



Life Science Talent Initiative

Presented to the
Massachusetts Workforce Board Association
Based on the Interim Report of the
Life Sciences Talent Initiative

December 17, 2007





Overview of Study

- The Commonwealth is a recognized global leader in the life sciences. Governor Patrick's \$1 Billion Life Sciences Initiative recognizes the importance of a skilled workforce.
- Secretary O'Connell, chair, Life Sciences Center Board, asked UMass through the Donahue Institute to:
 1. Undertake, in collaboration with industry, state government, higher education, and workforce development, a systematic analysis of the current and future talent needs of the industry and the capacity of higher education to respond to those needs;
 2. Describe current Massachusetts strategies for life sciences education and training, and examine successful models from Massachusetts and competitor states and nations;
 3. Develop recommendations on the actions that state government, industry and higher education need to take to respond to the gap between current/future needs and the capacity to meet them; and
 4. Track and monitor the trends in the industry and the progress made in meeting the recommendations in the year following the completion of the study.



Life Sciences Talent Initiative Interim Report

- **Purpose:** Present research to date
- **Context:** Study is 1/3 complete; findings are very preliminary
- **Desired Outcome:** Feedback from WIB Association on preliminary findings



Life Sciences Talent Initiative Progress Report

OVERVIEW

- Occupational Growth Projections
- Graduating Student Pipeline
- Industry Perspectives
- Higher Education Inventory
- Innovations from Other States
- Summary and Next Steps

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OCCUPATIONAL GROWTH PROJECTIONS





What is the purpose of these projections?

- To describe current life science workforce in some detail:
 - Size of the workforce
 - Workers by occupational type
- To provide a snapshot of expected workforce needs based on current data:
 - Estimate job growth by specific occupation
 - Document education and training needs (as defined by BLS)
 - Help identify potential shortages expected due to demographic and broad economic trends



Step 1: Identify the occupations that comprise the “core” sectors of the life science industry

“Core” Life Science sectors:

All workers that represent > 2% of jobs in any one of the following four industry sectors are considered life science workers

- Biotechnology
- Pharmaceuticals
- Medical devices and instruments
- Commercial R&D in the life sciences

This method allowed us to identify a group of 112 “critical” occupations. We prepared projections of expected growth between 2006 and 2014 for each of these critical occupations.



Step 2: Identify Life Science Workers in “Partial Sectors”

Core life science occupations

The number of workers in each of the following eight occupational groupings were used to estimate the percentage of workers in higher education, hospitals and testing laboratories that are considered “life science” workers.

- Biomedical engineers (17-2031)
- Biochemists and biophysicists (19-1021)
- Microbiologists (19-1022)
- Medical scientists (19-1042)
- Life scientists, all other (19-1099)
- Biological technicians (19-4021)
- Chemical technicians (19-4031)
- Life, physical, and social science technicians, all other (19-4099)

For the purposes of this analysis, in 2006 approximately:

4.6% of higher education workers are considered to be “Life Science Workers”

1.5% of hospital workers are considered to be “Life Science Workers”

3.3% of testing laboratory workers are considered to be “Life Science Workers”



Step 3: Examine the recent growth history of the industry in the context of recent total employment growth in Massachusetts

The life science industry has been adding jobs even as overall job creation in the state economy has continued to lag.

- Between 2001 and 2006, employment in the “Core Life Science” industry sectors *grew* by 15%* (Source: ES-202, MA Department of Workforce Development)
 - During this same period, overall employment growth in Massachusetts *declined* by 2.4% (Source: ES-202, MA Department of Workforce Development)
 - The expected total growth for all industries in Massachusetts between 2006 and 2011 will be 4.3% (0.9% annual rate of growth) (Source: New England Economic Partnership)
- * Please note: The definition of pure life science sectors for the purposes of tracking employment change is different from the definition used to assess the occupational outlook. This is due to the availability of more detailed and precise data on overall employment (6 digit NAICS) and less detailed data on employment by occupation (4 digit NAICS). Accordingly, it is not valid to compare the historical rate of job growth reported here to the projected rate of occupational growth reported elsewhere in this presentation.



What these occupational projections consider:

The projections rely heavily on the work of the Massachusetts Department of Workforce Development and the US Bureau of Labor Statistics and follow a standard approach that is widely utilized by labor economists and workforce analysts.

