REPLICATING SUCCESS: INNOVATIVE COLLABORATIONS BETWEEN THE BIOTECH INDUSTRY AND EDUCATION
About This Report

This publication is based upon work supported by the National Science Foundation under grant number 0402139 to the Bio-Link National Advanced Technological Education Resource Center for Biotechnology, Elaine Johnson, PI/Executive Director.

Report Author: Lori Lindburg, Director of Workforce & Education, BayBio Institute
Design: Paula Adduci, Adduci Studios

This report will be of interest to individuals and organizations engaged in workforce development activities at community and technical colleges that prepare students for employment in the biotechnology industry. It is intended to inspire dialogue, build linkages, and spawn additional reporting of model biotechnology programs. However, it does not seek to capture the full range of pioneering partnerships in life science education across the country. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author and the individuals quoted and do not necessarily reflect the views of the National Science Foundation.

The first section of the report will focus on community colleges in the Northern California region to highlight ways in which other community colleges may want to involve life science partners as they introduce, develop, or bolster their biotech programs. Taken together, these programs illustrate a number of key components and interactions that can form the backbone of successful industry and education partnerships.

The second section of the report highlights several innovative industry-education partnerships from across the country that merit mention because of the creative ways that partners have collaborated and helped drive these programs. What stands out in a number of these case studies are the ways in which the programs have “worked with what they have” to harness the strengths of their regions and turn challenges into remarkable opportunities.

The National Science Foundation (NSF) is an independent agency of the U.S. Government whose mission is to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense. The foundation competitively awards grants for research and education in the science, technology, engineering and mathematics fields.

Bio-Link National Advanced Technological Education Resource Center for Biotechnology is hosted at City College of San Francisco. Bio-Link’s mission is to strengthen and expand biotechnology technician education at community and technical colleges throughout the nation. The Center seeks to increase the number and diversity of well-trained technicians in the workforce, meet the needs of industry for appropriately trained technicians, and help community colleges develop effective educational practices.

BayBio Institute (BBI) is a non-profit 501(c)(3) public benefit corporation headquartered in South San Francisco, California. The mission of the BayBio Institute is to maintain the region's leadership in biotechnology through support of education, entrepreneurship, and innovation. Established as a discussion group of the Bay Area Economic Forum in the late 1980s and independently incorporated in 1990, the BBI has a long history of supporting workforce development and science education efforts in our region.

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INTRODUCTION

As the site of the biotech industry’s origins, California’s San Francisco Bay Area and its surrounding counties have been home to a number of innovative and fruitful collaborations between community colleges, the biotech industry and other community stakeholders. Such interactions have resulted in the creation of several unique and complementary biotech programs that are yielding shared rewards for students, teachers, industry and local communities. The success of these colleges’ programs can be attributed in large part to the creative ways that they have engaged industry, and in many cases, other key partners, in preparing their students for careers in the life sciences.

In addition to hosting a mature biotech cluster and several outstanding community college biotech programs, the region is also home to Bio-Link, the National Science Foundation’s National Advanced Technological Education Center for Biotechnology. Fundamentally, Bio-Link is a national network of regional centers dedicated to increasing the quality and number of biotechnology programs for students preparing to enter the workforce. The network supports professional development for instructors and a system of information-sharing among programs, facilitating the expansion of industry-relevant education for secondary and post-secondary institutions (see inside back cover to learn more about Bio-Link).

Without the collaboration of this region’s industry-driven community college programs, the National Center would not have developed into the key axis for biotechnician training that it still serves as today after ten-plus years in existence.¹

Several biotechnology programs in other parts of the country – many from regions that do not have a large or mature biotech cluster – have also designed model initiatives involving industry that may provide useful examples for community colleges that have not yet taken this step.

