National Center for the Biotechnology Workforce

Grant Final Report

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SECTION I: EXECUTIVE SUMMARY

Years of research in biotechnology unlocked productive secrets within the genome and produced discoveries now being applied in many industries. Breakthrough bio-pharmaceuticals in the pipeline, such as cancer-fighting avastin, bring hope to millions of patients and, once they gain Food and Drug Administration approval, trigger massive biopharmaceutical manufacturing operations in this country and overseas. New bio-engineered processes for innovative bio-industrial products, such as biodegradable plastics, or non-food sources for biofuels, such as algae oil, create jobs and help clean the environment, save energy and improve lives around the world.

As biotechnology companies realize and implement these new ways to grow and expand, workforce resources become their top priority. Availability of skilled workers is a make-or-break factor in relocating or creating new plants and jobs in any region. Demand for prepared biological technicians is expected to grow by double digit rates through 2014.

One obstacle to recruitment is the general public retains a notion, which was true in the past, that the biotechnology industry seeks talent only at high levels for advanced research and development. This is shifting. Industry organizations now conduct outreach efforts geared to individuals with bachelor of science or two-year associate degrees. Industry leaders also note difficulties in finding workers with specialty skills in manufacturing processes, quality control, validation, Food and Drug Administration regulations, plus standard laboratory and aseptic practices.

In response, the President's High-Growth Job Training Initiative announced, on June 28, 2004, a $5 million grant for Forsyth Technical Community College in partnership with four other community colleges around the nation to develop the National Center for the Biotechnology Workforce (NCBW) across a three year period (2004-2007). These colleges were designated Centers of Expertise (CoE).

Each CoE was selected for its leadership in developing biotechnology workforce training in a specific area. Coordinating the five into a synchronized network enhanced capabilities of each one in providing biotech training and faculty development across all regions and industry concentrations.

Center of Expertise	Region	Functional Expertise
Forsyth Technical Community College Winston-Salem, North Carolina	Southeast	Biotechnology Research and Development
New Hampshire Community Technical College Portsmouth, New Hampshire	Northeast	Biomanufacturing
Indian Hills Community College Ottumwa, Iowa	Midwest	Agricultural Bioprocessing and Renewable Fuels
Bellevue Community College Bellevue, Washington	Northwest	Life Science Informatics
MiraCosta Community College San Diego, California	Southwest	Bioprocessing

Regions unified and developed this process to amplify their own strengths and work together toward a common goal - increased biotechnology workforce training across the nation. Initial meetings gathered input from all centers, formulated, and gained consensus within the coalition for a strategic plan and its implementation. Emphasis was on easy replication and online access for all deliverable teaching resources produced. The NCBW is a working example of how a nationally charged consortium can become a model of systemic cooperation between geographically dispersed sites.

The National Center Office (NCO), directed by an Executive Director and located at Forsyth Tech, administers the grant and conducts strategic planning, coordination and leadership. The NCO fosters partnerships among educational institutions and industry that spark and maintain initiatives to help overcome trained worker obstacles and achieve the grant's workforce development goals.

Community colleges have few opportunities for meaningful exchange, and many institutions cannot access those that do exist, due to lack of resources in support of travel. Frequently, a college's program building horizon is within its own campus, and very frequently is limited to its home state. The support given the five diverse colleges in this grant enabled them to transcend traditional limitations and synergistically develop a new national initiative that's brought regional benefits. The fruits of this association can be seen in the active labs and motivated faces of biotech students enrolled at each of the colleges.

Because of its focus on easy replication, the NCBW created a critical mass of synthesized biotech teaching resources to benefit all community and technical colleges. One primary outcome is its role as a model of partnership with community, employer and other national and regional biotech training stakeholders.

The NCBW work resulted in excellent examples of cooperative education for immediate workforce training through partnerships, such as pilot plants and other actual, hands-on workplace experiences. The program produced multiple publications on its lessons learned. A variety of presentations, including US DOL/ETA webinars, twenty national workforce presentations and the development of a unique "human capital" newsletter called the *Biotech Resource Line* have all been made available online at www.biotechworkforce.org. The web site measures approximately 23,000 hits a month. The program has been recognized for its efforts.

Setting and Achieving Goals

One of the most crucial NCBW goals was to generate industry and other forms of outside support. This goal was met, region by region. Every dollar invested in the NCBW program returned two dollars in leveraged resources.

Leveraging employer and other partnerships resulted in better teaching facilities; improved equipment and infrastructure; increased overall training capacity; and it brought invested professionals into the program as available mentors and participants. Program quality improvements included more hands-on experiences with real equipment that helped improve job placements for participants. Strengthening biotech training programs with visible links to employers also helps attract students.

Each CoE has a strong list of multiple community, industry and educational partners, consistent with the NCBW's overall program of working together. The NCBW mandate created a lot of synergy - much more was accomplished through the partnerships than could have been realized individually.

National Center for the Biotechnology Workforce Goals:

- Develop a coordinated network of leading institutions in the biotechnology arena, each with broad capabilities in a specific area of the industry, to provide support for workforce program and faculty development across strategic regions.
- Enhance capacity and hands-on opportunities at each of the regional centers to increase biotech training in each region and area of industry expertise.
- Take national responsibility for development of skills standards and obtaining workforce data for designated functional areas of the biotechnology industry.
- Provide leadership in rolling out biotechnology training and re-training programs that can be easily replicated.
- Work together with partners, stakeholders and the Employment and Training Administration (ETA) to disseminate new knowledge and resources.

In 36 months NCBW efforts resulted in thousands of newly trained workers adding skills and advancing in good paying biotech industry jobs. Numbers include approximately 400 students graduated from its programs plus training for more than 835 teachers and reaching at least 12,000 incumbent workers, primarily in the rapidly growing biofuels sector.

Through the NCBW's innovative and collaborative strategy, thousands more individuals, workers, students (including secondary school students), teachers and industry leaders learned about - and many will choose - career opportunities that are indeed within reach and have strong potential for themselves and the nation in biotechnology.

Implementation Strategies

To succeed in resolving crucial workforce issues, the NCBW embraced all education, employer and economic development stakeholders in its initial 2004 strategy.

From this inception, the NCBW grew as a facilitator and communicator, making sure workforce demands were quickly identified and addressed - always working hand-in-hand with industry. Many partnerships, collaborative agreements, networks, advisory boards, initiatives, annual events and other grant outcomes were formed and remain actively underway.

The NCBW actively linked with network partners, including US DOL/ETA; Bio-Link (NSF sponsored training initiative for biotechnology); BioNetwork of NC; California Statewide Biotechnology Education, the Biotechnology Industry Organization (BIO), San Diego Workforce Partnership, the League for Innovation, DOL Apprenticeship Office, the Washington Life Science Industry-Education Council, and others.

All five centers used grant funding and other leveraged resources to engage in active infrastructure enhancements, including building construction and upgrades, to purchase new equipment for more

active hands-on training to meet demands, and to hire and develop qualified faculty.

In particular, Forsyth Tech completed construction of 17,500 additional square feet of lab space and MiraCosta completed a 3500 square foot facility for bioprocessing training in partnership with its neighboring biopharmaceutical plant. The community colleges in New Hampshire and MiraCosta both picked up the newly hired biotech faculty in tenure tracks. At Bellevue, the Life Science Informatics CoE, a new gene sequencer was purchased.

Each CoE program increased its capacity to take recent high school graduates, returning students, dislocated workers, and people in other demographic groups, such as single mothers returning to the workforce, and prepare them all for good-paying jobs that can turn into careers and lifelong learning in biotechnology. Many non-traditional students, who lost jobs in fading industries, attained training that will make them employable. The NCBW estimates its placement rates to be 80 to 90 percent.

Each CoE responds to current labor market information in its region to increase capacity, capabilities and numbers of students.

The five CoEs of the NCBW:

- Developed articulation accords: including 1-plus-1 agreements with other community colleges and 2-plus-2 agreements with four year colleges and universities, plus, initiatives with local high schools.
- Worked to develop "on-ramp" programs attractive to high school students.
- Defined articulation pathways through community college systems and four year institutions.
- Produced flexible, modular curricula to assist colleges in starting or bringing existing biotech related programs more current.
- Reached out and served many incumbent workers ready to increase their skills and move up.
- Created partnerships, collaborative agreements, networks, initiatives and annual events.
- Increased systemic capacity by improving infrastructure, hiring qualified new faculty plus other leveraged projects.
- Published results and learning resources online for dissemination and replication.
- Consulted with other institutions seeking to advance biotechnology training.

The NCBW supported local and regional outreach programs specifically designed to reach those seeking new job opportunities, or to re-enter, upgrade, or transition in the workforce.

The group developed highly innovative ways of training individuals, from 3-D computer visualizations to online courses to hands-on experience with state-of-the-art bioreactors. The net result is efficiently meeting local needs in technical, skilled, good-paying jobs - and letting people know about the opportunities.

The NCBW developed a novel newsletter that facilitates dissemination and replication for others. Many colleges and organizations outside of the NCBW now use these models in their own biotech programs.

NCBW Organization

Each Center of Expertise was responsible for its own direction. The group is highly collaborative, collectively meeting and discussing issues which initially seemed regional in nature but often proved to be common to each site. Leaders of the regional Centers have taken to the airways and traveled across the nation to share their expertise with other leaders in college training or at national conferences or other worthwhile gatherings.

The National Center Office (NCO) is the coordinating body for the synergistic output of each CoE within the coalition. The CoEs plan their own work; the NCO coordinates at the national level. The executive director reviews CoE reports on a quarterly basis and works to implement the strategic plan, with input from all CoEs. The director met with coalition members on a regular basis and coordinated national group meetings. Each CoE was responsible for its own management.

The NCBW experience shows that a nationally coordinated framework is extremely helpful in identifying translational outcomes for the betterment of the biotechnology workforce audience across the nation. A national office assembles the output of the CoEs and disseminates these tools (best practices, curriculum, training materials) in a proven model. The web site created for the NCBW, www.biotechworkforce.org, successfully became the conduit for products and services created. In addition all products and services considered best practices were shared with the ETA web site, www.workforce3one.org.

Another successful practice implemented by the NCO was the preparation of quarterly reports for the ETA. Both narrative and financial reports were coordinated by the NCO from offices at Forsyth Tech, the lead institution. The Grants Financial Director, Grants Director and the Executive Director of the NCBW at Forsyth Tech prepared these reports in a timely and accurate manner. The NCO carried out site visits to the CoEs to maintain compliance with ETA grant guidelines on finance and programs according to grant policy.

Conclusions

As the independent evaluator notes in his report, all NCBW goals were met or exceeded on all measurement levels: “Based on a review of program outputs and independent interviews of the principals and/or statements from corporate partners associated with the five community colleges and the distinctly focused centers of expertise they established, the three-year effort achieved its stated goals.”

“The five community colleges that comprised the grant partnership significantly exceeded numerical targets for important programmatic outputs including businesses served in their individual regions, workers trained, matriculants in certificate and/or degree programs and potential new students reached through the various outreach initiatives funded by the Department of Labor grant."

The NCBW's collective work also made intangible progress to its stated goals. By leveraging industry, employer, and community economic development support for new educational partnerships, lasting connections have been forged across the nation, while creating enthusiasm and motivation for biotech

programs to grow. Awareness of biotechnology's extraordinary opportunities was also expanded.

Susan Seymour, a consultant and former BioNetwork Director for the North Carolina Community College System, makes this recommendation regarding the NCBW's work:

"Having assisted in the start-up of the nation's leading statewide network of specialized biopharmaceutical training, I recognize the potential impact that the National Center can have on increasing our country's market share of biotechnology expertise and employment."

In further recognition and support of the NCBW office and mission, the NCCCS BioNetwork Director Matthew Meyer said:

"The decision to sustain the National Center for the Biotechnology Workforce with BioNetwork funds was a simple and quick decision to make. BioNetwork needs innovative leaders, established connections with other state community college systems for best practice sharing, and contacts within federal and state funding agencies. The NCBW has developed assets in all these categories and has demonstrated that it excels in facilitating partnerships and innovation. BioNetwork's investment in the Center will undoubtedly provide much greater benefits to the Network's colleges, students, and industry partners."

Initiating the program required innovation and response to various challenges, some foreseen, some unforeseen.

Key lessons learned are:

- Biotech is about constant change - biotech markets are dynamic and fast paced, training needs in biotechnology change quickly.
- A wide diversity of jobs in biotechnology - with new sets of skills - is created almost daily - training must keep pace with such innovations.
- Solid apprentice or internship experiences better prepare individuals for employers, helping transition into real world working situations.
- Training programs have to be practical and sensitive to needs of both employers and students - training times and schedules must be realistic to competencies required.
- Training is for life - students undertaking biotech programs - and management hiring these students - must embrace life-long learning.

The availability of a well trained and knowledgeable workforce is critical to attracting and retaining biotechnology and life science enterprises. As this industry continues its unprecedented growth, the National Center for the Biotechnology Workforce distinguishes the US as the leading location for biotechnology and life science capital investment and job creation.

Through the NCBW the community colleges have learned that the best way to meet demands for the biotech workforce is to produce a highly skilled, tailor fit employee who is comfortable working in the rigorous biotechnology environment. This means offering real world working situations, whether in academic environments using multiple versions of the same equipment; in a cooperative pilot plant

environment in which students work shoulder-to-shoulder alongside industry experts; or by creating internships, apprenticeships, and other cooperative pathways into the industry workplace itself. Learning how to operate together in group situations is crucial; graduates must be able to take on assigned responsibilities, adapt to changing requirements, and, not only be able to think for themselves, be able to work as effective team players for the company or institution.

The National Center for the Biotechnology Workforce is well established and has developed the expertise and mechanisms for sharing specialized biotechnology curricula, innovations and strategies nationwide. This Center is a vital, strategic economic development catalyst for the United States to retain and attract biotechnology and life science business. Without continued support of this unique national center, the potential on-going economic and employment benefits to our country will not be realized. This final report documents the dynamic successes and impact realized during the National Center's start-up and early implementation phases. It should be the basis for consideration for continued funding."

The NCBW Final Report gathers the components, efforts and results of its three and a half year program. It presents the background, time line, activities, progress, partnerships, obstacles and other data related to the grant. It consists of six documents combined – one on each center plus this initial, overall report on the National Center Office (NCO) itself.
Each CoE report documents relationships, educational materials and successful practices developed through the grant.

Each CoE has a link and a Profile at www.biotechworkforce.org that further describes the increased capacity and resources of its program as a result of the grant's implementation.

SECTION II: GRANT ACTIVITIES

Biotechnology comes in varied forms, from bioinformatics to biodiesel, and different types of people are needed to keep the U.S biotechnology industry growing. Biotechnology employers need to fill every position in their companies, from entry-level up, through mid-level technicians to the most advanced. All employees must be qualified, skilled individuals.