- US Bureau of Labor Statistics (BLS) projections of the production levels of U.S. industry sectors: total output of goods and services
- BLS projections of the number of jobs that will be needed in the industries to produce those goods and services.
- BLS and Mass Department of Workforce Development (DWD) analyses of the current size of the Massachusetts labor pool and projections of future changes in the state's population and labor force.
- BLS knowledge about industry dynamics: the mix of occupations that will be in demand is determined both by the amount of goods and services produced and by the ways in which industries produce them
- DWD's adjustments made to approximate Massachusetts industry conditions



What these occupational projections do not consider:

- The impact of future business relocations
- The impact of future layoffs due to product failures
- Unanticipated changes in industry dynamics
- Industry responses to changes in state policy
- Policy changes in other states that could effect job growth in Massachusetts

While 11.6% overall growth appears modest, demand for life science workers is expected to grow nearly 45% faster than for workers across the larger economy

SOC Description	Current Population in Life Science Sectors	Occupation as Percent of Total Life Sciences Sector	Projected Increase in Demand, 2006-2014	Projected Total Growth Rate, 2006 - 2014	Projected Annual Growth Rate, 2006 - 2014
Computer and Mathematical Occupations	10,462	10.6%	2,386	22.8%	2.60%
Life, Physical and Social Science Occupations	13,530	13.6%	2,262	16.7%	1.96%
LS Occupations for which no detailed data are available	15,075	15.2%	1,683*	11.2%*	1.3%*
Architecture and Engineering Occupations	11,178	11.3%	1,626	14.5%	1.71%
Management Operations	10,861	11.0%	1,061	9.8%	1.18%
Business and Financial Operations Occupations	6,016	6.1%	803	13.3%	1.57%
Legal Occupations	3,575	3.6%	726	20.3%	2.34%
Sales and Related Occupations	2,405	2.4%	183	7.6%	0.92%
Healthcare Practitioners and Technical Occupations	1,173	1.2%	157	13.4%	1.58%
Office and Administrative Support Occupations	12,526	12.6%	91	0.7%	0.09%
Nursing, Psychiatric, and Home Health Aides	402	0.4%	42	10.4%	1.24%
Education, Training and Library Occupations	247	0.2%	37	15.1%	1.77%
Production Occupations	11,708	11.8%	13	0.1%	0.01%
Total All Sectors	99,157	100.0%	11,069	11.2%	1.3%

* Assumes occupations for which detailed data are not available will grow at the same rate as the sector overall.

Note – Overall employment growth in MA is expected to be 0.9 percent per year between 2006 – 2011 (NEEP)



The top ten fastest growing occupations reflect the highly skilled and professional nature of the life science workforce

Distribution and growth projections of the top ten Life Science occupations, 2006 – 2014

SOC Code	SOC Description	2006 Population in Life Science Sectors	Occupation as Percent of Total Life science Sector	Projected Increase in Demand, 2006-2014	Projected 8-year (2006-2014) Growth	Projected Annual Growth
19-1042	Medical scientists	3,672	3.7%	917	25.0%	2.8%
15-1032	Computer software engineers, systems software	2,555	2.6%	707	27.7%	3.1%
23-1011	Lawyers	2,771	2.8%	579	20.9%	2.4%
15-1051	Computer Systems Analysts	2,017	2.0%	537	26.6%	3.0%
15-1031	Computer software engineers, applications	1,889	1.9%	520	27.5%	3.1%
19-1021	Biochemists and biophysicists	1,454	1.5%	421	28.9%	3.2%
19-4099	Life, physical and social science technicians	3,621	3.7%	373	10.3%	1.2%
17-2071	Electrical engineers	2,095	2.1%	278	13.3%	1.6%
13-2011	Accountants and Auditors	1,845	1.9%	264	14.3%	1.7%
13-1111	Management Analysts	1,510	1.5%	250	16.6%	1.9%

Over 80% of job growth is expected to occur in positions that require a 4 year degree or better

Education and training requirements for critical life science occupations

Education Requirement*	Projected Occupational Growth 2006-2014	Percent of Total Projected Occupational Growth
Work Experience in a Related Occupation	69	0.7%
Short-Term on-the-job Training	-154	-1.6%
Moderate-Term on-the-job Training	463	4.9%
Long-Term on-the-job Training	8	0.1%
Associates Degree	1,355	14.4%
Postsecondary Vocational Award	4	0.0%
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%
Grand Total	9,385	100%

