



Strategic Plan: 2005-06

Prepared for:
The National Center for the Biotechnology Workforce

August 2005

	Page
A Changing Biotechnology Workforce	1
<i>The High Growth Job Training Initiative</i>	<i>1</i>
<i>The Growing Biotech Workforce</i>	<i>2</i>
<i>Changes in the Types of Skills Needed</i>	<i>2</i>
<i>The Role of Community Colleges</i>	<i>3</i>
The National Center.....	3
<i>The Center’s Major Goals</i>	<i>3</i>
<i>Progress to Date</i>	<i>4</i>
<i>Industry Partnerships</i>	<i>4</i>
<i>Curriculum Development</i>	<i>4</i>
<i>Workforce Training</i>	<i>4</i>
<i>Outreach</i>	<i>4</i>
<i>Next Steps</i>	<i>5</i>
<i>Industry Partnerships</i>	<i>5</i>
<i>Curriculum Development</i>	<i>5</i>
<i>Workforce Training</i>	<i>5</i>
<i>Outreach</i>	<i>5</i>
Summary.....	5
Other Resources	6
Appendix:	7
<i>Goals and Objectives</i>	<i>7</i>

A Changing Biotechnology Workforce

Governments and communities around the world are working hard to make sure that they are part of the biotechnology industry. The field is moving from a Research & Development phase, where the emphasis was on intellectual talent, to a high growth phase that requires people skilled in a variety of areas.¹ The training and education of people to support this growth is a major emphasis in many countries. In the U.S. community colleges are integral to training the people needed for the next phase of industry development. The National Center for the Biotechnology Workforce is leading the development of the Community College sector. Five community colleges with different expertise and foci have come together to help build the education and training programs that the U.S. needs to lead in the biotechnology industry.

The High Growth Job Training Initiative

The High Growth Job Initiative (HGJI) is a strategic effort to prepare workers to take advantage of new and increasing job opportunities in high growth, high demand, and economically vital sectors of the U.S. economy. Biotechnology is one of the 12 areas identified as a strategic high growth industry. The Employment and Training Administration (ETA) administers the Initiative and is investing in models and demonstrations of workforce solutions.² These investments are designed to address skill shortages and improve the training pathways by:

1. Targeting investment of workforce development resources and supporting private and public sector partnerships to ensure the development of workers' skills based on industry need.
2. Increasing opportunities to use apprenticeship training (combining on-the-job training and academics) as skills development methodology to ensure a pipeline of skilled workers.

¹ *The Biotechnology Industry: Identifying and Addressing Workforce Challenges in an Emerging Industry*. Prepared by New Economy Strategies, LLC and The Leonard Resource Group, Inc. for The U.S. Department of Labor Employment and Training Administration Business Relations Group. October 2004.

² More information on the Initiative can be obtained at <http://www.doleta.gov/BRG/JobTrainInitiative/>

3. Increasing integration of community and technical college efforts with business and the public workforce system activities to meet the skills training needs.
4. Providing workers with paths to career enhancing opportunities in high growth occupation.

From a series of forums with senior biotechnology industry representatives, community colleges and other education and training providers, and representatives from the public workforce system, three broad challenges to the biotech industry were identified: Recruitment and Retention; Skills Competencies and Training; and Image and Outreach to the Public.³ Consequently, eight workforce solutions based on the biotechnology industry's priorities were identified:

- Expand the pipeline of youth entering the biotechnology industry.
- Help alternative labor pools gain industry-defined skills and competencies.
- Develop alternative training strategies, such as apprenticeship, distance learning, and accelerated training, for training biotechnology professionals.
- Develop tools and curriculum for enhancing the skills of biotechnology professionals for nationwide distribution.
- Develop industry-defined career ladders and lattices and corresponding competency models and curriculum.
- Enhance the capacity of educational institutions to train to industry-defined competencies.
- Develop strategies to retain and help incumbent workers move into higher-level positions.
- Assist transitioning individuals from declining industries to high growth industries by building on their existing skills and training them for high growth biotechnology occupations.