This demand is complicated by the rapidly changing environment in which the industry operates. Advances in underlying sciences keep affecting processes and technologies used by the biotechnology industry. This makes it necessary for employees already working in the industry to continuously upgrade their skills to remain productive.

When the National Center for the Biotechnology Workforce (NCBW) started in 2004, biotechnology firms were projected to need more workers than were enrolled in training programs. A lack of nationally-recognized articulated skills presented an immediate training challenge, as did the void in visible biotechnology career ladders or available sources of training. Many technician jobs in biotechnology don't require advanced degrees.

The NCBW began working directly with concerned professional colleagues plus other public and

community advocates - all aware of the need and committed to preparing qualified biotech workers with innovation, passion and creativity. These leaders integrated community college services with industry resources to reach and motivate students, both young and old, offering easy access points. Their activities increased biotechnology training recruitment, enrollments, employment outcomes, and public awareness.

The NCBW recognized the importance of making biotech training available to a maximum number of qualified individuals, including job seekers and those already working in the industry. The NCBW strategy targeted partnerships with employers, educators, and economic development stakeholders to provide outreach, scholarships, apprenticeships and other unique programs designed to attract diverse populations and enhance skill set preparations.

Links formed with industry demonstrate how laboratory training, dovetailed with classroom curricula, clearly lead to good jobs for participants and cut training and production costs for industry. More people became skilled and ready to hire in this high-growth industry - and more are enrolling now.

Community Colleges have long been known as the most direct route to transfer new skills to students and job-seekers throughout the nation. These community-driven, state-supported institutions share mutual goals - they consistently deliver workforce upgrades that benefit their own regional economic development. But they also all face common obstacles in attaining them. Bringing colleges from different regions and with different biotech industry expertises together in the NCBW opened new ways to overcome such obstacles by communicating and profiting from each other's unique experiences, ideas and solutions.

The professional community college educators who run the Centers of Expertise (CoEs) know how to develop, implement and disseminate new curricula and course materials that get students skilled and aligned with current industry needs. These are people experienced in fostering partnerships among local community groups, colleagues, plus their own counterparts within the industry.

Activities of the National Center for the Biotechnology Workforce (NCBW) began and these individual community colleges formed themselves into a dedicated leadership organization in biotech education and training. Initial meetings produced consensus on a national strategy that would engage and help overcome training obstacles, primarily through active, engaged and motivated stakeholder partnerships.

The National Center for the Biotechnology Workforce unites community colleges accomplished in biotechnology arenas into a coordinated network with three broad goals:

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

These goals are achieved through work in four primary areas:

- development of industry partnerships;
- curriculum development;
- workforce training;

- outreach and dissemination.

Activities at each Center of Expertise include:

- initiatives and faculty support to help produce programs, partnerships, and materials for biotech training and education;
- sharing resources and setting up dissemination avenues to facilitate recruiting and replication for these programs and materials.

Forsyth Tech - Research and Development
The primary use of biotechnology in North Carolina is in production of pharmaceuticals, especially research and diagnostics. The college prepares students with skills to work in this field and others. It also helps provide career opportunities with its two-year Associate in Applied Science degree program in biotechnology.

NHCTC- Biomanufacturing
The New Hampshire Biotechnology Education and Training (NHBET) Center was created to train biotechnicians in the tools, processes, and regulatory structures of the biomanufacturing industry. NHCTC is also an NSF ATE Center for Biotechnology Education, a Northeast center for Bio-Link. The program also trains faculty and teachers from community colleges, four year colleges and high schools with hands-on biomanufacturing skills in its high-tech labs.

BCC - Life Science Informatics
This CoE works with industry to develop biomedical informatics skill standards and curricula for community and technical colleges and high school learners. Its primary goal is to create industry-relevant learning for Washington's new, incumbent and displaced workforces in the important field of biomedical informatics.

IHCC - Agricultural Bioprocessing & Renewable Fuels
The program prepares workers for the robust Iowa biotechnology industry – including production of ethanol and other biofuels. Training is crucial for continued growth of this industry and vital to the nation's future. One example is its Process Control Certificate that enables flexible schedules for students and can be completed for employment in six to nine months.

MCC - Bioprocessing Training
Courses provide both theoretical background and practical experience necessary to gain employment in the bioprocessing industry. Career options include research, development, quality control and assurance, manufacturing, analytical testing, and work as a lab technician. San Diego County has up to 500 biotech companies and needs new workers 24/7. The short courses the college provides, using its new training facility, help students fill these positions.

National Center Office (NCO), located at Forsyth Tech, supports and coordinates the work of each Center of Expertise by fostering communication, arranging meetings and sharing ideas and innovations. The National Center administers a program, strategically targeted, with specific industry areas and geographic locations in mind. It helps each Center identify needed resources and then obtain them. By

supporting each individual Center's dedication to providing training services, skills standards, curricular products and models, the biotech industry's growth as a whole benefits.

The NCBW connects to the public workforce system through the Employment & Training Administration (ETA) Business Relations Group, regional and local workforce development staff. The Center also interfaces with other national organizations and federal agencies such as the White House Office of Science and Technology, U.S. Department of Commerce, American Association of Community Colleges (AACC) and the League of Innovation as well as the appropriate state and regional entities.

Responsibilities of the National Center cross multiple platforms and engage broad categories of existing and potential stakeholders in the outcomes of its grant activities. The activities selected for the table below represent a matrix of coverage coordinated through the work of all five centers plus the National Center Office.

Figure 1. Selected activities of the Regional Centers of Expertise and NCO by program goal

	Goal 1: Build regional biotech training capacity	Goal 2: Define technical skill standards	Goal 3: Develop and disseminate best practices
BCC	Science building construction Purchase of gene sequencer U. Washington faculty provide subject-matter expertise Founding membership in Washington Life Science Industry-Education Council Life sciences trends analyses for college program builders Flexible suite of curricular elements compiled & posted	Create rapid development of skills standard model Create a model for prior learning assessment. Create Medical Informatics Curriculum Guide Develop faculty support modules. Career pathways developed with the Washington State Office of the Superintendent of Public Instruction. State Skills Panel participation	Created Washington Life Science Education Advancement Partnership: community college and university partners reach high schools. Named Northeast Vocational Area Cooperative bioinformatics campus for Biomedical Skills Center. Comprised first regional advisory board for ten college health information programs. Hosted first-ever forum for high school and community college life science educators. 25+ interactive presentations Pilot use of emerging online tools, podcasts.
Forsyth Tech	300+ biotech student enrollment Articulation agreements with two- and four-year colleges and universities Tech Prep initiatives with local high schools Good job placement rate at Piedmont Triad companies, universities and medical center research labs Helped start and run NC Bio Network Pharmaceutical Training Center	Collaborative research efforts with principal investigators at Wake Forest Univ. HS and MWG Biotech. Specifically designed course modules prepare students for entry-level technician jobs. Chromatography Processes short course for students as well as currently employed technicians. Experimental Animal Handling short course created. Hands-on internships required.	Train-the-trainers programs for community college instructors Meet quarterly with advisory board composed of leaders with stakes in the biotech industry. Hosted February 2006 symposium on Bio-processing & Biomanufacturing Training. Resulting reports in *Biotech Resource Line,* national newspaper for community colleges *The Community College Times plus* local press.
IHCC	Mobile biotech lab visits more than 56 high schools Develop video conferencing and online classes to boost access 50% enrollment increase More than 12,000 incumbent workers receive training 264 K-12 teachers lab-trained Increase access and use of IBTC Pilot Plant by industries, Articulation agreements developed	Developed Iowa Biofuel Training International (IBTI) Certified courses Courses include Intro to Process Control, certificate in basic lab skills SOPs to facilitate technical assistance Ethanol production training created with input from plant builder and software designer. Training needs assessment for ethanol plants developed to shape curriculum for new 2-year degree in Ethanol Plant Maintenance	Co-sponsored eight major conferences reaching 2000+ Presented at 10 events to reach teachers, students, workforce developers, out-of-state colleagues and general public Iowa BioDevelopment website Workshop presentation at pre-BIO 2005 community college program for ~ 50 attendees Presentations at BIO 2006, 2007 Meet quarterly with advisory board composed of leaders with stakes in the biotech industry.
MCC	Only recognized, bioprocessing training in S. California Created tenure-track faculty slot Articulation agreements Customized training for incumbent workers Facilitates student internships. Ninety-five percent of students reach goals of work or transfer.	All existing biotech courses reviewed and revised, and new curriculum developed Industry-driven development of Certificates of Achievement, Certificate of Competencies and A.A. degrees in biotech	Courses and curricula put online Demonstrations for elementary & middle school students Presentations for teachers, industry representatives and general public Meets with industry advisory committees, responds to changing needs MiraCosta belongs to BIOCOM San Diego industry organization, education and workforce development committees
NHCTC	60 biotech majors/year 75 program graduates 200 incumbent workers trained New equipment cuts student-to-equipment ratio by 75% Grant-hired faculty member's salary assumed as of 1/1/08 Reverse articulation arrangement with UNH.	Ten biomanufacturing jobs added to National Apprenticeship Program Apprenticeships funnel high school graduates into A.S. Biotech program Consult with global biomanufacturing industries, develop skills standards, plan and build curricula materials for ten required biomanufacturing jobs. Two Biomanufacturing Apprenticeships developed, registered Global Biomanufacturing Curriculum (GBC), under development	DOL Apprenticeship Program regionalized in 12 NE states NE Biomanufacturing Institute Incumbent Worker Training BIOMAN Conference 2006, 2007 Community college program at BIO 2006, 2007 Presented at annual meetings of the League of Innovation in the Community College and the American Association of Community Colleges Posters featuring new apprentice program sent to high schools to build awareness of career paths

	Goal 1: Build regional biotech training capacity	Goal 2: Define technical skill standards	Goal 3: Develop and disseminate best practices
National Center Office	New technology building opens at FT, w/ 17,000 SF lab space Secured grant to gather biotech graduate outcomes Foster beneficial cooperation	Coordinate curricular development, training resources and materials Intellectual property study Service workers study	Coordinate strategic plan for outreach and dissemination More than twenty national presentations in cities across the US, plus many more local presentations. Create, maintain web site www.biotechworkforce.org Publications, videos, resources available online.

Education and Training Partnerships

The National Center for the Biotechnology Workforce developed strong links among its five partner Centers of Expertise and beyond.

Regional collaborations fostered by the NCBW created articulation and other agreements among community colleges, educational institutions, employers and other economic development stakeholders involved in biotechnology. These relationships increased the capacity and enrollments of biotechnology trainees. Agreements and connections with high schools were also initiated and continue.

ETA Grant funds were used to convene regional and national meetings with member community colleges and other training providers and stakeholders involved in serving the entire biotechnology industry by preparing technician-level employees. Partnerships among educators and employers were initiated, refreshed and energized by these events, with benefits of improved training.

The NCO worked with partners to develop a network that provides equipment for training needs. Models were developed for partnerships in the use and re-use of labs and other equipment for production and research with businesses, high schools, colleges and universities.

The NCBW maintained relationships with numerous national and regional organizations that added resources for its national network; these include DOL/ETA; NSF; Bio- Link (NSF sponsored training initiative for biotechnology); Performance Institute: San Diego Workforce Partnership; BIOCOM of San Diego; NC Biotech Center; BioNetwork of NC; NC Biosciences; League for Innovation; plus relationships with the international Biotechnology Industry Organization; among many others.

Innovative programs to track recruitment, training and post-training information using student applications, enrollments and graduations, plus incumbent and new worker data, was a priority. NCBW activities not only accrued and developed stores of new data, they distilled this information into useful, shareable knowledge for effective strategies in reaching future goals. For example, the NCO secured the first grant in North Carolina to look at biotechnology graduates' workforce outcomes. The National Center Office was also awarded a grant from the NC Biotechnology Center to study what training would be required for non-lab staff members working around laboratory environments.

Access to this previously unavailable information about training helps drive and improve results in programs and recruitment. It also aids economic development advocates in the communities as well as planners in the industry itself. Understanding labor market information and trends helps educators to grow their programs and be in a better position to help employers as partners. With human capital

emerging as a most crucial global competitive factor, employers need such lower cost community college services to help obtain, train, and retain high-skilled workers who can meet pressing demands of their rapidly growing businesses.

All these activities are documented further in the individual CoE sections of this report, in the profiles on www.biotechworkforce.org; and in the issues of the *Biotech Resource Line*, the videos and other resources found at the same web site.

Industry Partnerships

Each Center of Expertise is organized with its own, regional board of advisers, including representatives from biotech industry employers. The NCBW program helps ensure activities and contact cycles are set up and coordinated with regular partnership meetings held. Industry and community round tables and initiatives are scheduled. Educators often serve with industry leaders in state appointed regional economic development enterprises. Industry representatives often speak at or otherwise contribute to community college programs and events. The Centers develop and maintain industry partner contact database and partner files.

Tim Bertram, Senior Vice President for Science and Technology of Tengion, Inc., in Winston-Salem, said that the Forsyth Tech Center turns out “hands-on graduates who can be trained in half the time” in the new, sophisticated techniques of regenerative medicine that his company employs.

The NCBW was active at the annual worldwide Biotechnology Industry Organization (BIO) meetings, conducting Community College Programs at the last three such industry conventions. The Centers of Expertise presented together to a national, and increasingly international, audience during these meetings.