Source – Education and training requirements determined by the U.S. Bureau of Labor Statistics

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

There is a significant dependence on non-citizens in some key occupations

Occupation Group	% Non-U.S. Citizens	Non-U.S. Citizen 95% Margin of Error	% Over 55 Years	Over 55 Years 95% Margin of Error
Medical Scientists	37.5	11.3	7.8	3.4
Computer engineers	21.5	4.8	9.1	1.8
Assemblers	14.9	4.3	19.4	2.6
Biological Scientists and Technicians and Chemists	12.9	8.4	11.3	4.3
Physicians and Surgeons	9.7	3.9	21.5	2.9
Computer and Network Specialists and Analysts	9.6	2.4	11.0	1.4
Engineers	8.1	3.0	19.4	2.4
Chemical and misc. technicians	7.8	6.2	11.1	4.0
MA All Occupations	7.3	0.2	18.6	0.3

Source: Bureau of Labor Statistics, American Community Survey, PUMS 2006

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GRADUATING STUDENT PIPELINE





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Graduating Student Pipeline

- **Goal:** Assess supply of students graduating from Massachusetts institutions with education in life sciences
- **Method:** Analyze graduate pipeline using Integrated Postsecondary Education Data System (IPEDS) for degree and non-degree granting institutions in Massachusetts for 2000, 2003, 2005
 - ***STEM (science, technology, engineering and math) fields:***
 - Biological and Biomedical Sciences (not including health care)
 - Computer and Information Sciences
 - Engineering (all fields)
 - Engineering Technology
 - Mathematics and Statistics
 - Physical Science (including physics and chemistry)
 - ***Health Professions and Related Clinical Sciences:***
 - Medical doctors, veterinarians, nurses and medical and veterinary technicians and other health and animal care practitioners and researchers
 - ***Not included:***
 - Agricultural, Horticultural, Forest Sciences
 - Food Science, Technology and Processing



Life Sciences Talent Initiative Graduating Student Pipeline

- **Status:**
 - Pipeline data available for broad fields of study
- **Work Remaining:**
 - Determine fields of study and academic institutions for which more detail is needed
- **Next Steps:**
 - Identify key fields for further research through Advisory Committee, Academic Task Force and Web Survey

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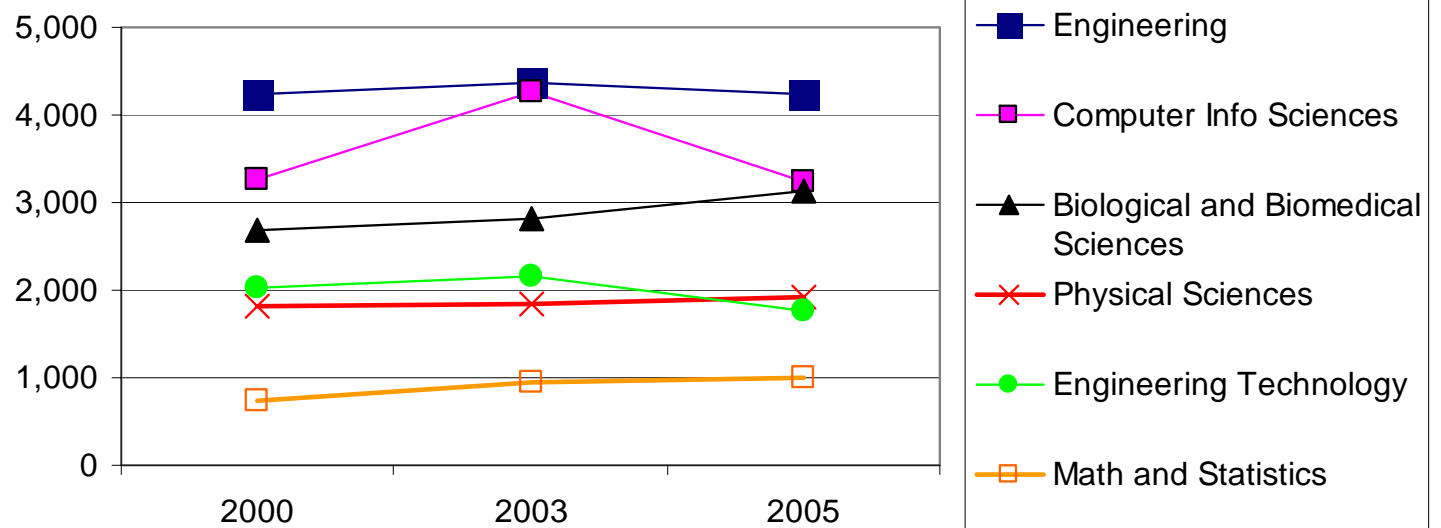
Graduating Student Pipeline

