than 100 people, executive interviews, and a survey of nearly 75 firms in the industry; an inventory of higher education and training programs; and investigation of best practices and model programs.

Since its inception, the project has been distinguished by an extraordinary level of engagement by key stakeholders. The project has particularly benefited from the guidance of an advisory group of industry, government and academic leaders, chaired by Zoltan Csimma, Senior Vice President and Chief Human Resources Officer at Genzyme. One of the project highlights was a day-long "Life Sciences Talent Summit" that attracted nearly 300 participants to help in reviewing project findings and developing recommendations.

For more information on the project, please go to:
<http://www.masslifesciences.com/talent/report.html>.





“The challenge here in Cambridge versus the pharmaceutical industry cluster in New Jersey is that we have extraordinarily bright and talented people here but many who do not have deep development or commercialization experience. Our challenge is to take highly educated high-potential people and turn them into experienced leaders who can drive this industry forward as it grows, but we also need to attract experienced talent from elsewhere.”

*Deborah Dunsire, President and Chief Executive Officer
Millennium: The Takeda Oncology Company*

“We need to get the message out that there are very rewarding jobs in science that don’t require a PhD. Students need to know that science is something great and fun. To be interested in science doesn’t mean you aspire to be an MD, but to understand that it is an important part of the world.”

*Dennis Berkey, President,
Worcester Polytechnic Institute*



Findings

1. The life sciences industry is a critically important, fast-growing cluster that provides high-quality jobs for Massachusetts residents and generates economic activity across the state economy

The life sciences super cluster employs a broad range of professional, scientific, technical, managerial and other highly educated and skilled workers across several industry sectors, including biotechnology, clinical research, medical devices, pharmaceuticals and related functions. The life sciences labor force encompasses approximately 100,000 workers, not including employment created in additional occupations in other sectors outside the cluster. Life sciences workers are well-compensated, earning 64 percent more than the average Massachusetts salary.¹

In addition to creating jobs, the life sciences super cluster represents the state's leading export industry, and the cluster brings tens of billions of dollars to Massachusetts in commercial sales and public research funds.

Production of goods and services by life sciences companies contributes to the broader Massachusetts economy through spending by life sciences businesses, institutions and their employees. Every dollar of production in the industry in Massachusetts results in additional production in other industries in the state, and every worker employed by a biotechnology firm, medical device company or academic medical center results in additional jobs in companies outside of the life sciences sectors. These multiplier effects are substantial. For example, studies suggest that each job in the Massachusetts biopharmaceutical industry is linked to the creation of more than three additional jobs in the state economy.²

2. Demand for highly qualified talent is growing, both in traditional R&D and expanding downstream business sectors, such as clinical trials and biomanufacturing

The life sciences industry — incorporating biopharmaceuticals, medical devices, therapeutics, diagnostics, and the research and development functions of universities and teaching hospitals — is growing nearly 45 percent more rapidly than other industry sectors in the state and will continue to create high-quality employment in the Commonwealth. Occupational analysis using a business-as-usual scenario projects approximately 11,000 net new life sciences jobs in the Commonwealth between 2006 and 2014. This does not include jobs created due to the “multiplier effect,” or the impact of additional public and private investment, such as the \$1 billion Life Sciences Initiative and the recent moves and expansion by firms such as Novartis, Bristol-Myers Squibb and Organogenesis. Clearly, the state has the potential for greater than business-as-usual growth, but meeting the demand for talent will be critical to realizing that potential.

The majority of new life sciences jobs — more than 80 percent — will require at least a four-year degree. A steady stream of high-level talent is needed in the biological sciences to sustain the state's worldwide leadership position in biomedical research. While most life sciences jobs require higher education, the industry continues to offer opportunities for skilled technicians and manufacturing workers without a four-year degree, especially in the medical device sector.