Figure 2. Center of Expertise Partners, by Stakeholder Focus

CoE	Employer	Economic Dev.	Educational
BCC	Airex , Amgen, Arkitek, Battelle, Cerep, Christensen, O'Connor, Johnson, Kindess, PLLC, Columbia Primary Care, Computer Associates, Craic Computing, Deaconess Hospita, ECG Management, Envision Consulting, Etubics, Fred Hutchinson Cancer Research Center, Geospiza, ICOS Corp, Illumigen Biosciences, Inc, Inland Imaging, Inland Northwest Health Services, Insilicos, INTEC, Institute for Systems Biology, Microsoft, Nanvapor U.S.A., Pathology Associates Medical Laboratories, Rosetta Inpharmatics, Userspacei, Valley Medical Center, VizX, Zymogenetics	Community Health Assoc. of Spokane, Washington Dept. of Community Trade and Economic Development, U.S. Senator Maria Cantwell's Office, Seattle/King County Workforce Development Council, Snohomish County EDC, Washington State Hospital Association	Columbia University, Seattle Biomedical Research Institute, Pacific Northwest National Laboratory, University of Washington
Forsyth Tech	Banner, Corn Products International, En-Case Analytical Laboratories, Finetex, Inc., LabCorp Prosperon Pharmaceuticals, MWG Biotech, Targacept, Inc., Tengion, TransTech Pharma, Inc., Wake Forest University School of Medicine	Action Greensboro, Greater Winston-Salem Chamber of Commerce, High Point North Carolina Economic Development Corporation, The Piedmont Triad Research Park, NCBIO, Piedmont Triad Entrepreneurs Network, Piedmont Triad Partnership	Alamance Community College, North Carolina Agricultural & Technical State University, North Carolina Community College System BioNetwork, Salem College, Simon G. Atkins Academic & Technology High School
NHCTC	Lonza Biologics, Wyeth, Bentley Pharmaceuticals, Stryker Biotech, Bio-Concept, Wunderlich-Malec, Glycofi	DOL Apprenticeship Office, Biotechnology Industry Organization	Seacoast School of Technology, Milford High School, Nashua High School, University of New Hampshire
IHCC	Ajinomoto Food Ingredients, Ajinomoto Heartland, Alliant Energy, Cargill, Garst Seed, Genencor, Kemin Industries, MidAmerican Energy, Phytodyne, Pioneer Hi-Bred International, Wacker Biochem Corporation, Wapello County	Indian Hills Regional Development Corporation, Iowa Biotechnology Association, Iowa Economic Development, Iowa Renewable Fuels Association, Iowa Workforce Development, U.S.Dept. of Agriculture - Rural Development, U.S. Dept of Commerce - Economic Development Administration	Des Moines Area Community College Southern Prairie Area Education Agency,
MCC	Beckman Coulter, BiogenIdec, Broadley-James Corp., Caltrol, Cardinal Health, DPR Construction, DynalectricCo., Emerson Process Management, GE Healthcare, Genentech, Genprobe, Hope Engineering, Invitrogen, Irvine Scientific, Lab Trader, McGraw/Baldwin Architects, Molecular Medicine Bioservices, Nova Biomedical, Pro-Tech Process, Randall Lamb, SD Analytic, Siemens Building Technologies, Smith and Nephew Wound Management, STERIS Corp.	International Society of Pharmaceutical Engineers, Statewide Biological Technologies Initiative	The Southern California Biotechnology Center, University Mechanical & Engineering Contractors

Skills Standards / Curriculum Development

Strong partnerships between educators and employers, fostered by the NCBW, helped create comprehensive, demand-driven competency models that are current and accurately address immediate needs of industry. Validated in the workplace, this process was designed to continue; upgrades, for new modalities and focuses in curricula are part of these initiatives.

Defining technical skill standards for biotechnology sectors was a first step in the NCBW strategy to improve biotech training for new and incumbent workers. In close association with industry, the NCBW conducted regional and national focus groups to explore emerging job requirements and needed skills. Job descriptions were created based on agreed-upon skill standards and competency models for each functional area identified as required.

For example, Dr. Sonia Wallman at NHCTC worked with Northeast biotech companies, many of which are global, and the Northeast Biomanufacturing Center and Collaborative (NBC^2), to develop competencies for ten targeted biomanufacturing jobs. Working together to include education, employer and economic development representatives, the Northeast Biopharmaceutical Manufacturing Industry Skill Standards were finalized and published on January 31, 2005.

The DOL Center of Expertise in Biomanufacturing used the skill standards to develop new curricula, instructional materials and resources for both students at the NHCTC programs and incumbent technician training short courses. The skill standards were also used to develop ten competency based Biomanufacturing Apprenticeships, two of which have been registered as U.S. DOL Apprenticeships: Biomanufacturing Technician Upstream and Biomanufacturing Technician Downstream.

Skills standards rapidly developed in all regions are now employed and monitored in working relationships between industry employers and educational resources. Community economic development resources are involved in advisory roles. Complete new courses were developed and offered in partnership with local industry. The NCBW helped develop national and regional partnerships that can keep these courses and skills standards current through follow up industry validation studies. Students, in their evaluations, indicated willingness to return and take similar courses after graduation.

CoEs continue to monitor what companies are doing, who may be moving into the region, who is hiring, where they are, types of jobs offered and potential income levels. It's a network operating locally, regionally and nationally. Program alumni working in the industry voluntarily contribute to the database, and often return to assist in community college, or other events. Such visible alignments with employers help recruit students and job candidates.

In the Pacific Northwest region near Seattle, for example, Patricia Dombrowski, Director of the Center of Expertise for Life Science Informatics at Bellevue Community College, spearheaded creation of the Life Sciences Industry-Education Council. This first-of-its-kind advisory group includes CEOs, executive directors, company presidents, college presidents, university chancellors and school superintendents. Washington State Governor Chris Gregoire incorporated the initiative into her

Comprehensive Bioscience Strategy, and the Washington Biotechnology and Biomedical Association now hosts it. In December 2007, the council's steering committee recommended that council projects use Dombrowski's model for aligning life science education at every level throughout the state.

Incumbent Worker Training

Working partnerships with industry helped the CoEs create advanced short courses both for incumbent workers and program participants. All CoEs reached out and served many incumbent workers who were ready to increase skills. MCC created certificate programs specific to industry; IHCC brought custom training to more than 12,000 workers in its thriving bio-fuels program; and NHCTC supplied aseptic training to workers at Lonza's nearby biomanufacturing plant on a regular schedule.

Cooperative Education

Cooperative education with industry, facilitated through the NCBW, results in more hands-on, actual workplace opportunities for biotech students.

Everyone agrees this strategy meets immediate needs for trained workers with appropriate skills much better than more classroom-focused methods because candidates who prepare in actual work situations arrive ready to begin productive work. Hands-on training in groups, using multiple versions of high-tech equipment in labs that duplicate actual workstations, facilitates transfer of skills. Plus, lessons in group dynamics and other intangible skills, so crucial in timely, sensitive, sequentially linked and interdependent processes of industrial biotechnology, can also be given.

New apprenticeship and internship programs created through the grant, in concert with industry, are mutually beneficial and sustainable. They combine valuable experiences in the workplace with mentored academic guidance and progressive training while on-the-job. Results accelerate employability for more students.

One of the first Biomanufacturing Apprentices matriculated into the A.S. in Biotechnology degree program at New Hampshire Community Technical College in fall 2004. This "pilot" person apprenticed at Lonza full-time in summer 2005 and part-time in fall 2005. She continued to work part time at Lonza as she worked to complete her A.S. degree (the first in her family to do so) in April 2007. She was subsequently hired as a Purification (Downstream Processing) Operator 1. She will continue her education now with support from her employer.

More applicants continue to matriculate into the NHCTC program and begin their apprenticeships. Industry provides stipends for training in this program and it is being replicated throughout the Northeast.

A Forsyth Tech internship at Wake Forest School of Medicine (where Dr. Anthony Atala constructs new bladders from a person's own cells) put a 57-year old job-changer to work on core tissue culture techniques. He is now employed as a research lab technician at the Wake Forest Institute for

Regenerative Medicine.

Pilot projects engage educational institutions in useful, industry-guided collaborations. These projects offer quality, cut-rate product development or other process assistance that can be done in small scale and produce big results for biotechnology entrepreneurs and businesses. Students gain hands-on experience working directly with professional mentors, and their results, once proven and ready to scale up, could mean more jobs. This model, employed by the NCBW, produces "win-win-win" situations for students, employers and educators involved.

Along with state-of-the-art equipment and group training techniques, student participants gain hands-on experience working shoulder-to-shoulder with industry professionals in actual workplace situations. Job seekers can advance their careers in these projects while employers gain workers trained in timely skills very specific to their needs.

One example of this collaboration is a new biofuel related pilot plant project at IHCC developed in partnership with industry. An experimental process piloted by students is being evaluated for use in a major biofuels plant. This winning concept is proving to be a model generating interest among other community colleges and stakeholders around the nation and the world.

Upgraded, industry-specific equipment, available in sufficient student ratio numbers, also enables real time professional laboratory opportunities. Hands-on educational experiences gained in such well-equipped and staffed laboratories produce graduates ready to work and greatly assist industry. Agreements are in place for industry to donate their high tech equipment to educational and training programs. Motivated industry underwriters help expand statewide biotech workforce training by region.

More details, case studies and examples of cooperative education underway are presented in the individual CoE reports, and on the website www.biotechworkforce.org.

Outreach

Youth, educators, and job seekers lack clear information about career options within the biotechnology industry and generally fail to understand the depth and range of the industry's activities. This disconnect is a challenge for the industry because the lack of definition and outreach limits the number of people who consider the biotechnology field to be a viable career option.

The NCBW helps develop clear "on-ramp" programs attractive to high school students, returning students, incumbent or transitional workers. It facilitates outreach and dissemination of opportunities in biotechnology, making entry points or ladders of job progression accessible to potential workforce candidates. Numerous programs are underway around the nation, many supported by grant funds, that reach out to candidates of all types. They feature visible articulation pathways through community college systems and four year institutions that lead to good-paying jobs with career potential.

The five centers are involved in local and regional activities, such as New Hampshire Community

Technical College's annual BIOMAN summer institute for biotech teachers; Bellevue gives interactive presentations and receives requests for consultation at high schools; MiraCosta conducts regular high school & industry outreach; the Indian Hills Science Educational Mobile Instruction Lab (SEMI) tours the state doing high school teacher training; and Forsyth Tech's Summer Science outreach program and Biotech Academy reaches dozens of young people.

NHCTC also ran a creative poster campaign in regional high schools; IHCC's mobile unit traveled to 56 schools in Central Iowa and introduced scientific concepts to more than 3,000 students who wouldn't know about biotechnology otherwise.

These initiatives continue to reach many middle school and high school students. They and their teachers are being exposed to the interesting careers that biotechnology can provide with community college level training.

Community college outreach partnerships with industry include hands-on teacher and student workshops, biotechnology company tours, plus speaking engagements and presentations.

Dissemination

Each CoE program was created to be further utilized by other colleges or institutions in the United States, assuming adequate resources. The NCBW delivered on its strategic plan to create a web-based program, accessible to those who seek guidance or who have inquiries about such state-of-the-art programs and practices. Colleges and organizations, not members of the NCBW, are using these models to help create their own curriculum and programs now.

A powerful web site was developed through professional web master Tim Dubuque, working out of NHCTC. Two web sites are used to connect people seeking NCBW tools and resources. They are www.biotechworkforce.org and www.workforce3one.org.

The National Center Office (NCO) coordinates a strategic, national dissemination plan with priorities and tactics. This plan includes an informative multimedia approach, using professionally produced videos, white papers, profiles and other links and resources, all highly useful to anyone working in biotech workforce training and accessible online at www.biotechworkforce.org. Known as a strong, innovative partner working for the betterment of biotechnology training across the country, the NCBW was frequently invited to deliver numerous presentations, including in DOL/ETA webinars and at other national conferences and meetings related to the biotech industry workforce.

The NCO projects this "trusted partner" national brand identity through dynamically developing and regularly refreshing the useful content on its national website www.biotechworkforce.org. The NCO developed a unique "human capital" newsletter called the *Biotech Resource Line*, circulated to community colleges, workforce partners and investors. Generating well-read profiles concerning the NCBW and its related activities, including videos, and making them easily accessible online, reinforces the NCBW brand among biotech training providers and consumers, while helping to deliver services and fulfill its mission.

The US Department of Labor conferred a Recognition of Excellence, Honorable Mention, in the category of "Educating The 21st Century Workforce" in 2006 and the NCBW was recognized by the Piedmont Triad Biotechnology Advisory Committee, Winston- Salem, NC, March 2007 for "Support and Leadership Service Excellence."

The NCBW invited 24 biotech teachers from around the country to participate in the first ever "National Biotech Teachers Fly-In," hosted by Forsyth Tech in N.C., Oct. 17 -19 2007. Together, the teachers explored a series of workshops and events designed to advance their pursuits of a highly skilled, 21st century biotech workforce.

Numerous interactive presentations and demonstrations were conducted by all five CoEs, including "train-the-trainers" efforts for biology teachers, in regional collaborations and events. Forsyth Tech offers prep initiatives with local high schools and IHCC took 264 K-12 teachers into labs for training. NHCTC instituted its annual BIOMAN institute that attracts dozens of biotech faculty from two and four year colleges and universities, plus high school teachers, from multiple states, for a week long event that features keynote speakers, a vendor show, panels and hands-on workshops piloting instructional materials.

The NCBW is committed to improving access to biotechnology technician training through video conferencing, online learning and other practical media innovations. The BCC informatics program, for example, developed its own podcast and makes use of social networking sites such as Facebook.

In its final conclusion, the independent evaluator's report says: "all will continue to provide both conceptual blueprints and personal guidance for business, education and workforce development partnerships throughout the nation. The National Center for the Biotechnology Workforce successfully used its High Growth Job Training Initiative Grant to demonstrate a replicable model for providing demand-driven job and workforce training on a regional basis in discrete sub-sectors of biotechnology. Using these best practices, the demand-driven model evaluated here would also be likely to succeed if it were deployed into new regions that supported different sub sectors of biotechnology."

SECTION III: GRANT OUTCOMES

Education and Training Partnerships

The National Center for the Biotechnology Workforce performance goals were to foster working partnerships and gain consensus on most-needed skills, create new competency models for learning, upgrade existing and initiate new training networks and infrastructures. Strategic and tactical plans were designed and agreed upon by the Centers of Expertise and their partnerships within each region.

Courses, training modules and components to help teachers transfer needed skills and improve the biotech workforce were then planned and implemented quickly. These teaching resources were created to be easily replicated by other institutions faced with similar biotech training needs.

One of the most critical goals was to generate industry and other forms of support. This goal was met, as mentioned above, with a return of two dollars in leveraged resources for every ETA dollar invested.

Strategies to improve, initiate, and grow biotechnology training programs were successfully executed; infrastructure and equipment was upgraded; degree programs and articulation agreements identified clear career paths; cooperative education initiatives in conjunction with industry increased hands-on, actual workplace experiences. Visible links to the biotech industry, with good-paying jobs and career possibilities, assisted participants in finding jobs and helped boost recruiting efforts.

New facilities to accommodate increasing space needs for associated programs were constructed and completed. Newly constructed labs and classrooms were put into operation. Grant funds were used to furnish new labs with state-of-the-art equipment; all items budgeted for were purchased, installed and are currently in use.

Certificate programs and short courses geared towards incumbent workers and industry's immediate needs were concurrently developed and implemented. New apprenticeship and internship arrangements were initiated that were conducive to the "hands-on team player experience" and offered year after year for the mutual benefit of all the participants. New regional collaborations among community colleges, secondary schools and four year institutions of learning were started or strengthened.

As detailed in the accompanying individual reports of the five CoEs, and noted in the independent evaluator's report, this grant partnership "significantly exceeded numerical targets for important programmatic outputs, including businesses served in each individual region, workers trained, matriculants in certificate and/or degree programs and potential new students reached through the various outreach initiatives funded by the Department of Labor grant."

Not only did numbers of skilled technicians produced at the regional centers increase, the NCBW grew into a real network of community colleges that connected educational, economic, and employer partnerships.