- STEM graduates increased 3.7 percent between 2000 and 2005

STEM GRADUATES, 2000 -2005	Number of Graduates in 2005	Change from 2000	% change
Total (not including health & clinical)	15,310	543	3.7%
Biological and Biomedical Sciences	3,134	452	16.9%
Math and Statistics	1,013	271	36.5%
Physical Sciences	1,923	106	5.8%
Engineering	4,240	9	0.2%
Computer and Information Sciences	3,246	(30)	-0.9%
Engineering Technology	1,754	(265)	-13.1%

Life Sciences Talent Initiative Graduating Student Pipeline

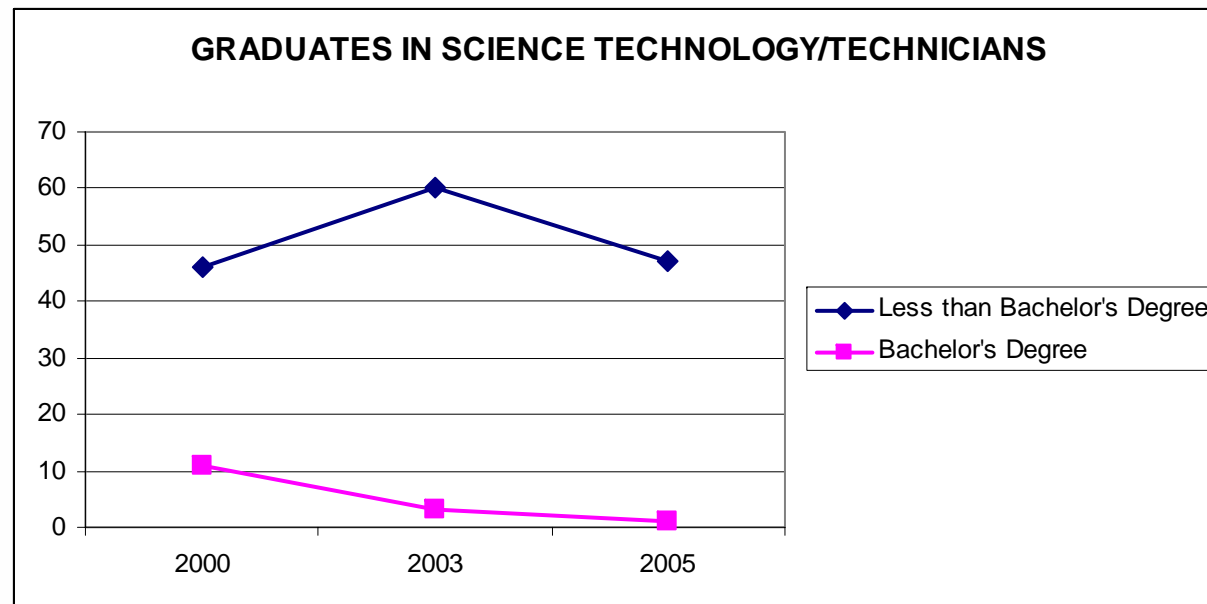
STEM GRADUATES, 2000 - 2005



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Graduating Student Pipeline

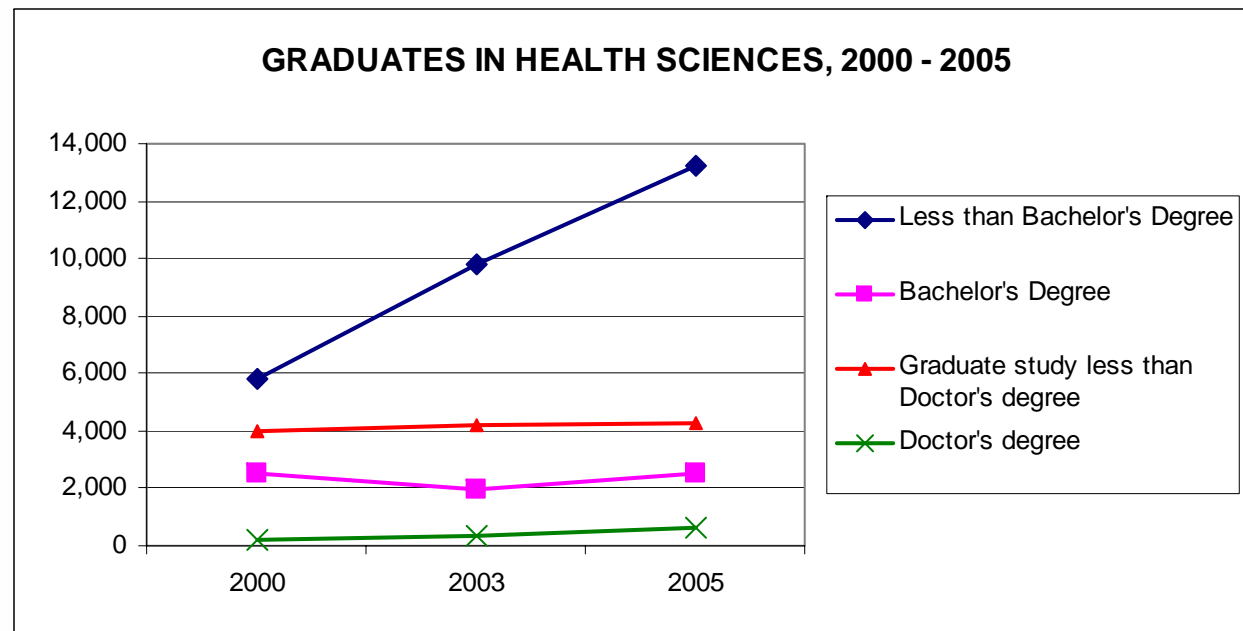
- According to IPEDS, the field that represents biotechnology technicians is producing less than 100 graduates per year.



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Graduating Student Pipeline

- **Graduates in health science professions increased by 64.3 percent between 2000 and 2005**
 - 91 percent of this increase was in graduates with less than a bachelor's degree
 - These workers may not have the appropriate skills of training for positions in the life sciences industry outside allied health professions
 - Students graduating with doctor's degree in health sciences increased 236 percent, from 189 to 635



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INDUSTRY PERSPECTIVES





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Industry Perspectives

Focus Groups

- **Goal:** Gain industry perspective on current and future need for talent
- **Method:** Conduct focus groups with human resource professionals in biopharma, medical device and clinical research industry
- **Status:** 8 focus groups conducted, total of more than 75 participants
- **Work remaining:** Conduct additional focus groups with medical device industry and human clinical research personnel directors
- **Next steps:** Use findings from focus groups to design web survey of larger group of HR professionals in industry