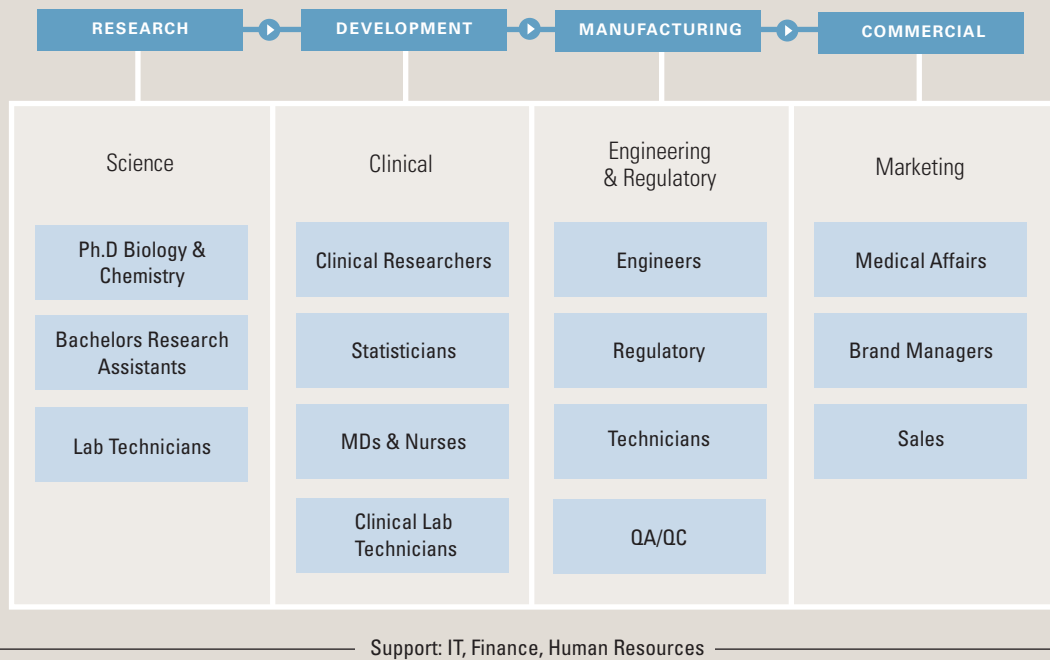
The state's life sciences workforce is highly mobile, with strong competition among firms inside and outside of the state to hire professional staff in key fields. Industry surveys, focus
(Continued on page 13)

Growth Projections for the Top Ten Life Sciences Occupations

Occupation	2006 Population in Life Sciences Sectors	Projected Increase in Demand 2006 – 2014	Projected 8-year (2006 – 2014) Growth
Medical Scientists	3,672	917	25.0%
Computer Software Engineers, Systems Software	2,555	707	27.7%
Lawyers	2,771	579	20.9%
Computer Systems Analysts	2,017	537	26.6%
Computer Software Engineers, Applications	1,889	520	27.5%
Biochemists & Biophysicists	1,454	421	28.9%
Life, Physical & Social Science Technicians	3,621	373	10.3%
Electrical Engineers	2,095	278	13.3%
Accountants & Auditors	1,845	264	14.3%
Management Analysts	1,510	250	16.6%

Source: UMass Donahue Institute projections based on U.S. Bureau of Labor Statistics and Massachusetts Department of Labor and Workforce Development data.

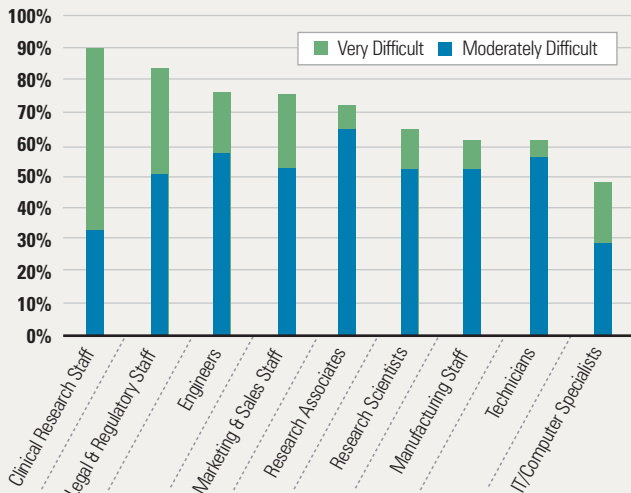
The Diverse Array of Functions and Occupations in the Biopharmaceutical Product Innovation Chain