Establishment of such enduring partnerships in workforce training between local biotech companies

and academic institutions continues to generate employment opportunities for community members. Surveys of employer partners in the biotech industry, and student surveys as well, confirm satisfaction with the outcomes of their investments and participation.

The international biotechnology giant, Cargill, for example, considers the training of bioprocess technicians to be the number one success story of its partnership with Iowa's NCBW Center of Expertise for Agricultural Bioprocessing & Renewable Fuels Training. When their cooperative eight-week internship program ends on a Friday, graduates typically start working with the company full-time the following Monday. According to Marvin R. Knoot, Technical Training Coordinator, Health & Nutrition, for Cargill in Eddyville, Iowa, these new workers have noticeably higher levels of skills and knowledge than new employees who did not go through the program.

Leveraged Resources

Because America's need for trained workers to remain globally competitive in biotechnology is widely recognized; and because the nation's community college system is known for being able to attract, enroll, and transfer such needed skills quickly, the National Center for the Biotechnology Workforce was able to attract willing supporters and succeed in generating grants, contributions and committed assistance from numerous sources.

Evidence of the strong market forces at work in meeting this critical need for trained workers is the NCBW's healthy return of doubling every ETA dollar invested in leveraged resources. The return on ETA investment is a flexible and responsive system that effectively supports workforce improvements in biotechnology across the nation.

The grant opened the door for more networking, training and lab equipment grants and donations. Details on these productive partnerships are contained in the individual CoE reports. Highlights are:

New Hampshire Community Technical College (NHCTC)
Major additional grants from DOL and NSF, totaling nearly $5M, extended the reach and capabilities of this CoE in advancing biomanufacturing workforce in partnerships initiated throughout the Northeast.

Neighboring partner Lonza, the Swiss-based leader in biopharmaceutical manufacturing worldwide, contributes significantly to the NHCTC biotechnology program. It pays for two to three biomanufacturing apprentices a year. Lonza also pays the department $1,500 per graduate it hires, upon reaching three months on the job. This money is used for scholarships for other students pursuing biomanufacturing careers.

Center Director Dr. Sonia Wallman worked with the Biotechnology Industry Organization and its Education and Outreach Committee to integrate well-attended, industry-supported Community College Programs at annual BIO conventions. Dr. Wallman's program linkage with Ireland was supported by the American Association of Community Colleges and FAS, the National Training and Employment Authority of Ireland.

MiraCosta Community College (MCC)
Biotech giant Genentech, with a major manufacturing facility located near the college, contributed nearly a half million dollars in faculty and infrastructure support, including the construction of the college's new biotech teaching facility. Genentech also contributes to student scholarship funds.

Architects, engineers and contractors from the region, all members of the International Society of Pharmaceutical Engineers (ISPE), embraced the MCC teaching facility project and provided services free or for much reduced fees.

MCC's grant-supported biotechnology program leveraged support from the college itself. More than $180,000 was invested from the college's general fund money in building the biotechnology/ bioprocessing program. In addition, the college created a tenure track faculty position in bioprocessing (initially sharing this cost with Genentech); institutionalized a classified laboratory technician; and set an instructional budget to support the program.

MiraCosta worked with the San Diego Workforce Partnership (SDWP) to provide customized training outside normal college degree curriculum. The SDWP contributed funds to retrain displaced electrical workers in biotechnology, resulting in a 95% successful placement rate. With support from the SDWP, the college also delivered contract instruction to incumbent workers of Invitrogen

Bellevue Community College (BCC)
Recognized as the Information Technology Center of Excellence for Washington's 34 community and technical colleges, BCC's new designation as one of two Microsoft IT Showcase Colleges in the nation is due, in part, to its CoE Life Science Informatics effort. As a result, the program was given special access to formative resources within Microsoft. These resources were extremely valuable in forecasting community college programming needs and in completing deliverables.

BCC's two primary industry collaborators, the Health Information Systems Society and Geospiza, advised, contributed to and reviewed all deliverables. The resulting skills standards and informatics products bear a strong industry bias, one the CoE fostered and encouraged.

The Seattle/King County Workforce Development Council (WDC) assisted BCC throughout the course of this grant. BCC benefited greatly from the WDC's extensive network of contacts and projects in the life science sector. Bellevue was awarded a grant from the WDC to develop and present biotechnology workshops for high school science teachers

A gene sequencer was purchased through an industry grant and college Foundation funds. This essential link to life science informatics is an important part of the CoE's mission. The sequencer is housed in a new science building. These life science and informatics resources will serve high school students from nine districts, as well as BCC's own learners.

Forsyth Technical Community College (Forsyth Tech)
A series of four NC BioNetwork and NC Biotech grants, totaling over $200,000 helped purchase lab equipment and strengthen Forsyth Tech into the largest biotechnology training program in the state.

A North Carolina Biotech grant was obtained for a specialized voluntary tracking system of students and graduates of the biotechnology programs in the NC BioNetwork system. This Student to Workforce study was the first of its kind. This grant was very novel in approach and includes a Bio- Link partner, Alamance Community College.

A NCBW Center sub-recipient grant for $160,000 was geared at strengthening the eight NC partner community college consortium for biotechnology training under the national grant.

Indian Hills Community College (IHCC)
Contacts with executives at Fagen, the largest builder of ethanol plants, and Novatech, a software designer whose programs are used to run the plants, were used to develop ethanol production training programs from their inception.

The Cargill donation of two New Brunswick 80L Fermenters, at an estimated value of $93,000, set a needed stage for project scale up from the four 13L bench top BioFlo bioreactors to the 150L fermentors.

The pilot facility continues to grow with the addition of an entrepreneur in Ames (Glycon/BiOva) who is using the programs BioFlo 110 equipment with our students when they fulfill internships.

Indian Hills has other DOL and NSF grants. Its projects run concurrently and enhance each other. For example, the NSF grant has established the fermentation virtual reality training facility. The first iteration of the device can be used to teach fermentation concepts while later iterations will be used to teach ethanol plant employees in optimization and problem solving skills.

The college general fund is a leveraged resource. Two of the college's staff personnel are paid 60 percent from another DOL grant, and another staff person is paid 50 percent from that grant.

National Center Office (NCO)
The Demand Driven Biotech Workforce Training Videos were produced by utilizing in-kind donations of time, space, and people.

The NCBW attracted strong interest and advocacy from additional community colleges and industry partners, not among the original five, to help expand production of skilled biotechnicians in other regions of the nation.

Given the worldwide operations of some of the partner biotech companies involved, and the scope of other companies yet to benefit from the grant's successful demonstration of demand-driven training, prospects emerge for leveraging an international market in training support that could extend the proven concept the NCBW has validated.

Figure 3: NCBW Leveraged Resources

BELLEVUE COMMUNITY COLLEGE	
MEDICAL INFORMATICS STATE	$511,001.00
NSF STRENGTH CONNECTIONS GRANT	$260,878.00
BCC 46.1% COLLEGE INDIRECT LEVERAGE	$260,184.00
TOTAL LEVERAGE	$1,032,063.00

MIRACOSTA COMMUNITY COLLEGE	
GENENTECH FACULTY SALARY CONTRIBUTION	$200,000.00
GENENTECH FACILITIES BUILDING DONATION	$250,000.00
INTERNATIONAL SOCIETY OF PHARM ENGINEERS	$80,000.00
SAN DIEGO WRKFORCE PRTNRSHP LIFE SCIENCE	$173,220.00
CMTC INCUMBENT TRAINING	$55,000.00
MCC PERSONNEL MATCH	$180,000.00
TOTAL LEVERAGE	$938,220.00

- NCBW BIOMANUFACTURING

NEW HAMPSHIRE COMM. TECHNICAL COLLEGE	
DOL GRANT CBJT bioCONNECTnh	$1,999,040.00
NSF ATE NBC2	$2,998,015.00
APPRENTICESHIP MENTORING	$216,000.00
APPRENTICESHIP PROG. THRU NBC2	$100,000.00
NY WIRED APPRENTICESHIP AT FLCC (NBC2 Hub)	$280,000.00
CHROMATOGRAPHY COLUMNS & TFF SKID	$180,000.00
APPLIED BIOSYSTEMS PCR MACHINE	$12,000.00
BIOPHARMACEUTICAL MFG. SKILL STANDARDS	$25,000.00
TOTAL LEVERAGE	$5,810,055.00

- NCBW RESEARCH & DEVELOPMENT TRAINING

FORSYTH TECHNICAL COMMUNITY COLLEGE	
NC BIOTECHNOLOGY CENTER-Evaluate Non-Credit Courses	$8,852.00
NC BIOTECHNOLOGY CENTER - Training Outcomes	$72,776.00
GOLDEN LEAF - ROUND I with GUILFORD TECH CC	$320,000.00
GOLDEN LEAF-BioNetwork Grant-Purchase Lab Equip.	$149,229.00
GOLDEN LEAF-Bionetwork Grant - Lab Equipment	$18,417.00
NEW BLDG: IN-KIND FACILITY USAGE - Classrooms, Labs & Offices	$518,312.88
TOTAL LEVERAGE	$1,087,586.88

10,163 sq. ft. x $17 sq.ft. = $172,771 / 12 = $14,397.58 p.month x 36mos = $518,312.88

NCBW AGRICULTURAL BIOPROCESSING & Renewable Fuels

INDIAN HILLS COMMUNITY COLLEGE	
IndustryTraining	$93,392.00
Charges for courses	$66,610.00
Assistance from industry	$18,684.79
Donations	$107,000.00
Collaborations	$340,000.00
Other DOL Biotech Grant	$994,551.45
TOTAL LEVERAGE	$1,620,238.24

TOTAL NCBW LEVERAGE TO DATE $10,488,163.12

Education and Training Outcomes

Each Center of Expertise program took recent high school graduates, dislocated workers, returning students, and job candidates in other categories and prepared them for careers in biotechnology.

Each increased its capacity, capabilities and numbers of students and successful graduates as a result of its participation in the grant. Among the highlights:

MiraCosta Community College (MCC)
Built capacity for hands-on instruction in a novel course focused on validation. Product and process validation continue to be challenges for industry and practical training for this type of work is a burden that must be carried by individual companies in expensive forms of on-the-job training. This course provides both theoretical and practical training to become qualified to work in validation.

MCC developed model lessons for online and hybrid instruction in bioprocessing. A challenge for many students is being able to balance work with class time. Hybrid courses moved lecture and discussion online into a more flexible format students can better fit into their schedules. Laboratory hours always remain hands-on.
Average annual biotech enrollment: 100
Biotech related degrees, certificates awarded in grant period: 70

New Hampshire Community Technical College (NHCTC)
Established the first DOL Registered Biomanufacturing Apprenticeship Program with long-term planning, dedicated partnerships, resources, work, and persistence. Today the program reaches out to high school students and other eligible candidates; runs as a competitive program; and provides stipend incentives to both students and companies participating.

NHCTC initiated the Northeast Biomanufacturing Institute (NBI) and developed new short courses for incumbent worker training. One of them, the Aseptic Techniques course, including the popular behavioral videotaping, is regularly given to Lonza employees at NHCTC facilities. The NHCTC program has trained 200+ incumbent workers in Aseptic Practices since Fall 2006.

There have been a total of 60 students enrolled as Biotech majors each year of the grant.
The program graduated a total of 75 graduates during the period of the grant; 20 biotechnology A.S. degrees, 11 academic certificates, 27 certificates, and 17 “reverse articulations” completing the biomanufacturing cornerstone course, BTEC 220.

Of the 75 graduates, 17 are working at Lonza in production or QC; 10 are at Wyeth in process development, production or QC; 2 are at Amgen-CA in process development; 2 are at Millipore in QC; 1 each is at Amgen-RI, Dakota Systems, Perkin Elmer Life Sciences, GlycoFi, Millenium, Parsons (Design), East Coast Validations Services, VA Hospital, Harbor Consulting, Military, Comcast; 2 are teachers; and 21 are pursuing further education at NHCTC, UNH, University of Massachusetts at Lowell, or the University of Southern Maine.

Indian Hills Community College (IHCC)
Developed online training packages for bioprocessing industries in the areas of biofuels, microbiology, introduction to biotechnology, maintenance, chemistry, math, safety, process control and industrial operations.

- Distance Learning: 69 short, one and two part, biotechnology presentations broadcast four days a week for a total of 230 hours.
- Four credit courses that fulfill biotech/ethanol program requirements are available through distance learning.
- 164 short courses are available online including Maintenance Technician: 78 courses: Plant Operation Tech: 75 courses; and Process Control: 11 courses.
- Professional Development: 264 (K-12) teachers received professional development for graduate credit or recertification earned through IHCC DOL grant.

This training benefits all bioprocessing industries and can be sustainable by offering savings and improved results for biotech companies.

- Lease pilot facility with the use of trained staff to facilitate industries and academia in the development and advancement of biotech businesses.
- Purchase and maintain equipment and continue to promote research capabilities.
- These pilot projects can also generate income.

Enrollment for the Bioprocess Technology A.S. degree program and the new Ethanol Technician A.A.S. increased fifty percent, going from 28 to 44 through fall of 2007.

- Numbers of participants successfully completing training: 22
- Total number of job placements obtained by participants: 90%
- Incumbent workers received training: 12,381

Forsyth Tech Community College (Forsyth Tech)
Short courses in biotechnology geared towards incumbent workers and prospective students were delivered in collaboration with the Continuing Educational Department. Attractive to job seekers, these courses were designed to quickly expose and prepare participants in the field. The short courses are now being offered both traditionally and non-traditionally, employing technology and distance learning features.

Processing and engineering tissues through cell sorting and manipulation are vital, growing business directions for biotechnology companies engaged in regenerative medicine. New partnerships and plans are being carried out to acquire the advanced equipment and training modules for these technologies so more graduates can secure employment with these in-demand skills.

The program started with five students in 2002 and the first graduates of the program completed the curriculum in May 2004. Most started their careers soon after. Presently, there are more than 300 students who have enrolled in the program. Enrollments typically exceed 100 students per semester. The program has graduated a total of 92 students in the four years it has had biotechnology graduates.

Bellevue Community College (BCC)
Created a suite of resources, including teaching modules and informatics skill standards, to assist community college program builders infuse existing biology classes with industry relevant technology learning. Focus has raised the bar of student biotech awareness and hands-on experience utilizing accessible bioinformatics curricular elements.

E-newsletters were sent to community college and high school biology teachers across the country focusing on the new tools available to them from this grant.

Bellevue infuses curriculum with informatics, no specific enrollments.

Competency

Competency models, which are basically lists of both hard and soft skills needed in specific biotech industry jobs, were formulated. Ways to regularly update this list, by acquiring and using feedback from employers, partners, and graduating students, were developed and shared through NCBW interactions.

Using agreed upon skills sets and competency models as guides, the first goal of the NCBW, to develop replicable curricula, was accomplished. The Centers of Expertise guided these processes to make sure their courses were tailored to the specific needs of their different regions.