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Industry Perspectives

Focus Groups

- The Massachusetts workforce is a strength for the life sciences industry
 - World-class universities and teaching hospitals are a magnet for talent
- There are limited opportunities for workers with less than a bachelor's degree in the life sciences industry in Massachusetts
- Managers identify shortages of workers in key fields:
 - quality assurance and quality control
 - regulatory affairs
 - clinical trials management
 - process development and manufacturing engineers
 - chemistry
 - pharmacology
 - specialty scientific fields, such as toxicology
 - commercial personnel, including sales managers and representatives
 - laboratory animal care
- Participants in focus groups report strong competition between firms to hire experienced workers in high-demand fields



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Industry Perspectives

Focus Groups

Considerations in hiring employees with limited work or industry experience:

- Reputation of academic institution
- Applied problem-solving and laboratory experience
- Industry experience as a component of education
- Experience working in teams
- “21st Century Skills” (e.g. communication and information technology, critical and systems thinking, creativity and intellectual curiosity, self-direction, accountability and adaptability, global awareness, and financial, economic and business literacy)
- Building a diverse workforce



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Industry Perspectives

Focus Groups

- Concern about adequacy of pipeline of K-12 graduates with interest in science and preparation to succeed in college
- High housing costs and commute times
 - Cost of living/quality of life issues may be most acute with respect to younger professional staff and recruiting employees from other states or nations
- Threat to ability to hire workers who are foreign nationals
 - Increasing difficulty in obtaining visas and permanent residency combined with growing opportunities in life sciences in Europe and Asia