Source: Mark Trusheim, Co-Bio Consulting

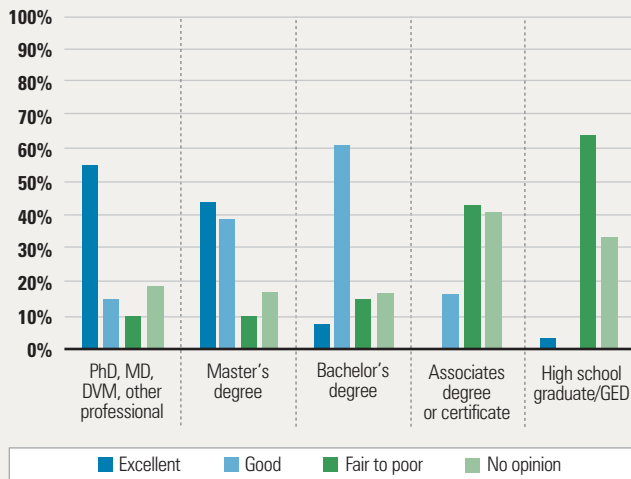


Challenges in Hiring Staff by Functional Area



Source: LSTI Employer Survey

The Adequacy of Preparation of Massachusetts Students for Life Sciences Careers



Source: LSTI Employer Survey

(Continued from page 11)

groups, interviews and industry job posting data suggest that as Massachusetts companies evolve from their focus on early stage research and development to downstream functions such as clinical trials, manufacturing and commercialization, they are seeking expertise in a broad range of functional areas, including clinical research, quality assurance and quality control, legal and regulatory affairs and sales and marketing, as well as in several fields of expertise, such as information technology, chemistry, engineering, toxicology and pharmacology. Life sciences firms rely heavily on an immigrant workforce in R&D and manufacturing, which adds uncertainty for employers due to limitations and restrictions on immigration entry documents including H (1) (b) visas.

3. Massachusetts has many excellent higher education and workforce training programs in life sciences fields, but they need to be better coordinated and more responsive to the needs of industry

Public and private higher education institutions in the Commonwealth offer a broad and comprehensive range of highly regarded programs in the life sciences. But findings from interviews, focus groups, surveys and working groups of employers indicate that the independent efforts of individual institutions and partnerships between companies and campuses are not sufficient to meet the collective needs of the industry as its grows and evolves.

Limited coordination between and among institutions offering life sciences education programs, and



lack of effective communication between employers and educators on program offerings and curricula, results in duplication of effort in some areas — such as two-year biotechnology technician programs — while other needs, such as the demand for clinical research associates and skilled machinists — go unmet. Employers and educators are eager to work together to improve student preparation for life sciences careers, but there are few existing mechanisms to facilitate such collaboration.

The overall percentage of Massachusetts higher education graduates with degrees in life sciences fields is comparable to competitor states. Educational statistics and conversations with employers indicate that Massachusetts is strongest in its graduate programs, both in terms of quality of education and share of graduates. Employers report that Massachusetts graduates with bachelor's degrees could be better prepared to enter life sciences careers. They suggest that more laboratory research and industry-related experiences through cooperative education programs and long-term internships would improve undergraduate-level programs in the life sciences.

There are good examples of vocational education, workforce training and two-year degree programs in Massachusetts that are successfully training workers for jobs in biopharmaceutical and medical device companies and research hospitals. The industry trend in Massachusetts, however, is clearly toward hiring at higher levels of education, especially in the biopharmaceutical sector. A

bachelor's degree is increasingly required as a minimum qualification for technician and manufacturing positions in biopharmaceutical companies in Massachusetts, whereas similar positions might be filled by workers with short-term training or a two-year degree in other states.

It is important to remember that Massachusetts workers generally have more higher education than their counterparts in other states. While it is possible that the research-intensive nature of the life sciences manufacturing and technical jobs in Massachusetts simply requires workers with advanced education, several industry experts who participated in the Life Sciences Talent Initiative believe that education and training programs below the bachelor's degree could be modified to expand employment opportunities in life sciences sectors and meet industry needs. More work is needed to identify the specific knowledge, attributes and skills required for entry-level life science positions in Massachusetts, and to develop and improve programs designed to prepare students for these opportunities.

Recent work in other states could help guide further research in this area. The San Diego Workforce Partnership has identified nearly 200 life sciences occupations, developed career ladders and described educational requirements for jobs in administration; business development, marketing and sales; clinical research; information systems; process development, manufacturing and production; quality assurance; quality control; regulatory

Education and Training Requirements for Critical Life Sciences Occupations

Education Requirement*	Projected Occupational Growth 2006 – 2014	Percent of Total Projected Occupational Growth
Work Experience in a Related Occupation	69	0.7%
On-the-job Training	317	3.4%
Associates Degree	1,355	14.4%
Bachelors Degree	4,218	44.9%
Bachelors or Higher Degree, Plus Work Experience	1,283	13.7%
Doctoral Degree	1,540	16.4%
First Professional Degree	599	6.4%
Bachelors Degree or Higher	7,640	81.4%
Total (For occupations with detailed data)	9,385	100%

* An occupation is placed in one of 11 categories that best describes the postsecondary education or training needed by most workers to become fully qualified in the occupation.