³ *The Biotechnology Industry: Identifying and Addressing Workforce Challenges in an Emerging Industry*.

The Growing Biotech Workforce

The biotechnology field certainly meets the criteria for rapid growth. For example, exports from U.S. biotechnology industries increased 176% in two years, from \$2.1 Billion in 2002 to \$3.7 Billion in 2004.⁴ This large and sustained growth rate places strong demands on regional economies to be able to provide the skilled people necessary to support government, business, and education institutions.

The U.S. Department of Commerce and the Biotechnology Industry Association (BIO) define the field of biotechnology as *“the application of molecular and cellular processes to solve problems, conduct research, and create goods and services.”*⁵ Biotechnology is sometimes referred to as an enabling technology, something that has wide applications in a number of industries. Many people associate the industry with the widely publicized discovery and development of new drugs, but biotech is advancing in other areas such as chemicals, agriculture, pharmaceuticals, medical devices and equipment, nanotechnology, information technology, and facilities and infrastructure management. This means that there are changes occurring in the types of people being employed in the biotech sector.

Currently most U.S. biotechnology has been focused in nine super clusters, four on the west coast and five on the east coast (Boston, San Francisco, San Diego, Research Triangle Park, Seattle, New York/New Jersey, Philadelphia, Los Angeles, and Washington DC/Baltimore).

Much of this has been Research and Development with these nine regions receiving the majority of research funding and providing the majority of patents.⁶ However, as biotechnology expands other areas of the U.S. are starting to see a need for skilled workers.

National and international agencies all agree that the demand for people skilled in biotechnology areas will increase dramatically, and outstrip the

current education and training systems. In the U.S. the biotechnology industry employed 713,000 workers in 2002 and is anticipated to employ 814,900 workers in 2007, an increase of 14%.⁷ Individual biotechnology occupations may see much higher growth rates.

Biotech-Related Occupations	Number Employed 2002 (000's)	Number Employed 2012 (000's)	Numeric Change (000's)	Change %	2002 Median Annual Earnings	Postsecondary Education & Training
Medical scientists, except epidemiologists	58	73	16	26.9%	\$56,960	Doctor's degree
Biomedical engineers	8	10	2	26.1%	\$60,410	Bachelor's degree
Environmental scientists and specialists, including health	65	80	15	23.7%	\$47,600	Masters degree
Biological scientists, all other	27	33	6	22.3%	\$53,300	Bachelor's degree
Biological technicians	48	57	9	19.4%	\$32,710	Associate degree
Medical and clinical laboratory technicians	147	176	29	19.4%	\$29,040	Associate degree
Chemists	84	95	11	12.7%	\$52,890	Bachelor's degree
Agricultural and food science technicians	20	22	2	9.3%	\$28,360	Associate degree
Chemical technicians	69	72	3	4.7%	\$37,430	Associate degree

Source: *Biotechnology High Growth Industry Profile*. ETA Business Relations Group www.careervoyages.gov/pdf/biotech-profile-504.pdf

Changes in the Types of Skills Needed

To date the biotechnology industry has focused on the development of talent at the Masters and Ph.D levels as it strove to develop the R&D it needed. This is shifting.

Industry leaders have noted a difficulty in finding workers with adequate skills not only in math and science, but people who have specialty skills. Industry organizations are now conducting outreach efforts geared towards individuals that possess Bachelor of Science and Associate degrees. In addition, many firms are searching for existing and alternative labor pools that understand manufacturing processes, quality control, Food and Drug Administration regulations and laboratory practices.⁸ MassBio reported that the types of skills required by small biotechnology companies, that employ some 60% of the overall biotechnology workforce, include a wider range of occupations.

⁴ *U.S. Trade in Advanced Technology Products – Biotechnology*. www.census.gov/foreign-trade/statistics/product/atp/2004/12/atpctry/atpg01.html

⁵ *Critical Technology Assessment of Biotechnology in U.S. Industry*. U.S. Dept. of Commerce, July 2002, p. 3.

⁶ Summarized from NIH funding data for 2003.