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ACADEMIC PROGRAM INVENTORY





Life Sciences Talent Initiative Academic Program Inventory

- **Goal:** Compile baseline inventory of higher education and workforce training programs relevant to life sciences industry
 - Identify gaps and redundancies
 - Identify and profile model programs
- **Method**
 - Higher education: gather information through websites and confirm accuracy and completeness by emailing administrators and faculty
 - Workforce training: web search and workforce panel
- **Status:** Preliminary list of programs at community colleges, state colleges, UMass, Northeastern, WPI, BU, Tufts Veterinary
- **Work remaining:**
 - Complete inventory of public and selected private institutions
 - Prepare summary and case vignettes of model programs
- **Next steps:**
 - Work with MassBioEd Foundation to complete inventory



Life Sciences Talent Initiative Academic Program Inventory

Community Colleges

- At least 10 colleges offer degree or certificate programs in biotechnology, including several specialty programs
 - Biomedical Technology 2 + 2 Program, Bioinformatics, Genomics (Bristol)
 - Biotechnology Technician (Middlesex, includes internship)
 - Biomanufacturing (Mount Wachusett and Springfield)
 - Marine Biotechnology (Mass Bay)
- At least 9 colleges offer degree or certificate programs in engineering, engineering technology and/or engineering 2 + 2 programs
- Limited offerings in clinical lab science, pre-veterinary studies/veterinary technician and animal care at community college level



Life Sciences Talent Initiative Academic Program Inventory

State Colleges

- **At least 6 state colleges offer undergrad biotechnology degree or biotech track in biology degree; several offer biology MS, Worcester also offers biotech MS**
 - Several of these programs have 2 + 2 articulation agreements with community colleges (e.g. MCLA and Berkshire, Worcester and Mass Bay & Quinsigamond)
 - Several schools report increasing undergraduate enrollment in biology & life sciences
- **Several schools offer pre-medical and pre-veterinary track in undergraduate biology degree or specialization in biomedical field**
 - MCLA offers Biology BS with medical technology and cytotechnology track, including clinical learning experience at an accredited hospital
- **At least 5 state colleges offer undergrad chemistry degree; at least three offer a biochemistry concentration**
 - Worcester offers a nuclear medicine concentration; Framingham has major and concentration in food science with biotechnology component
- **Only one state college offers an engineering program**
 - Fitchburg offers electronic and manufacturing engineering program with internship opportunities
- **Extensive offerings in computer and information science in state college system**



Life Sciences Talent Initiative Academic Program Inventory

University of Massachusetts

- **The UMass system offers undergraduate, MS, PhD and MD programs in all life science disciplines**
- **Many specialty program relevant to life sciences industry—a few examples (not comprehensive)**
 - **Amherst:** MS/PhD in Animal Biotechnology & Biomedical Sciences, Dual Degree MBA/MS Industrial Engineering
 - **Boston:** PhD in Chemistry/Green Chemistry track
 - **Dartmouth:** BS in Medical Laboratory Science with Cytotechnology and Biotechnology track and practicum option
 - **Lowell:** Bioinformatics, Biomedical Engineering, Bioprocessing, Clinical Lab Science, Chemistry Co-operative Education, Medical Plastics Design & Engineering
 - **Worcester:** PhD in biochemistry and molecular pharmacology
- **Intercampus multidisciplinary PhD program in Biomedical Engineering and Biotechnology**



Life Sciences Talent Initiative Academic Program Inventory

Private Colleges: Approaches to Practical Training

- **Northeastern University Undergraduate Cooperative Education**
 - Three 6-month coop jobs working in industry
 - Students paid by employer; no tuition payments for duration of co-op
 - Students retain campus housing and health insurance while on co-op
 - Students gain practical experience and hands-on skills, employers gain access to graduates with skills and experience
- **Worcester Polytechnic Institute Major Qualifying Project**
 - All undergraduate students complete MQP in major area of study
 - MQPs involve applied, real-world problem solving
 - MQPs completed over several terms for the equivalent of three courses of academic credit
 - MQPs often completed by students working in teams
 - MQPs may be undertaken in cooperation with industry
 - Students prepare proposal and budget for MQP and deliver written and oral presentations



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INNOVATIONS FROM OTHER STATES



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Innovations from Other States

- **Goal:** Identify approaches to education and training in life sciences employed by other states and nations that could serve as models for Massachusetts
- **Method:**
 - Web Search
 - Literature Search
 - Discussions with experts in field
- **Status:** State-level programs reviewed and some domestic experts identified
- **Work remaining:**
 - Identify model programs at international level
 - Prepare summary and case vignettes
 - Engage expert panelists for Life Sciences Talent Initiative Summit in February