Source: U.S. Bureau of Labor Statistics

affairs; and research and development.³ In North Carolina, an “industrial curriculum committee” representing employers and higher education institutions prepared detailed descriptions of the academic, technical, practical, industry-specific and interpersonal knowledge, skills, attributes and experience required for key positions in the biopharmaceutical industry. This information is being used to provide guidance on curriculum development at community colleges and workforce training centers.⁴

4. Massachusetts needs to increase the pipeline of residents entering both higher education degree programs and careers in the life sciences

Employers express deep concern about the long-term pipeline of Massachusetts students who are motivated and prepared to succeed in careers requiring academic training in science, technology, engineering and math (STEM). Higher education leaders observe that many students who enter college intending to study science are disadvantaged by inadequate preparation at the high school level, especially in quantitative skills and reasoning. Providing remedial education at the undergraduate level is time consuming and costly for both students and academic institutions.

1. PricewaterhouseCoopers, 2007. Data from Bureau of Labor Statistics Quarterly Census of Employment and Wages, and PricewaterhouseCoopers analysis.

2. Milken Institute. *Biopharmaceutical Industry Contributions to State and U.S. Economics*, October 2004; and Sum, Andrew et al. *The Economic, Labor Market, and Fiscal Performance and Impacts of the Biopharmaceutical Industries of Massachusetts (Research Summary)*, PhRMA Research Paper No.15. Center for Labor Market Studies, Northeastern University, August 2007.

3. San Diego Workforce Partnership. *Biotechnology in the United States: The Industry, Centers, Occupations, and Education Sources*. 2006. See also www.biotechwork.org.

4. The North Carolina Biomanufacturing and Pharmaceutical Training Consortium. *The Model Employee: Preparation for Careers in the Biopharmaceutical Industry*. North Carolina Biotechnology Center, May 2005.





“We typically have over 200 job openings at Vertex. Of course, there are lots of scientific positions. But, we also need people in accounting, mathematics, project management, quality assurance, legal, human resources, information technology, public policy, procurement and logistics, and medical writing. For the latter, we have more trouble finding people who can write a paragraph than juggle a beaker; support of English education is also supportive of the life sciences.

*Joshua Boger, CEO
Vertex Pharmaceuticals*

“There are some exciting examples of how community colleges and other higher ed institutions have partnered with industry to meet talent needs. But, in the life sciences, we need to scale up effective programs and develop new ones if we’re going to truly meet the full range of industry’s requirements.”

*Carole Cowan, President
Middlesex Community College*



New Strategies:

GROWING TALENT THROUGH COLLABORATION

Massachusetts has a strong foundation for producing talent to support the life sciences industry. However, the state faces challenges due to current industry dynamics — business creation and expansion; the growing importance of downstream functions; reliance on an immigrant workforce; and the lack of sufficiently strong and widespread connections between and among industry, educational institutions and workforce development organizations.

If industry's future talent needs are to be met, the state, industry, academic institutions and workforce training organizations need to move in new, more effective, and more collaborative ways than we've seen to date.

Specifically, action is needed in five areas:

Produce and Retain More Graduate Students with Interdisciplinary Training

Although Massachusetts already has world-class graduate programs, it needs to produce and retain more young scientists who have training in business, management, information technology and regulatory affairs. The state also needs to do a better job of encouraging domestic students to pursue graduate degrees in fields of study that are important to long-term growth of the industry, such as medical science, engineering, computer science and mathematics.

More institutions should consider Professional Science Master's (PSM) degree programs that integrate graduate study in life sciences with professional training in business and management, as Northeastern University, for example, has done. New degrees or certificate programs may be needed in targeted areas such as legal and regulatory affairs, quality control and assurance, and clinical research. Finally, new financial incentives should be considered to help

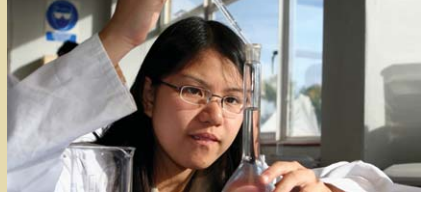
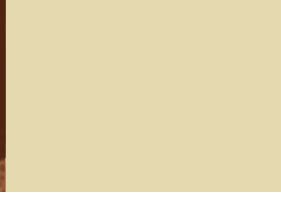
graduate students with the cost of higher education and keep Massachusetts residents with advanced degrees in life sciences fields in the state after they graduate.