⁷ *Critical Technology Assessment of Biotechnology in U.S. Industry*

⁸ U.S. Dept. of Labor. www.doleta.gov/BRG/Indprof/Biotech_profile.cfm
The Biotechnology Industry: Identifying and Addressing Workforce Challenges in an Emerging Industry.

Overview of Jobs in a Small Biotechnology Company (1-49 Employees)			
Research: Discovery and Preclinical	Operations: Process/Product Development	Quality: Control and Assurance	Finance, Administration and Information Systems
VP of R&D	Director	Director	Chief Financial Officer
Senior Scientist	Supervisor	Supervisor	Accounting Manager
Scientist	Associate	Analyst	Applications System Specialist
Research Associate	Technician	Technician	Accounting Clerk
Laboratory Support	Facilities Manager	Documentation Coordinator	HR Manager
Laboratory Support	Facilities Technician		Receptionist
			Administrative Assistant

Source: Fenna D. Hanes, New England Board of Higher Education, for MassBio Cambridge MA.

The Role of Community Colleges

Community colleges are a significant source of biotechnology related training, but are limited by funding that often prevents them from providing enough courses to meet local demand. Additionally, a lack of standardized certification programs for the biotechnology industry makes it difficult for employees to follow a clear career advancement path, or transfer skills from employer to employer.

Employers within the industry have identified the skills and competencies needed in high demand occupations within the industry. However, there is still a need for common definitions of skill sets and competencies across industry sub sectors. These definitions would let the industry market its positions and allow for education and training providers, as well as the public workforce system, to develop biotechnology and life sciences training programs to meet the needs of business. Common definitions and increased funding would also allow community colleges and other education and training providers to create baseline curriculum. Such curriculum would better prepare new entrants for employment within the industry and allow incumbent workers to continuously upgrade their skills, thereby helping the industry retain and promote incumbent workers.

ETA is now partnering with employers and education providers to develop and model training solutions that can be replicated and sustained

throughout the state and local public workforce system.

The National Center

The National Center for the Biotechnology Workforce is committed to developing programs to train the next generation of skilled staff needed to continue the development of the U.S. biotechnology industry. The Center is also dedicated to biotechnology in all its varied forms, from bioinformatics to biodiesel, and the different types of people needed to make U.S biotechnology a success. The Center is a partnership of five community colleges focusing on different aspects of biotechnology:

- **Research and Development** - Forsyth Tech (Winston-Salem, North Carolina)
- **Biomanufacturing**
New Hampshire Community Technical College (Portsmouth, New Hampshire)
- **Bioinformatics** -Bellevue Community College (Bellevue, Washington)
- **Bioprocessing** - MiraCosta Community College (San Diego, California)
- **Agricultural and Food Processing** - Indian Hills Community College (Ottumwa, Iowa)

These community colleges are *Centers of Excellence*. The Centers of Excellence aim to develop the skills, students, and staff necessary to provide a skilled workforce for different parts of the biotechnology industry.

The Center's Major Goals

The National Center is a coordinated network of leading institutions in the biotechnology arena that has three broad goals:

- To enhance capacity for biotechnology training by region;
- To develop, implement, and disseminate curricula and best practices; and
- To define technical skill standards for biotechnology sectors.

These goals will be achieved by work in four areas: the development of industry partnerships, curriculum development, workforce training, and outreach and dissemination. For each of these

goals the National Center and its five Centers of Excellence have defined particular tasks and actions (see Appendix for detailed goals).

Progress to Date

Developing curricula and training biotechnologists is just the beginning. The Center is committed to developing the partnerships needed to make sure the education and training programs developed reflect the needs of regional and national industry.

Industry Partnerships

Industry partners are key. Good partners will help the Center develop programs, materials, and students that will enhance the biotechnology in regions throughout the country.