Competency lists are used to recruit and orient students. They are given to employers in response to questions about particular skills students acquired.

Competency is achieved through faculty development and upgraded equipment geared towards providing more hands-on experiences in different modalities and procedures required by industry partners. Accurate documentation and adherence to formulated Standard Operating Procedures are among basic skills transferred in Good Manufacturing Practices.

Teamwork, the ability to think fast, adapt to changing circumstances, and play supportive roles for others are among the intangible, "soft" skills community colleges are good at identifying and transferring. These add to a graduate's overall competence and willingness to work in biotechnology environments.

Employability

Because biotechnology is not one discipline, but the interaction of several disciplines, the best preparation for work begins with basic grounding in fundamental science, mathematics and writing.

Factors described as key in attaining biotechnology related positions are: hands-on laboratory skills, team playing soft skills, an ability to communicate and write, plus an ability to work independently. Factors described as hurdles in attaining positions are a limited exposure to potential employers, limited job counseling, poor people skills, and lack of regional opportunities.
Nothing improves employability more than actual work experience. A major component of NCBW advancement was in creating models for placing students and other trainees in cooperative education programs so direct experiences in the workplace can be more easily obtained.

Educators and employers agree that mentored, progressive academic training combined with actual working experiences provides the best training and produces the best workers. Interviews with students and faculty show a strong belief that internships, apprenticeships and other innovative, cooperative models are most likely to lead to post-graduate employment with industry partners.

Trained technicians must be ready to work in often-rigorous industrial biotech situations that require meticulous and detailed procedures; stringent aseptic requirements; wearing gowns; cooperating and coordinating as part of a synchronized team. These skills are best realized with on-the-job experiences guided directly by accessible mentors and peers working together in groups. Also, soft skills are important because they can often be the difference in winning a good job in competitive situations.

Centers of Expertise blend the unique requirements of biotechnology with existing community college systems of support, guidance and retention to achieve high employment rates. Each CoE maintains its own contacts and database concerning area employers. Alumni networks also contribute to employment knowledge, industry relationships and cooperative education resources.

More internship placement positions with other local biotech companies and biomedical labs are being secured. Successful cooperative training programs, primarily internships, require extra efforts on the part of faculty to launch. Each position requires multiple contacts and activities to establish.

The CoEs strategically designate times to visit and share objectives with potential employers. This helps employer partners to be more aware of the program and open their companies for more internship opportunities. It translates into more jobs being offered to students and graduates.

Consultation

The NCBW is a vital and trusted resource on how to establish a biotechnology program. Leaders of the regional CoEs regularly hosted visiting delegations and representatives of educational institutions and employers seeking knowledge in setting up biotech training programs. They also traveled extensively across the nation to share experiences at national conferences or with others in biotechnology training. NHCTC, for example, established two-way links with counterpart training programs in Puerto Rico.

Faculty visit other sites as mentors and guides to help others plan. They provide experiences and best practices on the technicalities of establishing a curriculum, furnishing state-of-the-art labs, and recruiting faculty. They relate experiences on how to collaborate with other stakeholders in the biotechnology fields, such as universities, employers or government.

One key to success is that each of the five CoEs was fashioned locally, tailored to meet specific needs, but with a modular approach flexible enough to adapt to changing needs of local biotechnology employers. This enables a program developed at one center to be adapted for use at another community college.

A prime example is in biofuels. In August 2006, North Carolina's General Assembly mandated creation of a strategic plan for biofuels. Among other recommendations, the plan submitted to legislators the following April called for an annual appropriation to advance biofuels workforce development. Insights from the Center of Expertise in Agricultural Bioprocessing and Renewable Fuels in Iowa helped to inform the North Carolina plan's development, and the experiences at IHCC will likely translate directly into workforce development initiatives and teaching tools at NC community colleges in the coming years.

Other examples of consultation include:

Davidson Community College - NC	Sent a biotechnology advisor for discussions and advise on the synergy between the two colleges. Logistics of transferring students for specialty courses were worked out.
Johnston Community College - NC	How to establish a biotechnology program. The faculty visited and plans to make more visits.
Dayton Community College - GA	Sent program director, Ms. Marylyn Bowe, for a site visit to learn how to establish a Biotech Program.
Stark State University of Ohio	Dr. Jeffery Schumer (Ph.D) consulted on starting a Bioprocessing course. He was given all required materials during this visit.
Cuyahoga Community College and the Omeris (Ohio Biosciences Group)	Assisted with program development and formation. Three representatives met with faculty and toured the center.
Central Georgia Tech Community College - GA	Met with a team of specialists investigating how to start its own program in biotechnology. Program was demonstrated and questions answered included: How was the program conceived? How is the demand driven process carried out?
North Louisiana Partnership for Innovation and Rowan Cabarrus Community College - NC	Assistance in establishing biotechnology curriculum with a demand driven program
Atkins Biotech Academy (high school) - Forsyth County, NC	Lucas Shallua (and Russ Read) met with Terry Howerton, Director of the academy on ways and means of developing further articulations with the students and faculty. Howerton went to visit Salt Lake City Community College in May 2006 and met with Cr. Tami Goetz to review their biotech academy on campus at SLCC, observe vest practices, and report back as to how these can be incorporated in the Atkins / Forsyth Tech model.
Northwest Iowa Community College	Visited to discuss development of a biotechnology training curriculum for their students
Iowa secondary teacher professional development program	Biotech curriculum development
Madison Area Technical College (North Central Region Bio-Link Center)	Visited to discuss Bioprocess Technology and Ethanol Tech programs and received copies of Ethanol Plant Assessment, Shift Maintenance and Operator Job Guides to utilize in their program development.
Economic developers and community leaders	"Ottumwa Allies Day" included a facility tour and discussions of training and pilot resources.
Cargill	New training developed called "Daily Dose"
Iowa State Area Education Advancement Partnership	Media/Tech directors visited for an introduction to bioprocess technology education, especially the virtual reality fermentation program.
Salt Lake Community College; Eastfield College (Dallas Community Colleges); Burlington County College (NJ); Renton Technical College (WA)	Requested consultation regarding life science informatics program building
Texas Gulf Coast economic development researcher	Best practices in biotech program building and industry relationships
Cape Cod Community College	The dean and program chair obtained information about program start up of clinical informatics program
Life Science Education Advancement Partnership (regional educational outreach consortium for higher ed to high schools)	Published a directory of resources and held a conference for high school counselors and teachers

Dissemination

In many ways, this third goal of the NCBW is most important. While the first two goals support rapid acceleration of training capacity for job skills most in demand, the third goal is about opening people's eyes to fertile possibilities in biotechnology. Dissemination stresses the importance of keeping America competitive with a biotech workforce ready for the future.

The challenge is to alert new generations of high school students - plus other job seekers - about well-paying employment opportunities in biotechnology that are growing, and the message is that many of these jobs are at multiple levels below that of graduate-level scientists. This increase in awareness is especially important given that advanced sciences are traditionally seen as academic rather than vocational. The result has been few career paths or technical education initiatives in high tech sciences.

The NCO and CoEs developed and executed a dissemination strategy to address this in conjunction with ETA to maximally disseminate the opportunities and NCBW products and services to community colleges and the general public across America. Forsyth Tech was chosen by DOL as the site for its National Wired Biosciences Institute, February 5 and 6, 2008. Partnerships were formed across numerous communities.

Each of the five CoEs reached out to high school (and even younger) students with many activities, including forums and advanced training opportunities for their teachers; Tech Prep-type partnerships with local school systems; demonstrations; plus a mobile biotech lab that went from school to school.

The main vehicle for continuing CoE learning dissemination is the well-developed and groomed web site, designed in NCBW partnership: www.biotechworkforce.org

The CoEs made short videos (5-7 minutes) describing each one that were posted on the web that now serve as templates for other colleges to use to build their own biotechnology programs. They also serve as a record for ETA/DOL.

Even the processes used by the National Center Office itself, in obtaining, planning, implementing, disseminating and documenting the activities of the grant and its outcomes, were captured and made available for others to use.

The NCBW is often called upon and utilized as necessary by the ETA/DOL BRG staff as a webinar resource or direct resource to respond to inquiries from many kinds of organizations.

Active at the last three annual BIO meetings through the Community College Program, the CoE leaders presented together at these meetings to national audiences. These events were written up in the Biotech Resource Line series and posted on the web site www.biotechworkforce.org

Other activities included participation and public demonstrations through such forums as the ETA Workforce Innovations Conference, the League for Innovation in Community Colleges Innovation Conference, and the American Association of Community Colleges Annual Conference.

In early February 2006 several members of the NCBW team traveled to Winston- Salem and joined a symposium on Bio-processing & Bio-manufacturing Training hosted by the CoE. This symposium was done in partnership with BioNetwork, the community college system-wide biotech training organization for North Carolina. Material from this event was used to produce the first edition of the *Biotech Resource Line*. It was distributed to DOL and placed on the web sites www.workforce3one.org and www.biotechworkforce.org.

This dissemination publication was picked up and further distributed by several organizations, e.g., Bio-Link and the national newspaper for community colleges *The Community College Times*. Local press also covered the conference; two articles were published. It was a community success which included multiple academic and economic partners.

At one session of the DOL-ETA Workforce Innovations conference in Anaheim 2006, an apprentice from New Hampshire's NHCTC, Katrice Jalbert, 18, and an intern from Forsyth Tech, Jim Crawford, 56, told compelling stories of why they each chose biotech education as a pathway to success. Both are now gainfully employed and love their chosen careers.

A similar success story was the NC Biotech conference May 22 and 23, 2006 in Winston- Salem, NC, held in cooperation with NCCCS Bionetwork's Susan Seymour and in conjunction with Alamance Community College that is the S.E. Bio–Link Regional Center. Alan Beard of Forsyth Tech joined the NCBW team which included: Ric Matthews (MCC); Sonia Wallman (NHCTC); Janet Paulson (IHCC); Patricia Dombrowksi (BCC); and Russ Read (NCBW); in presenting a session called "Biotechnology Workforce Training Trends." The NC Council for Entrepreneurial Development(CED); Targacept, a Winston- Salem based biopharmaceutical company; the NC Biotech Regional Office; and the Winston-Salem Chamber of Commerce all helped Forsyth Tech and the NCBW office to organize this panel and presentation.

A second session followed on day two, entitled "Raising Human Capital". This was organized by the same partners and the NCBW office. Panelists included CEOs and senior representatives from Wyeth Biotech (vaccines), Biolex (plant farmed GM proteins for therapeutic use), and GSK (pharmaceuticals) as well as US DOL-ETA representative Erika Baum, Chief of Staff for Assistant Secretary Emily Stover de Rocco. The session was moderated by Dr. Gary Green, President of Forsyth Tech, and was very well attended with about 120 present. This was an open and honest session about job training for the future in U.S. Biotechnology. The two sessions were captured in an exciting issue of the *Biotech Resource Line*. Slides and the *Biotech Resource Line* can be seen at www.biotechworkforce.org .

Results of the NCBW's collective work also achieved intangible success relative to its stated goals. By leveraging industry, employer, educator and community economic development support for new educational partnerships, lasting connections have been forged while creating enthusiasm and motivation for programs to continue and grow. Awareness of biotechnology's extraordinary opportunities is expanding.

Current and Anticipated Outcomes

To assist in the understanding of the current and anticipated outcomes of the NCBW grant, the following table has been prepared:

Figure 4: NCBW Inputs, Activities, Outputs and Outcomes, by Stakeholder Focus

STAKE-HOLDERS	INPUTS	MAJOR ACTIVITIES	REPRESENTATIVE OUTPUTS	SHORT-TERM OUTCOMES OBSERVED	MEDIUM- & LONG-TERM OUTCOMES EXPECTED
EDUCATION **EMPLOYERS** **ECONOMICS**	Students Workers displaced, incumbent or seeking new opportunities Existing curricula & training programs Training requirements specific to individual biotech companies in each of the five regions Institutional, industry, economic development and other community support in five regions DOL grant Complementary grants and other leveraged funding totaling $7M	Create infrastructure for National Center Office to support and promote Centers of Expertise Five centers of expertise created to serve regional biotech workforce needs Skills standards Curricular development Recruit Train Retain Job Skills competency employable Pilot Projects Cooperative learning	Hundreds of students in biotech programs, both on-site and remotely Career pathways, skills standards & assessments Website; newsletters; videos; presentations at local, state, regional and national meetings Graduates of industry-driven biotech programs Ongoing collaborations flexible responsive to changing conditions Thousands of incumbent workers receive training tailored to local industry	National and regional organizations realize value of NCBW expertise and seek input on projects including the biotech section at careervoyages.gov Growing awareness of and reliance on regional centers as evidenced by: DOE naming IHCC as a national model for community college/industry partnership U. Washington Human Genome Outreach Project using BCC for informatics training to high school biology teachers Vocational Area Cooperative names BCC as a virtual campus for Biomedical Skills Center IHCC and Iowa State University work on articulation agreements Ethanol plant techs improve QC t accuracy after IHCC workshops Visits by educators independent of the grant seeking advice and consultation for their programs Creation of Washington Life Science Industry-Education Council to drive state policy	NCBW widely regarded as "trusted partner" to inform national policy debate on issues relating to biotech workforce training and development Replication of centers of expertise in other regions with similar needs Creation of new centers of expertise in other biotechnology sectors based on the grant's pioneering approach New biotech clusters emerging around centers of expertise Greater career interest in biotech fields among high school graduates Greater support for biotech training by local, state & national funders

Sustainability

The NCCCS BioNetwork, a statewide initiative that connects community colleges across North Carolina, made the decision to sustain the work of the National Center for Biotechnology Workforce office.

Matthew Meyer, Director, NC BioNetwork, made this statement: "BioNetwork needs innovative leaders, established connections with other state community college systems for best practice sharing, and contacts within federal and state funding agencies. The National Center for Biotechnology Workforce has developed assets in all these categories and has demonstrated that it excels in facilitating partnerships and innovation."

Synchronized across multiple, strategic business sectors, in robust industry partnerships currently yielding leveraged dollars, this merger will greatly benefit the work of NC Bionetwork while providing the NCBW office with new life.

The NCBW will function as liaison with all national bodies and stakeholders. Grantwriting and more development activities will be furthered.

All North Carolina Community Colleges serving pharmaceutical and biotechnology sectors are part of BioNetwork. Its mission is to provide specialized training, curricula and equipment in development of a world-class workforce focused on the biotechnology, pharmaceutical and life sciences industries.

Russ Read, NCBW executive director, will work with a modified National Center Office team at Forsyth Tech.

SECTION IV: GRANT DELIVERABLES

From its outset, the NCBW strategic plan included tactics to capture and document all the processes and activities involved in achieving the grant's mission; this work produced more knowledge for more dissemination.