Strengthen the Interdisciplinary Curriculum and Experiential Learning Programs in Undergraduate Education

Undergraduate curriculum can be enhanced by integrating education in biological sciences with the study of chemistry, physics, mathematics and information science. Harvard and UMass Amherst represent models of this new type of curriculum. On campus, undergraduate life sciences programs should emphasize laboratory skills, research and problem-solving experiences.

Medical device employer representatives singled out WPI's "Major Qualifying Project" requirement as an excellent example of training in applied problem solving. Off-campus work experience in research, development and manufacturing facilities is an important component of preparation for careers in the industry. Industry competition to hire students through Northeastern University's cooperative education program is strong, and life sciences employers are eager to work with other higher education institutions to expand internship and cooperative education opportunities for undergraduates.

Massachusetts also needs to increase the number of domestic students who complete undergraduate courses of study in the science, technology, engineering and math fields that feed the pipeline of entry-level professional workers in the industry. Retention and graduation rates for life sciences majors — especially women, African-American, Latino and first-generation college students — can be improved through stronger advising, tutoring and mentoring efforts. Finally, increased need-based financial assistance is



required to ensure that all students have access to higher education in the life sciences.

Improve and Target Technical Training

Special attention needs to be given to exploring the potential for developing life sciences career opportunities for workers with less than a bachelor’s degree. More can be done to develop technical education and training programs that prepare young workers for skilled labor positions and help incumbent workers meet the changing needs of their employers. Employers and vocational schools can develop partnerships to train students for well-paying careers in fields with existing and future projected employment demand, such as machinists in the medical device sector.

Workers from other sectors of the economy who have skills relevant to employment in the life sciences, such as chemical and food processing industry workers,

can be retrained to take advantage of opportunities in biomanufacturing (e.g., as has recently been done with Polaroid workers at WPI).

Finally, employers can identify occupations where there is an insufficient supply of workers with bachelor’s degrees or a high turnover of these workers and partner with community colleges to develop targeted two-year training programs for these positions (e.g., Bristol-Myers Squibb and Mt. Wachusett Community College; and Middlesex Community College with Wyeth in bio-manufacturing).

Further Develop and Expand the K-12 STEM Pipeline

While the scope of research for this report did not include issues at the elementary and secondary education levels, the educators and employers involved in the project consistently and insistently stressed improving preparation and motivation of K-12 students in STEM (Continued on page 20)

Strategies for Meeting the Talent Demand: A Survey of Employers

How useful would each of the following strategies be in helping your organization meet its human capital needs in Massachusetts?	% of respondents that said “highly useful”
• Implement targeted programs to increase supply of workers for specific high-demand, hard-to-fill positions	56.6%
• Promote life sciences careers to college students and career counselors	54.8%
• Increase student internship and co-operative education programs	50.0%
• Publicize current job openings in life sciences to students and recent graduates	46.8%
• Increase industry input into higher education, workforce training programs, and curricula	43.5%
• Promote life sciences careers to middle and high school students, parents and guidance counselors	41.9%
• Increase emphasis on laboratory research and skills in higher education programs	32.3%
• Increase training for workers displaced from other industries	32.3%
• Increase visas for foreign workers in high demand positions	30.6%
• Increase programs to improve the skills of incumbent workers	29.0%
• Provide financial incentives for students trained in life sciences to stay in Massachusetts	29.0%
• Provide housing assistance to recruit and retain workers in high-demand positions	27.4%
• Conduct an annual human capital needs assessment of Massachusetts life sciences employers	25.8%
• Increase emphasis on independent and applied research in higher education programs	25.8%
• Expand English as a Second Language programs	19.4%



■ GRADUATE PROGRAMS

The Professional Science Master's Degree

— *Northeastern University*

Typically, a master's degree in the sciences is designed as a step toward a Ph.D. degree. However, industry's growing need for individuals with advanced skills in both the sciences and business management has led to the development of a new, innovative kind of graduate degree — the Professional Science Master's (PSM). Northeastern University has been a leader in the Northeast in developing this type of degree. Currently, the University offers PSM degrees in both bioinformatics and biotechnology. These degrees are designed to provide individuals with both science and mathematical knowledge as well as business fundamentals, project management, and team-building and communication skills.