The National Center and the Centers of Excellence are developing unique partnerships with industry, schools, professional associations, and universities. For example, MiraCosta Community College has found creative solutions to working with industry and local professionals. MiraCosta has established partnerships with the San Diego Chapter of the International Society of Pharmaceutical Engineers, and construction and architectural firms. Working with nearby Lonza Biopharmaceuticals, New Hampshire Community Technical College has established the first site apprenticeship for the Biomanufacturing Apprenticeship System, a system based on industry skill standards created through the input of technicians and supervisors from a consortium of Northeast Biomanufacturing companies. NHCTC has also established the Northeast Biomanufacturing Institute for training incumbent workers and graduates of NHCTC's Biotechnology programs. Finally, Forsyth Tech has partnered with Wake Forest University, and two private companies for joint laboratory use and training.

Curriculum Development

The curriculum being developed reflects a wide range of partner needs and community concerns, from short incumbent worker courses to long-term retraining. Bellevue demonstrates the fundamental approach to understanding the workforce needs of the community. The Faculty conduct needs analysis with partners to assess what are the real

needs within the community and to forecast capacity. Focus groups are used to determine, refine, and structure curriculum and content. For example, they have determined that the community requires a range of informatics training courses that include certification, short duration courses for retraining incumbent and dislocated IT workers, and cross training of incumbent biomedical staff. Bellevue and Washington State's Office of the Superintendent of Public Instruction are also creating a clinical informatics and bioinformatics curriculum for grades 11 and 12. The curriculum will be available to all US high school teachers.

Indian Hill's team has been providing "Train the Trainer" sessions at the Iowa Bioprocess Center for wastewater management in collaboration with AceOps. Finally, New Hampshire celebrated the launch of the U.S.'s first Biomanufacturing Apprenticeship program that allows for graduated high school students to enter NHCTC's Associate in Science in Biotechnology Degree program.

Workforce Training

Workforce training is a key part of the project. While curriculum that can be used throughout the U.S. is important, the Center is also committed to providing students with the skills needed to participate in their local biotechnology industry.



Source: New Hampshire Community Technical College

Forsyth Tech, in conjunction with Wake Forest University and a local company have just begun a lab handling and experimentation course that already has 16 students enrolled. Forsyth Tech hires are consistently rated as excellently trained and great employees. MiraCosta has just begun a bioprocessing course that has an enrolment of 20, with one student already hired.

Outreach

It is not enough to develop these programs and skills. Disseminating of curriculum and best practices are essential to the success of the project.

The Center is active in providing an expert source of information about biotechnology education and training. Whether radios show, such as San Diego's KPBS discussion on biotechnology, or presentations, exhibitions, and a national focus group at the Health Information Management Systems Society national conference, members of the Center have been there.

Iowa and New Hampshire have also worked on ways to help other organizations and regions understand the skills needed for the biotechnology workforce. Iowa has professional development programs in establishing wastewater management skill standards. New Hampshire has developed online skill standards for a biomanufacturing apprenticeship system.

Next Steps

Curriculum development and dissemination of curriculum and best practices are still the core of the project. There is also an emphasis on moving beyond traditional partners and working on ways to track the future paths of graduates. The Centers are also working hard to deepen their relationships to create a stronger core network.

Industry Partnerships

Partnerships are moving beyond industry to universities and professional organizations. For example, Bellevue Community College is working with Columbia University on a proposal to the National Science Foundation to develop biomedical learning objects for infusion into existing biotechnology curricula.

Curriculum Development

Curriculum development is moving ahead. Iowa, with key partners such as Cargill, are developing a fermentation virtual reality training program and concurrently modifying it for use to train ethanol plant employees in facility optimization. New Hampshire's skill standards for Northeast biomanufacturing companies will be used to develop short courses for incumbent workers in a variety of technical skill fields. Forsyth Tech has developed articulation agreements with 8 sister community colleges where their students commute to Forsyth to complete the specialization in

biotechnology for their AAS degree.

The Colleges that form the core of the National Center are collaborating to develop stronger, innovative curricula. For example, Bellevue is working to develop a Clinical Trials Associate curriculum for informatics and is discussing with Forsyth on joint program development. Finally, Iowa, Bellevue, New Hampshire and Forsyth are developing joint training opportunities and summer programs for teachers and K-12 students.