Diligent efforts on the part of CoE directors, who filed regular quarterly reports among other documentation activities, and professional consultants, including John Grady and Sam McCormick, resulted in an extensive inventory of multimedia products made readily available as resources for community colleges or other stakeholders facing similar biotech workforce training challenges.

Easy access to all products, processes and practices is established on regularly maintained websites www.biotechworkforce.org and www.workforce3one.org,

Videos

Sam McCormick produced multi-media dissemination in professional audio visual productions on the NCBW:

National Center for Biotechnology Workforce: Key Learning & Future Plans
Hosted by Executive Director Russ Read, directors and representatives of each center, including an industry employer, are given the opportunity to talk about their programs. As Read says in the video, "I think the key lesson that we have learned is that you really have to understand employer's needs, and tailor any kind of educational program or training program to those needs."

Demand Driven Biotechnology: Directors at each of the five NCBW Centers of Expertise briefly explain their programs and how they responded to industry demands in formulating their curricula and training responses. The video also presents Laura Ramirez, a Forsyth Tech student, starting to work for a biotech company and Tim Bertram, Vice President of Science and Technology for the company, Tengion. He explains the close working relationship with the Forsyth Tech Biotechnology Program that's been very successful in helping to meet Tengion's objectives.

Careers & Pathways in Biotechnology: Features apprentices, interns and the program directors from Forsyth Tech and New Hampshire Community Technical College. This 29 minute audio visual includes a summation from an industry partner in the biopharmaceutical company, Targacept, who has successfully hired graduates and provided multiple internships. It was reviewed and refined by input from the Centers.

70th Anniversary of DOL Apprenticeship Program: Dr. Sonia Wallman and other leaders involved in creating the first DOL Apprenticeship in biomanufacturing explain how such training plays an important role in developing skilled workers. With its combination of on-the-job learning, associated instruction and mentoring - apprenticeship is a valuable tool in addressing the skill shortages many industries face. The video also introduces Katrice Jalbert, an apprenticeship program participant at the New Hampshire Community Technical College, who was subsequently hired at Lonza Biologics.

Center of Expertise for Biotechnology Research & Development Training:
Dr. Lucas Shallua, Director of the Center of Expertise for Research and Development Training, explains that training students in research and development is the basic need around the area because there are many start up biotechnology companies, and they need technicians in research and development. Most of our graduates get jobs in the school of medicine, pharmaceutical companies like Targacept, and tissue engineering companies like Tengion.

Center of Expertise for Bioprocessing:
Ric Matthews, Dean of Math and Sciences at MiraCosta Community College, Center of Expertise in Bioprocessing, explains his focus on working with industry developed curriculum, the building of a new state-of-the-art facility, and the benefits of hands-on training.

Center of Expertise for Life Science Informatics:
Patricia Dombrowski, Director of Life Science Informatics at The Center of Expertise in Life Science Informatics at Bellevue Community College, describes her Center's focus on life science informatics, teaching things like visualization, database administration in the life sciences area, clinical trials data management, etc.

Center of Expertise for Biomanufacturing:
Dr. Sonia Wallman, Director of the Center of Expertise in Biomanufacturing at New Hampshire Community Technical College, states how her Center responds to critical industry needs for trained technicians in biopharmaceutical manufacturing by building a facility that looks like and feels like a biomanufacturing facility and have trained over 200 people during the last two years.

Center of Expertise for Agricultural Bioprocessing and Renewable Fuels:
Janet Paulson, Project Coordinator for the Center of Expertise in Bioprocessing from Eddyville, Iowa, explains how they are developing a bioprocess technology and ethanol plant technology program; the development of numerous short courses such as HPLC, method development, waste water training, statistical courses, as well as courses for secondary education teachers offering bioprocessing activities.

Publications

Center Profiles
Available at www.biotechworkforce.org

Each of the Centers of Expertise is featured in its own comprehensive profile, one of five published by communications contractor, John Grady. He worked with colleagues at each site to capture and make available the resources, experiences, processes and best practices of the CoEs for use on websites and through printed form distribution.

Forsyth Technical Community College
Center of Expertise for Biotechnology Research & Development Training:

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

Combining strengths of five premier community colleges from around the nation for new learning models to build our biotech workforce

ForsythTech Community College

National Center Profile:
Forsyth Tech Community College
Biotech Research & Development Training Center of Expertise

Contact Lucas D. Shallua Ossi, Department of Biotechnology
lshallua@forsythtech.edu (336) 734-7575

www.forsythtech.edu

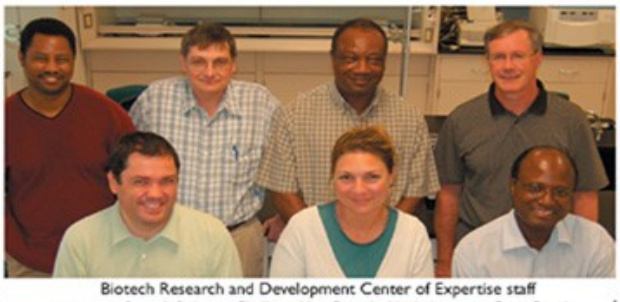
The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation. This Profile presents the Research & Development Center - ready to share ideas, resources and assistance at www.forsythtech.edu

Situated in Forsyth County's Winston-Salem - an emerging North Carolina research and biotechnology area called the Piedmont Triad - Forsyth Technical Community College prepares students to work in biotechnology companies in the Piedmont Triad and local research based institutions like the Wake Forest School of Medicine. Biotech is one of the Piedmont Triad technology growth areas that promise to reduce the impact of employment dislocations from declines in the region's traditional industries in furniture, textiles, and tobacco.

With a new building and facility, Forsyth Tech's biotechnology program prepares individuals to become the highly-skilled technicians the region needs to support medical, life science, and pharmaceutical research and development efforts vital to the economic, as well as physical, well-being of people here.

About three and half years in the making, Forsyth Tech is now the largest biotechnology training program in North Carolina. Teaching is done in real world research and development (R&D) settings, so graduates are highly qualified with preparation that's very "hands on." Internship is required; graduates know exactly how to work in professional R&D settings.

Center Director Lucas D. Shallua has a doctorate degree in Veterinary Medicine, Sokoine University of Agriculture, specialized in Cell Biology and Endocrinology. As head of the Biotechnology Department at Forsyth Tech he leads in partnerships to develop the workforce. Numerous partnerships are in place with local, regional and national biotech industries, academic institutions and pharmaceutical companies. Dr. Shallua's work was twice awarded Recognition of Excellence by the US Department of Labor. Similarly, the Piedmont Triad NC Biotechnology Advisory Board recognized the work of both he and Dr. Gary Green, Forsyth Tech president, for academic excellence in biotechnology education in 2005.



Biotech Research and Development Center of Expertise staff
top row, from left: Lucas Shallua, Alan Beard, Aju Lekwauwa, Russ Read;
bottom row, from left: Stephen Johnson, Toni Beery, Lucien Houenou

www.biotechworkforce.org

***To harness the power** of biotechnology industry potential – with a skilled, ready workforce – the U.S. Department of Labor Employment and Training Administration created the National Center for the Biotechnology Workforce in 2004. Because community colleges are actively involved in meeting the needs of workers and industries in their communities, the National Center focuses energy and investments on five community colleges with different but congruent strengths in the biotechnology industry to create new curricula and infrastructure models that can easily be shared and replicated.*

Contents include:

New Hampshire Community Technical College
Center of Expertise for Biomanufacturing:

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

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NH Community Technical College

National Center Profile:
New Hampshire Community Technical College
Biomanufacturing Center of Expertise
www.biotech.nhctc.edu

Contact Sonia Wallman, Director
(603) 559-1581 swallman@nhctc.edu

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation. This Profile presents the Biomanufacturing Center - ready to share ideas, resources and assistance at **www.biotech.nhctc.edu**

Thousands of biomanufacturing jobs are available within an hour's drive of the Biotechnology Education and Training Center (NH BET) at the Pease campus of New Hampshire Community Technical College. The Center educates students of all types for biotech careers, supplying workers ready to help biomanufacturing enterprises grow.

Responding to industry needs with about 300 biotech graduates already employed, the Center helps create a workforce needed now and for the future.

Expert college faculty use state-of-the-art training facilities to prepare traditional community college students, incumbent workers - and now student apprentices - for emerging opportunities in biomanufacturing.

"Having the enthusiastic support of biomanufacturing companies means we can better deliver the education and training these companies need now to grow and bring more jobs to our region," says Sonia Wallman, Ph.D., director of the Center and of Biotechnology at NHCTC.

Biomanufacturing Center staff (from left) Deb Audino, Tim Dubuque, Susie Harvey, Kari Britt, Sonia Wallman, Bob O'Brien

Since 1994, Wallman's program in New Hampshire has been training biotechnicians using the tools, processes, and regulatory structures of the biotechnology industry. See more at:

www.biomanufacturing.org

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Contents include:

Indian Hills Community College
Center of Expertise for Agricultural Bioprocessing and Renewable Fuels:

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
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Indian Hills Community College, IA
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INDIAN HILLS COMMUNITY COLLEGE

National Center Profile: Indian Hills Community College

Agricultural Bioprocessing and Renewable Fuels Center of Expertise

Contact Janet Paulson, Iowa BioDevelopment
jpaulson@indianhills.edu 1-800-726-2585

www.indianhills.edu/biodevelopment

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation. This Profile presents the Agricultural Bioprocessing and Renewable Fuels Center - ready to share ideas, resources and assistance at www.indianhills.edu

More than 1800 companies, employing over 83,000 skilled workers, are engaged in Iowa's biosciences. Many employers apply biological and biochemical sciences in agriculture, biofuel production, value-added processing and health products. Iowa leads the nation in production of raw biomass; ranking first in corn and egg production, plus large scale operations in soybeans, cattle and sheep.

These strengths in animal and plant sciences, according to the Battelle Institute's Report, point to increasing biotech breakthroughs, including growth in biofuels, with large-scale market potential. More investments mean more employment opportunities.

Indian Hills Community College (IHCC) heeds the call to provide skills for tomorrow's biotech workforce. Industry driven programs are delivered at the Iowa Bioprocess Training Center located in Eddyville, near a massive bioprocessing center. Multinational companies, anchored by Cargill's corn wet-milling operation, are producing many products from Iowa corn and soybeans here.

Janet Paulson, coordinator of the National Center in Eddyville, Iowa, says "Having strong industry partners is essential to success." She's proud of the $2.5 million pilot training facility built on land donated by Cargill, an international agricultural industry leader.

Agricultural Bioprocessing and Renewable Fuels Center of Expertise staff (from left) Jane Lewachowicz, Janet Paulson, Suzanne Keller, Chuck Crabtree and Eric Olson

"Our DOL grant has really enhanced our training and technical assistance capabilities," says Paulson. "We are now able to meet the training needs of the bioprocessing workforce and educators at a more technical level than before, which will enable more bio-based industries to start-up and thrive."

www.biotechworkforce.org

***To harness the power** of biotechnology industry potential – with a skilled, ready workforce – the U.S. Department of Labor Employment and Training Administration created the National Center for the Biotechnology Workforce in 2004. Because community colleges are actively involved in meeting the needs of workers and industries in their communities, the National Center focuses energy and investments on five community colleges with different but congruent strengths in the biotechnology industry to create new curricula and infrastructure models that can easily be shared and replicated.*

Contents include:

Bellevue Community College
Center of Expertise for Life Science Informatics:

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

Combining strengths of five premier community colleges from around the nation for new learning models to build our biotech workforce

BCC Bellevue Community College

Contact Patricia Dombrowski, Director
pdombrow@bcc.ctc.edu (425) 564-3164

National Center Profile: Bellevue Community College Life Science Informatics Center of Expertise

www.bcc.ctc.edu/informatics

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation. This Profile presents the Life Science Informatics Center - ready to share ideas, resources and assistance at www.bcc.ctc.edu/informatics

When the sequences of three billion chemical base pairs in human DNA genes were successfully mapped in 2003, it sent shockwaves through the world. Given enough data and processing power, the ultimate secrets of life can be revealed. Life Science Informatics makes this dream real.

Bellevue Community College, with a strong background in developing skills standards, curricula, and professional development programming in Information Technology (IT), was selected to develop the Life Science Informatics Center of Expertise. Like Microsoft, its partner and neighbor in nearby Redmond, Bellevue Community College (BCC) has entered an entirely new – and rapidly expanding - area of information technology on the ground floor.

"A technology backbone is forming in the Life Sciences and we are working with industry to create learning that supports and advances it," says Patricia Dombrowski, Director of the National Community College Life Science Informatics Center of Expertise. She was formerly vice president, operations, for Norfox Software, and vice president of Comtex Telecommunications. Her informatics team today focuses on industry-driven skills needed to face U.S. economic growth challenges in an increasingly connected world. "Biology has become an information science – and informatics is the driver."

Life Science Informatics Center staff (left to right) Patricia Dombrowski, Christina Semeling, Jennifer Jones, Michèle Royer, Stephanie Tatem Murphy

Forging nearly sixty partnerships with industry (including one with Geospiza, a Seattle-based producer of bioinformatics tools and systems) plus conducting high level focus groups, the BCC bioinformatics team combined resources to publish the first industry validated Life Science Informatics Skills Standards. This work is part of the National Center's strategic plan to create national standards; design curricula for college and high school use nationwide; provide faculty development; offer classroom and flexible on-line training - plus industry trends analysis - for community college use.

www.biotechworkforce.org

***To harness the power** of biotechnology industry potential – with a skilled, ready workforce – the U.S. Department of Labor Employment and Training Administration created the National Center for the Biotechnology Workforce in 2004. Because community colleges are actively involved in meeting the needs of workers and industries in their communities, the National Center focuses energy and investments on five community colleges with different but congruent strengths in the biotechnology industry to create new curricula and infrastructure models that can easily be shared and replicated.*

Contents include:

MiraCosta Community College
Center of Expertise for Bioprocessing:

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

Combining strengths of five premier community colleges from around the nation for new learning models to build our biotech workforce

MiraCosta College

National Center Profile:
MiraCosta Community College
Bioprocessing Center of Expertise
www.miracosta.edu/biotech

Contact Mike Fino
(760)757-2121x6499 mfino@miracosta.edu

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation. This Profile presents the Biprocessing Center - ready to share ideas, resources and assistance at www.miracosta.edu/biotech

San Diego county has roughly 500 biotech companies and needs new workers constantly. In response, MiraCosta Community College in Oceanside, California - the National Center of Expertise in Bioprocessing Training – built a program to provide both the theoretical background and the hands-on experience required to gain employment in biotechnology. This Pacific coast model is a resource that can be replicated.