Combining Science and Entrepreneurship

— *Biomedical Enterprise Program, Harvard-MIT*

Industry needs entrepreneurs who bring a mix of scientific and managerial expertise. The Biomedical Enterprise Program is a unique joint effort that is focused on preparing individuals to transform scientific discoveries into patient-oriented, commercially successful products and services. It combines world-class business and medical training with the opportunity to interact with leading scientists who are advancing the frontiers of the life sciences. The curriculum focuses on the complex process of product development and commercialization, while providing students with a solid grounding in physiology and issues involving patient care. Students in this program earn an MBA at the Sloan School of Management at MIT and a master's degree in Health Sciences and Technology from Harvard University.

Continuing Education for the Medical Device Sector

— *Certificate Programs at WPI and UMass Lowell*

The medical device sector is a key component of the state's life sciences industry. Both UMass Lowell and Worcester Polytechnic Institute have long had close ties with the state's medical device industry. Building on these relationships and core academic strengths, the two institutions have each developed new 12-credit graduate certificates responding to different needs in this sector. Lowell has a graduate certificate in Medical Plastics Design and Manufacturing to provide specialized training for engineering graduates. WPI offers a graduate certificate in Medical Device Management that serves a dual purpose as an entry point into the industry for individuals changing careers and a professional management tool for incumbent workers seeking advancement.

■ UNDERGRADUATE PROGRAMS

Interdisciplinary Biology for the 21st Century

— *A New Curriculum at Harvard College*

The National Academies BIO 2010 report on transforming undergraduate education for research biologists called for a more interdisciplinary approach to teaching biology. One of the most comprehensive changes in undergraduate life sciences education has been implemented at Harvard. In 2006, the college replaced its traditional biology major with concentrations in chemical and physical biology; human evolutionary biology; molecular and cellular biology; organismic and evolutionary biology; and neurobiology. The new specializations were integrated with several existing tracks in a life sciences cluster spanning five academic departments. A two-semester course is now required for majors in the cluster. The sequence, which is taught collaboratively by chemistry and biology professors, provides an integrated introduction to molecular and cellular biology, chemistry, genetics and evolutionary biology.

Emphasizing Experiential Education in the Life Sciences

— *Cooperative Education at Northeastern University*

As industry seeks to hire more new employees at the bachelor's degree level, they are placing increasing value on undergrads with industry work experience. Northeastern University has long been recognized as a national leader in cooperative education. Through "co-ops", students gain a distinctive form of experiential education in which they alternate semesters of academic study with up to three six-month periods of full-time work experience. More than 300 undergraduate life sciences majors at Northeastern participate in the co-op program every year, gaining valuable work experience at the region's leading teaching hospitals and biopharmaceutical and medical device firms. Industry leaders report that Northeastern co-op students are among the most sought-after entry-level professional hires.

Corporate Support for Undergraduate Education

— *The Genzyme Scholar-Intern Program and Abbott's Laboratory Instrument Donation Program*

Life sciences employers are investing in their future workforce through programs on campus. Genzyme recently piloted a Scholar-Intern Program at UMass Amherst, Boston, Dartmouth and Lowell. The company selected 10 juniors through a competitive application process. These students received paid 2008 summer internships at Genzyme, \$5,000 scholarships their senior year, and consideration for hiring after graduation. The MassBioEd Foundation is using Genzyme's program as a model for internships involving other employers and institutions. Abbott Laboratories has invested in higher education through donation of more than \$2.5 million worth of state-of-the-art lab equipment to 43 accredited colleges and universities nationwide since 2007. UMass Dartmouth and Lowell are among the recipients.

(Continued from page 18)

fields as a top priority. They emphasized that more public outreach is needed to promote the variety of exciting, challenging, rewarding and financially attractive careers available in the Massachusetts life sciences industry, and that K-12 outreach and education programs should be specifically designed to increase the number of female, African-American and Latino students entering higher education in STEM fields. Efforts to address K-12 STEM pipeline issues in Massachusetts could benefit from increased participation by life sciences employers.

Improve Communication and Coordination Between Industry and Higher Education

The Commonwealth needs to strive for the same excellence in producing scientific and professional talent across the education and training system as it has achieved within individual colleges and universities. More communication, coordination and cooperation is needed between schools and educators at all levels — K-12, community colleges, public and private four-year colleges and universities — as well as between educational institutions and employers to ensure that more Massachusetts students are well-prepared to take advantage of opportunities in one of the state's most dynamic industries, and that life sciences employers continue to be able to find the talent they need here. New approaches must be built on the knowledge and expertise of both educators and employers and will require increased resources from both the public and private sectors.