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Innovations from Other States

North Carolina

North Carolina Biomanufacturing and Pharmaceutical Training Consortium (BPTC):

- Consortium to develop laboratory-based educational network at all levels of higher education system to teach biomanufacturing and applied biotechnology fundamentals and experiences (see next slide)
- \$60 million in funding from *Golden Leaf Foundation* (tobacco settlement revenue)

Career Education

- ***The Model Employee—Preparation for Careers in the Biopharmaceutical Industry***
 - –prepared by BPTC, provides industry standards for academic background and skills for multiple positions
- ***Career Pathways Biotechnology Edition: A Guide for Students, Parents and Educators in North Carolina***
 - developed by the NC Biotechnology Center Education and Training Program for the NC Department of Public Instruction



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Innovations from Other States

North Carolina

BioNetwork (statewide initiative of Community College System)

- *Biowork* – standard 128-hour course taught on multiple campuses
- Centers that provide resources to entire community college system
- Website provides FAQ for employers & students, guide to educational programs statewide, scholarship opportunities, job listings
- Job fairs

North Carolina Biomanufacturing Training and Education Center

- State-of-the-art cGMP facility
- Stand-alone course, undergraduate minor & post-graduate certificate in biomanufacturing
- Advisory Board includes academic institutions, industry & state government

Biomanufacturing Research Institute and Training Enterprise

- lab/office facility
- Focus on drug discovery; 6 of 7 tenure track faculty have experience in pharmaceutical industry
- B.S. and MS in Pharmaceutical Sciences



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Innovations from Other States

California

- California Community College Biological Technologies Initiative
 - Statewide coordinating program for biotechnology career education at Community College level; 6 centers statewide
 - Responsible for implementing statewide biotech workforce training plan; coordinates with industry
- C-SUPERB (California State University Program for Education and Research in Biotechnology)
 - Multi-campus coordinating program designed to promote interdisciplinary, inter-campus, synergistic endeavors between Chemistry and Biology departments and between faculty from allied academic and research units
 - Official liaison between CSU, industry, government and public on biotechnology issues
 - Maintains statewide inventory of all post-secondary education and training programs in biotechnology and related fields by campus
 - Offers grant programs for curriculum and workshop development, faculty/student research and faculty and student travel to conferences



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Innovations from Other States

New Jersey

New Jersey Technology Fellowship Program (NJ Commission on Science and Technology)

- Places post-doctoral graduates from New Jersey universities in NJ technology companies
- \$65,000 in first-year funding; \$75,000 in second year funding (including \$25,000 company match in second year), plus \$10,000 yearly expense budget
- Company must have principal place of business and 75% of employees in NJ and less than \$10 million in annual revenue

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SUMMARY





Life Sciences Talent Initiative Summary

- **Based on research to date, while Life Sciences is not a large employment sector (99,157) we project an 11.6% overall employment growth over the next 8 years.**
- **Demand for life sciences workers is expected to grow nearly 45% faster than for workers across the larger economy.**
 - This projection is based upon standard statistical procedures and does not include extraordinary events such as expansions, relocations, or the infusion of significant additional investment into the sector.
- **Based on the research to date, there has been a modest growth in the number of STEM graduates at all levels of higher education both public and private over the past five years (3.7%), although this is not uniform across all fields of STEM. However, we are not able to say at this time if there is a sufficient pipeline to meet the demand in the life sciences.**
 - Web survey will help identify fields of study and levels of education that might be in short supply, such as clinical lab science or regulatory affairs



Life Sciences Talent Initiative Summary

- **Academic Inventory suggests breadth and diversity of program and course offerings in life sciences at public and private institutions and workforce training programs**
 - We will be seeking more information about these programs, industry awareness of and engagement in these programs, and whether they are matched to emerging career opportunities
- **Industry representatives report that recent graduates lack skills and experience needed to fill key positions.**
 - We will profile programs in Massachusetts and in other states and nations that address this issue and facilitate conversations between industry and academia to adopt and expand successful models, such as co-ops and internships
- **Research on approach to life sciences education in other states indicates significant investment in capital facilities, program development, coordination and marketing**



Life Sciences Talent Initiative Preliminary Findings

Discussion and Questions