MiraCosta College (MCC) completed a first full semester in its newly developed state of the art facility last year with support from initial industry partner Biogen/Idec. Ric Matthews, Dean of Mathematics and Science, said the center cost about $1.8 million, three-quarters of it from the college and the rest in donated services and supplies. Support from the DOL High Growth Jobs Initiative increased teaching capacity with equipment that enabled the immersive educational environment envisioned for the new facility.

Once Genentech acquired the nearby Biogen/Idec facility for its expansion, the college partnership continued to help train workers. Excitement about the program at MiraCosta reached high levels when a large percentage of the first biomanufacturing graduating class landed jobs even before they finished their classes. Regularly scheduled open houses attract throngs of interested applicants. Numerous other outreach and dissemination activities are underway. Genentech also donated $12,500 in scholarships to MCC students. "We want to support MiraCosta in getting people to enroll in their courses," says Mary Schwalen, education and training manager for Genentech.

Life Science Bioprocessing Center staff (from left) Mike Fino, Gail Baughman, Ric Matthews, Mike Urbach

The biopharmaceutical manufacturer builds its workforce primarily with students who earn associate degrees in the field becase it's found that such employees tend to be more loyal to the company and most of the actual biomanufacturing is handled by workers with this level of education.

"The program could not be what it is today without the partnerships between education, DOL, the industry, plus state and local governments united in workforce development," says Center Director Matthews. "There's a confluence of opportunity that formed when we looked to grow this program. A brand new program giving students the same technologies being used in industry is an expensive venture. We've received several hundreds of thousands of dollars in donations from local companies and service providers that see the value in the program and want to support and be a partner in our success. And we've learned others can do this too."

www.biotechworkforce.org

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Contents include:
Starting the Center
How to build a new biotech lab
Experience in the laboratory
Bioprocessing Certifications
Partnerships
Sometimes it's good to G.R.O.V.E.L.
Meet a student
Meet the staff
Outreach
Moving Forward
Thanks to Sponsors, Partners, Supporters, Participants

National Center Office - Processes Profile

National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

Combining strengths of five premier community colleges from around the nation for new learning models to build our biotech workforce

A report from the

National Center for the Biotechnology Workforce: Capturing Best Practices and Program Processes

developed under the President's High Growth Job Training Initiative through US Department of Labor - Employment and Training Administration

The National Center for the Biotechnology Workforce is successful in realizing its goals to develop the nation's biotech workforce because dedicated people support its mission, many in roles other than biotech. It's easy to overlook the behind-the-scenes but difficult and time consuming work being done by teams of people around the nation in areas such as grant writing, accounting, administration and dissemination. This report captures crucial process elements of the nationwide initiative that is preparing more and more workers to meet biotech industry demands.

A national effort to address workforce challenges facing the biotech industry involves many undertakings. The National Center for the Biotechnology Workforce (NCBW) combines five regional partner community colleges, each a Center of Expertise (CoE), into a comprehensive approach that solves multiple biotech worker training challenges. Each CoE specializes in a niche aspect of Biotech Workforce Training, dovetailing its training to local employers' needs. This is called "demand-driven" workforce training.

Each CoE focuses on its own specific area of biotech training expertise. These include research & development (Forsyth Tech), manufacturing (New Hampshire Community Technical College), informatics (Bellevue Community College); agriculture/biofuels (Indian Hills Community College) and bioprocessing (Mira Costa Community College). The models developed through the NCBW are being replicated at other colleges and institutions ready to upgrade training programs to produce a ready and competent U.S. biotechnology workforce.

In its first 24 months, the NCBW's collaborating CoEs awarded college degrees to approximately 400 students - and the vast majority of them immediately gained new employment in biotech jobs. Incumbent worker training and other short innovative programs have reached thousands of individuals. Training infrastructures and curricula resources have been created and strengthened. Through the NCBW's work with educational resources, industry representatives, public officials, and community groups, many networks, partnerships, collaborative agreements, initiatives and events have been formed and are underway.

Perhaps most important, many thousands of individuals, students, teachers, industry leaders and prospective workers around the nation have been exposed - through NCBW outreach events and dissemination projects - to the career opportunities and overall economic potential of biotechnology.

So, how does the NCBW coordinate so many resources across the nation to deliver this important, demand-driven training?

Assistant Secretary of Labor for Employment and Training Emily Stover DeRocco presents a Recognition of Excellence honor to Russ Read and leaders of the National Center for the Biotechnology Workforce at the 2006 Workforce Innovations event in Anaheim recognizing their innovative approaches for preparing workers in biotechnology. Pictured (from left) Janet Paulson, Patricia Dombrowski, Chuck Crabtree, Rebecca Keith, Sonia Wallman, Read, DeRocco, Ric Matthews, Ron Shelton.

'Our success is due to our teams of talented, dedicated people at our sites around the nation all working together through our centralized collection of evolving processes," says Russ Read, NCBW executive director.

"Yes we have dedicated educators and visible leaders who work with the public. But there are many more dedicated professionals working behind the scenes - writing grants, paying bills, doing accounting, managing labs, and accomplishing day-to-day, ancillary tasks that must be done or there would be no program. We are far enough along now to recognize our best practices and support more productive processes," says Read.

The director identifies four main processes driving the enterprise: administration, grant writing, accounting, and dissemination. Each CoE has dedicated staff professionals carrying out daily tasks within these common processes to drive their own expert workforce training center. These CoEs are profiled extensively; and may be reviewed at www.biotechworkforce.org

***To harness the power** of biotechnology industry potential – with a skilled, ready workforce – the U.S. Department of Labor Employment and Training Administration created the National Center for the Biotechnology Workforce in 2004. Because community colleges are actively involved in meeting the needs of workers and industries in their communities, the National Center focuses energy and investments on five community colleges with different but congruent strengths in the biotechnology industry to create new curricula and infrastructure models that can easily be shared and replicated.*

Contents include:

North Carolina Regional Consortium
Articulation Agreements Increase Biotechnology Training Opportunities

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National Center Profile:
North Carolina Regional Consortium
A Regional Model in the Piedmont of North Carolina

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation.

North Carolina with 377 bioscience enterprises is, based on number of companies, the third leading state for biotechnology. Employment in biotech has grown between five and ten percent every year here since 1996. An estimated $3 billion annual biotech payroll goes to about 47,005 employees earning average salaries of $63,010.

Because North Carolina is projected to be a national leader in percentage growth of biotech jobs through 2014, the National Center for the Biotech Workforce (NCBW) responds to this demand with innovative programs that combine and strengthen partnerships to produce trained and ready workers.

Forsyth Tech, one of the five NCBW Centers of Expertise, reaches out to educational partners in its Triad region to help accomplish this goal of preparing skilled workers.

The **Forsyth Tech/Piedmont Triad Regional Biotechnology Consortium** establishes working partnerships with eight regional community colleges in the Piedmont Triad plus the surrounding area. This endeavor creates new biotechnology training opportunities in a sixteen county area.

A brochure created by Guilford Community College targets high schoolers with career opportunities and other biotech ideas.

Each of the community colleges – all in various stages of new biotech curriculum development – was awarded a $20,000 grant to help accelerate new biotech training programs. This profile reports on progress made by the **Regional Consortium**, a model program, including specific updates from each of the eight associated colleges.

The community colleges affiliated with the Regional Consortium are:

Catawba Valley Community College
Caldwell Technical Community College
Davidson County Community College
Guilford Technical Community College
Mitchell Community College
Surry Community College
Rockingham Community College
Wilkes Community College

The grant funds enabled these colleges to buy equipment and/ or do faculty training and outreach. Plus the consortium enhances 1-plus-1 articulation agreements in which a student at any one of the community colleges involved may take a first year of the biotechnology associate degree curriculum at a college close to home, then complete the second year of the curriculum at Forsyth Tech in Winston-Salem. Each of the colleges is located within an approximate one hour commute of Forsyth Tech.

www.biotechworkforce.org

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Contents include:

National Biotech Teachers Fly-In
24 High School teachers from around the country gather for workshops, tours

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Profile of a Biotech Workforce Innovative Training Partnership Prototype

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation.

High school and middle school educators from all over the country, a total of 24, flew in to Piedmont Triad Airport in Greensboro, N.C. on Wednesday, Oct. 17 for the first ever "National Biotech Teachers Fly-In." Together, they explored a series of workshops and events designed to advance their pursuits of a highly skilled, 21st century biotech workforce.

In Partnership with Bio-Link
www.bio-link.org

With biotech production facilities opening in every region, offering more jobs in a burgeoning American industry, schools seek ways to bring potentially lucrative biotech skills to people in their own communities now.

"Our grant partners have always wanted to get a sense of what high school teachers need for the teaching of biotechnology," said Russ Read, National Center for the Biotechnology Workforce (NCBW) Executive Director. The National Science Foundation's Center of Excellence for Biotechnology - known as Bio-Link - was eager to cooperate. "Bill Woodruff, South East Director of Bio-Link, got very excited when we met and we both said, "we can do this together!" They approached Lucas Shallua at Forsyth Tech and Terry Howerton at the Atkins Academic & Technology High School and started to work on the 'Fly-In' program. "One ground rule was to have it be something teachers could learn and take back to their labs at their schools to their students without fancy or expensive equipment."

Teacher interest was high for this innovative training event sponsored jointly by NCBW and Bio-Link - along with other stakeholders (*see sponsor list on back cover*).

The three day event assembled regional education leaders who are working to start up their own biotech programs. Group interactions helped cross-fertilize emerging strategies and growing solutions to meet biotech industry needs. This profile captures the experiences and some of the lessons learned.

Biotech Teachers Fly - In Group 2007 (see names on back cover)

www.biotechworkforce.org

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Contents include:

Grant Partnership Meeting
Centers of Expertise Leaders, Allies, Meet, Summarize Grant Initiatives

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National Center for the Biotech Workforce Partner Grant Wrap-Up

Centers of Expertise Leaders meet, summarize grant initiatives

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation.

Biotech Grant WrapUp Meeting Participants (see names on back cover)

Leaders and partners of the National Center for the Biotechnology Workforce gathered at Forsyth Technical Community College in Winston-Salem, NC on Tuesday, Dec. 11, 2007.

Culminating 36 months of widespread work around the country, all of it sparked and supported by a $5 million Department of Labor, Employment and Training Administration grant (awarded June 28, 2004), the meeting surveyed achievements and lessons learned through the creation and progress of the National Center for the Biotechnology Workforce (NCBW).

A nationwide enterprise, developed under the President's High Growth Job Training Initiative, the Center engages numerous workforce challenges facing the biotech industry today. The five partners, all community colleges and each one a proven "Center of Expertise" in its own specific area of industry training and geographical region, came together and were united to represent the whole nation and all spheres of our nation's growing biotechnology industry.

www.biotechworkforce.org

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Contents include:
Russ Read Comments to Center Directors, Allies
One page reports from all five CoEs
Roundtable discussion at NCBW Grant Wrap-Up Meeting
Learning at lunch: Interns In Industry
Grant Wrap-Up Meeting Reception

Council on Economic Development BIOTECH 08 Report
Financial Community Joins Life Sciences Community, Education Emphasized For More Success

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NCBW Helps Sponsor Statewide Council for Entrepreneurial Development BIOTECH 2008 Conference May. 19-20, Winston-Salem, N.C.

Financial Community Joins Life Sciences Community, Education Emphasized For More Success

Success is raising the stakes in North Carolina's booming biotech business. Panelists, keynote speakers - including former Governor Jim Hunt - as well as participants in conversations up and down the aisles at this premier venture capital conference kept giving a lot of credit to the state's educational resources in fulfilling the promise of Biotech.

But the 700 industry-associated participants in the Biotech 2008 event sponsored by the Council for Entrepreneurial Development (CED) on Monday and Tuesday, May 19 and 20 at The Benton Convention Center in Winston-Salem, N.C., also heard about how efforts to improve training and ready the workforce must not let up.

While the gathering's primary focus was on strategies for financing - and profiting from - biotechnology development, crucial workforce and training issues emerged in the course of the packed two-day program.

Governor Hunt, now counsel with Womble, Carlyle, Sandridge & Rice, led the charge for a better workforce as he addressed the conference in a keynote. "I want to thank all of you involved for making us the third largest biotechnology state in the nation," said Hunt to loud, emotional applause. "We can keep it up if we do it right with homegrown companies."

Action around the NCBW booth with **Mona Cofer** displaying colorful products and informative posters.

Dr. Esther Alegria (above, left), vice president of manufacturing and general manager of Biogen Idec's Research Triangle Park site, and **Mike McBrierty**, Biogen Idec public affairs manager, greet **Russ Read**, executive director of the National Center for the Biotechnology Workforce on the exhibition floor.

That evening Dr. Alegria emphasized Biogen Idec's commitment to education when she announced a new $25,000 donation to NCCCS BioNetwork to help 25 students pursue two year degrees in the life sciences.

Thomas Powell IV, treasurer of Carolina Biological Supply Company (left) with **Richard Franks**, C.B.S.C consultant, are strong partners with Russ Read and the NCBW in preparing the biotech workforce. They help provide teacher education kits and equipment for schools and hands-on training.

He recounted accomplishments strengthening community college and other biotech education networks in the state during his terms in office. But he called for renewed efforts."We're not doing well enough in science education, we're not doing well enough in preparing the workforce - for them or for the nation. To compete today with Europe, China, India, we need a scientific trained workforce. Only 25 percent of fourth graders are proficient today; 47 percent of eighth graders are below proficient. This is the most important field for our future. We need people who can think, for new ideas, to invent. It starts with learning the basics."

Then he put his words to action and conferred awards to outstanding students in the field of biotech to more audience applause.

www.biotechworkforce.org *See list of high school biotechnology project award winners on next page.*

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Contents include:
Report on NCBW participation
Excellence in Science Education Awards presented by Biogen Idec and
James B. Hunt, Jr., former North Carolina Governor

NCBW Supports Innovative New Research Project - Teaching Tool
Forsyth Tech Biotechnology Students Gain New Skills With Hands-On, Real World Results

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NCBW Supports Innovative New Research Project -Teaching Tool

Forsyth Tech Biotech Students Gain New Skills With Hands-On, Real World Results

The National Center for the Biotechnology Workforce (NCBW) formulates responses to current biotech workforce demands with programs and curricula for easy access at community colleges. NCBW responses are rolled out in classrooms and equipped training laboratories, then disseminated and replicated at community colleges in other locations.

Results of these initiatives produce hundreds of new, skilled workers around the country.

A new project supported by the NCBW - launched at Forsyth Tech - takes the experience and skills of Lucien J. Houenou, Ph.D., an accomplished expert in neurobiology and experimental neurology formerly with Wake Forest University Medical Center, and translates them into an exciting new teaching tool that might also contribute to fighting several degenerative diseases that affect the nervous system.

"We are doing this to make an in-house research model that is replicable for the rest of the nation at the community college level," says Russ Read, executive director of the NCBW. "Dr. Houenou's project is a great model. He can conduct some needed basic research and at the same time offer students new skills in hands-on learning that produces meaningful and tangible results."