The Governor's Readiness Project can guide efforts to develop closer relationships between educational institutions and employers. Key proposals of the Readiness Project include: better integration of primary, secondary, and higher education curricula; improvement in public higher education coordination; creation of a Business/Education Taskforce to develop consensus on the education/training needed for college and the 21st century workplace; and expanding partnerships with industry to provide internships and other school-to-career opportunities for students.

The Massachusetts Biotechnology Education Foundation, which has been very successful in developing partnerships between K-12 schools and biotechnology companies, is well-positioned to expand its efforts at the college level, and is prepared to work in cooperation with the Massachusetts Biotechnology Council and the Massachusetts Medical Device Industry Council to expand internship opportunities for college students in life sciences firms.

The Readiness Project also recommends collaboration between educational institutions and employers at a regional level. A potential model is the Worcester Pipeline Collaborative, a comprehensive effort to "encourage, educate and challenge minority and/or economically disadvantaged students for success in the health care and science professions, where they are traditionally underrepresented."





■ TECHNICAL TRAINING

Pioneers in Biomanufacturing Education

— *Middlesex Community College and the Biotechnology Industry*
Middlesex Community College was the first Massachusetts college to establish a biotechnology program. The college offers both certificate and degree programs that provide the education and hands-on skills required for entry-level technicians in biotechnology. An industry advisory board keeps the curriculum current and responsive to changing employer demands. More than ten biotech companies annually provide internships for students. Most graduates obtain jobs at companies where they complete internships. Many graduates of the certificate program return to MCC to complete the associate degree program while they are employed in the industry. Wyeth has hired more than 40 program graduates. “Many of these employees have excelled and now hold supervisory level positions in manufacturing,” reports Wyeth staffing director Jack Fitzmaurice. “The program provides the students with a solid foundation in biotechnology concepts and techniques geared especially for the manufacturing sector.”

Partnering to Train Incumbent Workers

— *Boston Teaching Hospitals and Bunker Hill Community College*
Massachusetts teaching hospitals are facing a critical shortage of trained laboratory technicians. To address this need, three Boston medical centers are partnering with Bunker Hill Community College and the Boston Private Industry Council on an initiative to train current hospital employees to be Medical Laboratory Technicians. The program, which enrolled its pilot class in 2007, allows current employees of Beth Israel Deaconess Medical Center, Children’s Hospital Boston and New England Baptist Hospital to pursue training while supporting their families. Students take BHCC courses on site at their hospital after work. The course also includes a full-time six-month paid lab practicum. Graduates of the program will earn associate’s degrees in Medical Laboratory Technology. Those that pass the American Society of Clinical Pathology’s Med Lab Tech certification exam will be hired as Medical Laboratory Technicians. On average, they are expected to achieve a 20 percent salary increase, and will be positioned to move further up the career ladder to Medical Technologist roles after 2 years on the job and completion of additional courses.

■ COMMUNICATION AND COORDINATION

Statewide Coordination Across Higher Education

— *The California Strategy*
California has been aggressive and strategic in developing comprehensive life sciences education and training facilities and programs at its public higher education institutions. The “California Community College Biological Technologies Initiative” is a statewide coordinating program for biotechnology career education. The “California State University Program for Education and Research in Biotechnology” provides targeted support to institutions in the CSU system and serves as a central liaison between CSU campuses and industry. The University of California has created two new research institutions — the California Institute for Quantitative Biosciences and the California Nanosystems Institute — with missions, facilities, research and programming at the cutting edge of the life sciences. Each institute encompasses multiple campuses and industry partners, and the model is intended to “create a new environment for industry scientists to collaborate in fundamental research and to educate future scientists.”