Workforce Training

New Hampshire's program for Biomanufacturing Apprenticeships will serve as a template for a national approach to workforce development.

Outreach

The development of electronic communication systems is key to getting the word out, but the National Center will not forget other forms of outreach. In June 2005, the Bellevue Bioinformatics Center hosted 125 attendees to provide learning and support for those engaged in life science outreach.

The National Center is working with our ETA partners to create the biotechnology sections of the Workforce3 One and Career Voyages web sites. The National Center is providing the best practices, pictures and success stories. The Center is also preparing the biotech workforce web site. These tools will enable web access to the learning products of the National Center such as certification standards, curricula, sharing of best practices, course outlines, event schedules, "success" stories and "how to". The National Center will also make available marketing tools for conventions such as power point presentations, pamphlets and eventually reprints on best practices written. All materials will be produced to be both web based and in print versions or available on CDs for distribution.

Summary

Like other countries, the U.S. biotechnology industry has focused on the intellectual staff needed to participate in R&D. The development of biotechnology in the U.S. now requires the training of many individuals in a wide variety of skills,

including production staff, quality control experts, and people who understand how to sell and market biotechnologies. Community colleges are vital to developing this next generation of skilled biotechnologists.

The National Center and its associated Centers of Excellence are focused on providing the industry and its education supporters with models of how to train new and incumbent workers. The Center is leading the development of innovative and responsive education and training programs that can be used as models for other areas of the U.S. The National Center and the Centers of Excellence are committed to developing the partnerships and skills required to train the skilled people needed for the next phase of biotech industry growth.

Other Resources

Workforce3 One is a collaborative web site that offers the public workforce system, employers, economic development professionals, and education professionals a knowledge network for high growth industries. www.workforce3one.org

Career Voyages is a collaboration between the U.S. Department of Labor and the U.S. Department of Education. It is designed to provide information on high growth, high demand occupations along with the skills and education needed to attain those jobs. www.careervoyages.gov

The National Center works in partnership with Bio-Link. Bio-Link is a National Advanced Technological Education (ATE) Center for Biotechnology that originated in late 1998 with a grant from the National Science Foundation. Bio-Link enhances and expands biotechnology education programs by providing cutting edge professional development for instructors, by improving curriculum, by making use of technologies and by creating a system that promotes the sharing of information. www.bio-link.org

For more information on the National Center for the Biotechnology Workforce you can visit our website at www.BiotechWorkforce.org. You can also email the Executive Director, Russ Read, at rread@forsythtech.edu.



ForsythTech



The National Center for the Biotechnology Workforce is a recipient of a Presidential High Growth Job Training Initiative Grant as implemented by the U.S. Department of Labor's Employment & Training Administration. 04165/5-05

Appendix:***Goals and Objectives*****1. To enhance capacity for biotechnology training by region**

Establish & maintain industry partnerships that will inform regional biotechnology providers as to the needs of the regional industries

Tactics

- Develop and maintain industry partner contact database and partner files.
- Ensure regular partnership meetings & contact cycle.
- Lead the establishment of a Workforce Development Partnership.
- Develop Virtual Reality Fermentation Model.
- Develop Process Control Laboratory.
- Develop a Fermentation Pilot Plant.
- Develop in house training for lab assistants and research associates.
- Create an industry roundtable.
- Provide product development and process assistance for bioprocessing entrepreneurs and businesses.
- Serve with regional life science industry leaders on state appointed regional economic development initiatives.
- Partner with regional Workforce Development Council to create life science skills panel.
- Partnering with the Biotechnology Industry Organization (BIO) and the Biotechnology Institute to offer hands-on, industrial strength workshops, biomanufacturing company tour and a day-long session of speakers re: community college involvement in workforce training.