Lucien J. Houenou, Ph.D., brings his expertise and experiences in neurobiology into an exciting new teaching tool that could help fight disease

ForsythTech Community College

The primary use of biotechnology in North Carolina is in production of pharmaceuticals, medical research and diagnostics. Forsyth Tech's biotechnology program prepares individuals to become highly-skilled technicians needed to support growing medical, life science, and pharmaceutical research and development. Students emerge from the two-year associate in applied science degree program ready for career opportunities in biotechnology.

"Neuron degeneration contributes to diseases, including Alzheimer's, Parkinson and amyotrophic lateral sclerosis (ALS) - also called Lou Gehrig disease," says Dr. Houenou. "Although these diseases are believed to have a genetic component, the exact mechanisms involved are still unknown."

The challenge is to identify the effects and mechanisms of neurotoxins on the development of spinal cord neurons. The scale of experimentation and data collection in this challenge is enormous. The work, which at times seems like emptying the ocean with a tea cup, takes place using strict protocols in a specialized research laboratory.

www.biotechworkforce.org

Despite massive investments by pharmaceutical companies in research, there are still many unexplored areas and missing data. "Big companies are focused on production and sales, they don't always have the manpower to spare in pursuing all these questions on neuron degeneration," says Dr. Houenou. "Or they don't have particular skills, ones which may be more advanced or different than their areas of concentration."

The result is that Dr. Houenou's new project at Forsyth Tech, called "Mechanisms and Prevention of Spinal Neuron Degeneration in Animal Models," has significance within the industry and has the potential to produce breakthrough results.

"This is a real research project that builds on work I have been doing at Wake Forest University. It was thoughtfully considered and discussed with my partners and is important," says Dr. Houenou. "This real world aspect motivates students and complements our theoretical courses with hands-on work in the nitty-gritty of actual scientific discovery." *(continued on next page)*

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Contents include:
Interview with Dr. Lucien Houenou, an accomplished expert in neurobiology and experimental neurology formerly with Wake Forest University Medical Center and director of new Forsyth Tech research project into neuron degeneration.
Project brings hands-on, advanced research experience to students, along with upgraded equipment and includes the potential to make beneficial, real world discoveries.
Program can be replicated at community colleges facing similar training requirements.

Biotech Resource Lines

Available at www.biotechworkforce.org

Newsletters track trends in Biotechnology issues, including different aspects of best practices and training.

Faces of Success - A report from the 4th Annual Community College Program at BIO May 6, 2007 in Boston, Massachusetts featured successful participants in the program from around the nation.

Best Practices in Biotechnology Workforce Training - Based on a January 10, 2007 panel discussion sponsored by NCBW at Forsyth Technical Community College, featuring ten speakers sharing perspectives on how to best marshal a wave of biotech workers needed to meet the demands of research and industry in the 21st century.

Pathways to Successful Careers - Based on a September 12, 2006 panel discussion focused on Internships, Apprenticeships and Outcomes, sponsored by NCBW at Piedmont Research Park, Winston-Salem, NC.

Attracting and Retaining Biotech Companies - A Best Workforce Practices report from the Council for Entrepreneurial Development's Biotech 2006 Fifteenth Annual Conference held in Winston-Salem, North Carolina on May 22 and 23, 2006.

Building the Biotech Workforce - A report from the April 9, 2006 NCBW Community College Program at BIO 06 in Chicago, Illinois.

Addressing Manpower Needs in Biotech – A report on the Feb 2, 2006 panel discussion featuring biotechnology workforce leaders and NCBW CoE directors

Curriculum & Course Materials

Forsyth Tech
Experimental Laboratory Animals Certificate

NHCTC
Core Production System Book: 92 page book/pdf contains documented and self-contained curriculum utilizing CHO-tPA as a Core Production system designed for biomanufacturing training and education
ASEPTIC Awareness Training - one-day PowerPoint lecture, what it is, and to increase awareness of contaminants
ASEPTIC Media Fill SOP rev1.doc - Listing of procedures
Course outlines, agendas in ASEPTIC Awareness and Hands-On Biomanufacturing Training.

IHCC
Ethanol Shift Maintenance Job Guide - Maintenance Activities for Ethanol Machines, in pdf
Ethanol Plant Operator Job Guide - Plant rules and performance job guide
IHCC Chromatography Basics/Troubleshooting Day1, PowerPoint
IHCC Chromatography Method Development Day 2, PowerPoint
Syllabus for Intro to Biotech BPT 104

MCC
BTEC120 & BTEC220 and Official Course Outlines: seven pdf files

BCC
At the Convergence Zone - model for skill standards and curriculum, pdf
Clinical Trials Workflow Process - workflow of a clinical trial with focus on data management
Life Science Informatics Overview - defines informatics career roles and identifies resources

Program Management and Implementation Tools

BCC
Prior Learning Assessment Template - assesses various learning experiences of students, pdf
Industry specific program descriptions for community and technical colleges, four pdf files:
Trends Analysis: Vol. 1 Visualization
Trends Analysis: Vol. 2 Building Successful Industry Partnerships
Trends Analysis: Vol. 3 Virtual Worlds
Trends Analysis: Vol. 4 Business Intelligence

Outreach Materials
Indian Hills Virtual Tour.
Each program has its own web pages on its community college site.

NHCTC
Poster campaign in state high schools promotes apprentices, opportunities in biotechnology.

Reports and Databases
IHCC
ISU Bioeconomy Working Lunch Results 2006, in MS Word

Competency Models & Career Ladders
IHCC
A Training Needs Assessment of 10 Iowa Ethanol Plants - ascertains needs of Iowa's ethanol industry, in pdf files

BCC
Life Science Informatics Skill Standards - standards to assist community colleges with mapping program needs and content

Figure 5: Products Table

College/Center	Product Title	Product Documentation
Forsyth Technical Community College	Career Pathways Script Outline	MS Word Script Outline to Biotech Apprenticeship Video 9/11/06
	Forsyth Tech Video Diary Shooting Script	Microsoft PowerPoint Presentation Slide 1
	Career Pathways In Biotechnology Script	MS Word Script to Biotech Apprenticeships & Internships
	National Center for the Biotechnology Workforce	Video: Forsyth Tech Demand Driven Biotech Video Diary.MPG Creating Demand Driven Biotech Curriculum.MPG Career Pathways in Biotechnology.MPG
	Capturing Best Practices & Program Processes	PDF File: CenterProfilesNCBW. Profile of Best Practices of the NCBW
	Experimental Laboratory Animals Certificate Course	PDF File: Course Outline Describes Techniques Using Various Animals in the Lab for Experimental Purposes (Forsythtech_AH_Course_1.pdf)
New Hampshire Community Technical College	Duplicate of BiotechWorkforce.org Website	CD: "index.htm" File: Brings up Homepage - Proceed from here. Many Files-2 Products
	CoreProductionSystemBook032907.pdf	CD: PDF File: 92-Page Book file-Contains Documented & Self-Contained Curriculum utilizing CHO-tPA as a Core Production system designed for Biomanufacturing training and education.
	ASEPTIC Awareness Training	One-Day Lecture.ppt What Is? and to Increase Awareness of Contaminants
	ASEPTIC Media Fill SOP rev1.doc	MS Word Document Listing of Procedures
	ASCEPTIC Processing Class Schedule	MS Word Document Schedule of ASEPTIC Awareness Training
	Hands-On Biomanufacturing Training	PDF File: Seminar Agenda_1. 3/26/07 Training
Indian Hills Community College	Ethanol Shift Maintenance Job Guide	PDF File: EtOH Shift Maint 07-2005. Maintenance Activities for Ethanol Machines
	A Training Needs Assessment of 10 Iowa Ethanol Plants	PDF File: ETHANOLNeeds Assessment 7-05. Ascertain Training Needs of Iowa's Ethanol Industry
	Ethanol Plant Operator Job Guide	PDF File: EtOH Plant Operator 07-2005. Plant Rules & Performance Job Guidelines
	IHCC Chromatography Basics/Troubleshooting Day1	CD: Microsoft PowerPoint Presentation
	IHCC Chromatography Method Development Day 2	CD: Microsoft PowerPoint Presentation
	IHCC-NCBW Deliverables Index 0307	CD: MS Word Document
	Indian Hills Virtual Tour	CD: Windows Media Audio/Video File
	ISU Bioeconomy Working Lunch Results 2006	CD: MS Word Document
	Syllabus for Intro to Biotech BPT 104	CD: Firefox Document
Bellevue Community College	Prior Learning Assessment Template	PDF File: Assesses Various Learning Experiences of Students
	At the Convergence Zone	PDF File: Model for Skill Standards & Curriculum
	Clinical Trials Workflow Process	PDF File: Workflow of a Clinical Trial w/Focus on Data Management
	Life Science Informatics Overview	PDF File: Defines Informatics, Career Roles & Identifies Resources
	Life Science Informatics Skill Standards	PDF File: Standards to Assist Comm. Colleges w/Mapping Prog. Need and Content
	Trends Analysis: Vol. 1 Visualization	PDF File: Industry-Specific Program Descriptions for Community & Technical Colleges
	Trends Analysis: Vol. 2 Building Successful Industry Partnerships	PDF File: Industry-Specific Program Descriptions for Community & Technical Colleges
	Trends Analysis: Vol. 3 Virtual Worlds	PDF File: Industry-Specific Program Descriptions for Community & Technical Colleges
	Trends Analysis: Vol. 4 Business Intelligence	PDF File: Industry-Specific Program Descriptions for Community & Technical Colleges
	Five Informatics Life Science Case Studies	PDF File: Bioinformatics Programming; Bioinformatics Tools; Bio Statistics; Clinical Trials; and Medical Informatics to Download for Comm. Coll. Instructors & HS Teachers
	Bellevue DVD Video A070803_00	Video Showcasing the Informatics Program at Bellevue Community College
College/Center	**Product Title**	**Product Documentation**
MiraCosta Community College	Course Materials & Official Course Outlines	CD: Folders: Course Materials: BTEC120 & BTEC220 and Official Course Outlines: 7 PDF Files
	Enrollment_Degrees Folder	CD: Files: BTEC_annualsummary.xls and DegreesandCerts91-05.xls
	Mira Costa Equipment Summary	CD: Excel Spreadsheet 4/03/07 Summary: MS Word Document
	Index	CD: MS Word Document 4/03/07 Index of Folders
North Carolina Regional Consortium	A Regional Model in the Piedmont of NC	PDF File: RegionalProfileNC.pdf Describes NC Regional Consortium

Relevant media reports, features, articles (by date)

February 11, 2008
NC's Piedmont Triad Must Win Life-Science Entrepreneurs to Become State Bio Hotbed
BioRegion News: Tracking Biotech Cluster Development
Written by Alex Philippidis
A pair of high-profile life-science business leaders stress that the region, which connects Greensboro, Winston-Salem, and High Point, must attract entrepreneurs before it should go after capital, and that it should encourage life-sciences leaders to build roots in the region as they grow with it.

February 2008
The Biotech Boost
News & Record, Greensboro, North Carolina
Written by Craig Miller
Quotes Lucas Shalua, identifies workforce need.

September 19, 2007
BTEC Opens; Will Boost State's Biomanufacturing Industry
Benchmark article on NCU website
Written by Keith Nichols

July 2007
It's Bio-Logical
Seacoast Ventures Business Journal
Published by Seacoast Media Group, Portsmouth, NH
Cover photo and multiple stories about biotech workforce issues, NCBW Biomanufacturing CoE

July 27, 2007
News of BIOMAN 2007 at NHCTC
Biobus wheels in with job-creating force
Portsmouth Herald by Adam Leech
Mentions jobs, opportunities

July 26, 2007
BioNetwork Bus in Portsmouth
Manchester Union Leader
Written by Faith Swymer

May, 2007
Ottumwa Courier
SEMI offers fun lessons with high-tech equipment

March/April, 2007

President Bush Touts Biofuels in Novozymes Visit
BT Catalyst
News from North Carolina Biotechnology Center

November 20, 2006
Bellevue Community College named second Microsoft IT Showcase School
Microsoft Corporation News Release
Cites Life Sciences Informatics program and Center of Excellence designation as supporting factors.

September 18, 2006
Bioinformatics Is Going Back to School
BIO-IT World.com
Written by John Otrompke
Industry journal identifies CoE as leading informatics resource.

July 13, 2006
Labor Department Presents Third Recognition of Excellence Honors
Workforce Innovations 2006
Community Colleges, Industry Representatives Reveal Best Workforce Practices for Attracting and Retaining Biotech Companies
Department of Labor ETA Press Release including NCBW in Honorable Mention

Spring, 2006
Industrial Biotechnology
Genetic Engineering News Publishing
Training templates may prevent skilled worker shortfall
Written by John Grady
Global industry journal recognizes biotech workforce issues, focuses on solutions, including NCBW and Biomanufacturing CoE in New Hampshire.

March 3, 2006
Winston-Salem Journal
New building opens at Forsyth Tech
Classrooms, labs to prepare students for biotechnology jobs

February 14, 2006
Training must keep pace with biotech industry
College Times
Article distributed to community colleges focuses on panel discussion NCBW hosted Feb. 2 at the Piedmont Triad Research Center in Winston-Salem, N.C.

February 4, 2006
Stakes high for biotech in N.H.
The Portsmouth Herald, Portsmouth, NH
Written by John Grady

Editorial about need for biotech training

January 20, 2006
Looking Forward: grad gets running start in biotech field
Atlantic News
Written by Liz Premo
Published in 15 towns by Connelly Communications
Cover story, feature on biomanufacturing apprentice at NCBW CoE in Biomanufacturing

January 11, 2006
"MiraCosta facility aided by industry"
San Diego Union-Tribune
About program open house

December 17, 2005
"A biotech boom"
The Portsmouth Herald, Portsmouth, NH
Written by Michael McCord
Emphasizes job opportunities, training

October 2005
"Redefining the Workforce"
Pharmaceutical Manufacturing Magazine
Written by Paul Thomas
Identifies issues, quotes Russ Read, NCBE executive director

October 24 2005
"Three Triad Groups Receive Biotech Grants"
The Business Journal of the Greater Triad Area
Includes $72,776 grant to track student progress in biotech training program at Alamance CC

October 19, 2005
"Community-Based Job Training Grant"
ETA release - on Community-Based Job Training Grants includes $1,999,039 DOL grant to New Hampshire Community Technical
College and Workforce Partners

June 24, 2005
"Biotech a key to area's economy, official says"
Winston-Salem Journal
Written by M. Paul Jackson

September 5, 2003
Biotechnology Industry Success Stories
Department of Labor News Release
Regina Whitaker enters biotech program spring 2003, expects to graduate spring 2004 with a job.

APPENDIX A: NCBW Timeline Chart