Statewide Connections Between Industry and Academia

— *Collaborative Efforts to Build the Workforce in North Carolina*
North Carolina has taken a system-wide approach to higher education and training in the life sciences. The Biomanufacturing and Pharmaceutical Training Consortium is a collaboration among industry, the state community college system, North Carolina State University, North Carolina Central University and the UNC system that coordinates design and delivery of education and training programs in biomanufacturing. BioNetwork is a statewide network of community colleges that has developed a standard 128-hour course designed for entry-level technicians in life sciences industries. Individual campuses within this network have developed their own specialties targeted to local industry needs. The Biomanufacturing Training and Education Center is a 63,000 square foot cGMP facility that provides training on state-of-the-art equipment in a sterile manufacturing environment. The Biomanufacturing Research Institute and Training Enterprise is a new 52,000 square foot biotechnology and biomanufacturing research and teaching facility that currently offers bachelor’s and master’s degrees in pharmaceutical sciences. Finally, the North Carolina Biotechnology Center promotes life sciences careers to elementary, high school and college students in the state.



“If we are truly going to meet the talent needs of the Commonwealth in the life sciences, the academic community must intensify and broaden our level of collaboration with each other, as well as with the K-12 system and our partners in government and the life sciences industry.”

*Michael Collins, Senior Vice President for Health Sciences and Chancellor
UMass Medical School*

“Life Sciences is a dynamic, evolving industry — so we need a new system of workforce training and education that keeps pace as this sector grows. We will help meet the talent needs of this industry by providing new workforce training programs and by connecting our education and training systems with the needs of business.”

*Suzanne M. Bump, Secretary
Massachusetts Executive Office of Labor and Workforce Development*

“Along with state government and higher education, industry itself needs to ‘step up to the plate’ to develop an effective, working partnership that ensures that firms have the talent they need to grow and thrive here in Massachusetts.”

*Lance Hartford, Executive Director
Massachusetts Biotechnology Education Foundation*



Growing Talent:

EARLY MOMENTUM AND NEXT STEPS FOR GOVERNMENT, INDUSTRY AND ACADEMIA

Over the past year, the Life Sciences Talent Initiative has encouraged a new focus on growing the next generation of scientists, engineers, professionals and workers to sustain the Commonwealth's leadership position in the life sciences. In February 2008, nearly 300 high-level stakeholders from business, higher education and state government participated in the first-ever Life Sciences Talent Summit to help develop the ideas outlined in this report. Since that gathering, key players in industry, state government and educational institutions have begun to develop concrete new initiatives and position themselves to follow through on the findings and recommendations of *Growing Talent* and the momentum it has generated.

Government Leadership through the Life Sciences Center

The Massachusetts Life Sciences Initiative, recently enacted by the Massachusetts legislature and signed by Governor Patrick, presents an opportunity to capitalize on this momentum and move toward a real and sustainable life sciences talent strategy. Under the new legislation, the Massachusetts Life Sciences Center is well-positioned with the resources and authority to take the lead in developing a statewide strategy and providing incentives for educators and employers to work together in educating and training the next generation of life sciences innovators and workers (e.g., new curriculum, new degree programs, expanded co-ops). With its leadership drawn from the highest levels of state government, industry, higher education and research institutions, and its working relationship with the Life Sciences Collaborative, the Center is poised to ensure that both the public and private sectors do their part.

Industry Action through the Industry Associations

Hearing the call to action, leading industry groups — the Massachusetts BioEd Foundation, Massachusetts Biotechnology Council

and MassMedic — are designing an initiative to guarantee that educators and trainers will always have access to information and prudent guidance regarding the needs of the state's life sciences employers. These organizations are committed to marshalling the insight of employers through the new Massachusetts BioMedical Education and Workforce Development Consortium. This organization will engage academia, workforce developers, state government and other industry partners in determining short- and long-term talent needs, informing curriculum development, and identifying opportunities for concerted public-private-academic action to promote studies and careers in the life sciences in Massachusetts.

Public and Private Higher Education Initiatives

Public and private institutions are already acting on opportunities identified in *Growing Talent*. Boston University, Harvard, MIT, Northeastern, Tufts and WPI continue to strengthen their outstanding program offerings in the life sciences. Wentworth Institute recently launched a new bachelor's degree in biomedical engineering. UMass has convened a system-wide task force, undertaken a systematic review of its role in growing life sciences talent, and committed to a strategy for following through on the recommendations of the Life Sciences Talent Initiative across all five campuses. The recent adoption of a new master's degree in clinical sciences at UMass Medical School is an early example of this commitment. These are just a few of the many efforts being developed by educational institutions that directly address the talent needs of the life sciences industry as identified in this report.

Conclusion

The Commonwealth faces significant challenges to growing the talent needed to keep its life sciences industry thriving. With consensus among government, industry and academia on new directions and a strong commitment to collaborate, there is every reason to be confident that Massachusetts can and will meet this challenge.

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