Train new and incumbent workers in needed biotechnology skills

Tactics

- Work with industry to provide stipends for training.
- Establish partnerships in the use of labs and other equipment for production, research etc. with businesses, high schools, colleges, and universities.
- Work with partners to develop a network to provide equipment for training needs.
- Undertake statewide biotech workforce training by region.
- Engage in research collaborations.
- Create Advanced Short Courses in Biomanufacturing for incumbent workers and program graduates.
- Collect ratios of student to equipment as a marker for training.
- Work with US Department of Labor, Workforce Development Systems, NITAS, to develop national Biomanufacturing Apprenticeship Program.
- Launch the Northeast Biotechnology Institute for training incumbent workers in biomanufacturing for New Hampshire, neighboring states and the Northeast Region with offerings of short courses supporting state and regional biomanufacturing company training needs

Develop pilot program to analyze regional economic trends for biotechnology

Tactics

- Monitor who is hiring, where are they, types of jobs, income level, skills required.
- Monitor types and numbers of jobs through career center.

Develop mechanisms to recruit and retain biotechnology trained workers in the regions

Tactics

- Develop a pilot program to track recruitment, training, and post-training information on incumbent and new workers.
- Collect information on veterans – applications, enrolments, and graduation.
- Develop and administer student satisfaction surveys during and post training.
- Develop prior learning assessment tool for new students and how they found out about program.
- Develop employer satisfaction survey.

2. To define technical skill standards for biotechnology sectors

Develop regional and national partnerships to establish skills standards

Tactics

- Conduct regional and national focus groups to explore emerging job descriptions and need skills.
- Develop skill standards through industry validation studies.
- Create Skill Standards for a National Biomanufacturing Apprenticeship program for just graduated high school students entering the Associate in Science in Biotechnology program.
- Develop state approved "on-ramp" life science informatics curriculum for latter high school years, and articulation to community college life science informatics program.
- Working with industry, develop skill standards for bioprocess technicians, ethanol plant maintenance technicians, and ethanol plant operators.

3. To develop, implement, and disseminate curricula and best practices

Develop curriculum for new and incumbent workers

Tactics

- Develop a curriculum for research using animal/plant culture, DNA/RNA, biomolecular extraction separation, industrial bioprocesses, and research techniques and measurement.
- Expand the Medical Informatics Curriculum.
- Develop a Bioinformatics Curriculum.
- Develop and run short courses for industry – incumbent workers.
- Provide a center for Industrial Biotechnology Education and Training for state, region, and the nation.
- Develop a Bioprocess Technology A.S. Degree.
- Develop a Process Control Certification Program.
- Develop a Renewable Fuels curriculum.
- Develop new programs and conduct training on new topics: hydraulics, pump training, mammalian tissue cultures, HPLC UV via spectrophotometry, titrator, etc.
- In partnership with the International Medical Equipment Collaborative (IMEC), offer Service Learning for Biomanufacturing/Biotechnology students.
- Create a model for prior learning assessment in life science informatics.

Develop presentations and online materials to disseminate best practices and curriculum

Tactics

- Present to the Health Information Management & Systems Society (HIMSS).
- Conduct Microsoft Live Meetings for interested parties.
- Lead a National Conference.
- Development of national website www.Biotechworkforce.org
- Create Center of Excellence sub-websites.
- Set up a Yahoo listserv.
- Hold regular Centers of Excellence meetings.
- Create a National Brand Identity for the National Center.
- Create Center Brochures with program overview.
- Develop a K-12 Science Curriculum & Teacher Training Summer Course.
- Develop and maintain an Iowa Virtual Biotech Business Accelerator – a website where entrepreneurs and existing biotech businesses can go to access resources to help them become successful and competitive. (e.g.,: sources for loans and venture capital, attorneys, accountants, and other professionals who specialize in biotech companies, training and education programs, marketing help, consultants, etc.).
- Sponsor major state or regional educational events over a two year period (e.g., Biomass Conference, Renewable Fuels Conference, Iowa Biotech Symposium, etc.).
- Attend and display programs such as Iowa's Virtual Reality Tool at major events over two year period of grant. (e.g., BIO, DOL Workforce Innovations Conference, teachers conferences, Iowa State Fair, etc.).
- Improve access to all bioprocessing training through video conferencing and online learning.