While not all of the collaborations featured in the report are at the community college level, what is clear in each is that the biotech industry’s involvement is vital for providing students with the hands-on, relevant skills enhancement and industry awareness necessary to ensure the ongoing development of the life science workforce. The success of these programs flows from the sector’s commitment to provide a substantive learning experience for developing professionals, and from the creative and efficient ways that community colleges and other educational institutions have secured and channeled that commitment.

Bio-Link’s relationship with the BayBio Institute (the workforce and education affiliate of the biotech trade association for Northern California) models this valuable industry-education partnership. By encouraging industry involvement in student and faculty development, Bio-Link is working to ensure that the nation’s community college biotech programs are being developed in harmony with the sector’s rapidly evolving workforce needs. By sharing these and other best practices with additional community colleges around the country, Bio-Link seeks to facilitate the development of additional and new kinds of successful collaborative programs.

¹ The Northern California Biotechnology Center (NCBC) was one of two regional biotechnology centers created in 1996 by the California Community Colleges to connect the biotechnology industry with a well-trained operational workforce. This collaborative consortium of community college biotechnology programs shared program information and eventually secured the federal funding that allowed for Bio-Link’s creation. Currently, six regional California Applied Biotechnology Centers (CalABC) partner with industry, secondary schools, universities and public agencies and associations to implement the Biological Technologies Initiative, an initiative of the California Community Colleges Economic and Workforce Development (EWD) program. The Biological Technologies Initiative facilitates and enables improved community college effectiveness in supporting biotechnology-related economic and workforce development in California.
PART I: COMPONENTS of SUCCESSFUL INDUSTRY ENGAGEMENT in COMMUNITY COLLEGE BIOTECH PROGRAMS

Community colleges in the San Francisco Bay Area and surrounding counties are fortunate to be able to draw upon a large and mature cluster of bioscience companies and research institutes in the region for engagement in their biotech programs. While none of the community college programs in Northern California are identical, many of them have employed similar strategies for involving industry in their programs’ creation and ongoing evolution. Even those programs in the central regions of Northern California, where the sector is much smaller, are coming up with creative ways of serving and engaging their local industry and neighboring cluster. Several of those strategies are highlighted in this section.

Industry Input Through Advisory Boards and Other Feedback Mechanisms

Active industry engagement at the front-end of program design and curriculum development is crucial for developing industry-relevant training and education. Institutionalizing this input in an advisory board for ongoing feedback is one of the best ways of ensuring continued program relevance, though some community colleges employ other methods that allow for this valuable industry input. Most of the community colleges in the Bay Area and surrounding counties have created an advisory board that includes life science researchers and professionals, and most of these boards were established by the colleges well in advance of their program development in an effort to align with industry need.

As co-founder of one of the longest-standing programs in the region, City College of San Francisco’s (CCSF) Philip Jardim created an industry advisory board seventeen years ago, two years prior to developing the College’s

Advisory Boards

American River, Contra Costa, Foothill, Merritt, Ohlone and Solano Colleges have developed advisory boards that include industry representatives from both start-ups and more mature companies, including Actin Biomed, Allergan, Amgen, Applied Biosystems, Bayer, Bio-Rad, Boston Scientific, Genencor, Genentech, Johnson & Johnson, Mendel, Metabolex, Monsanto, Novartis, Roche, Solara, Thermo-Fisher/Lab Vision and Xoma, among others. Board representation ranges from CEOs to floor managers, thus offering valuable input from multiple levels of industry.

The advisory boards meet anywhere from one to three times annually, enabling community colleges to keep a real-time pulse on the types of current and anticipated jobs, as well as the corresponding skill sets needed. Board members provide feedback on new programs and curriculum, critically review course offerings, and provide input as needed on anything from equipment donations to website design.
biotech program. The advisory board included representatives from private companies and research institutes, such as Genentech, Roche Molecular Systems, Gene Lab Technologies, Genencor, the University of California, San Francisco (UCSF), and Lawrence Berkeley Labs (LBL). Jardim was originally provided with grant-funded release time to write the curriculum, which was circulated among board members and their colleagues in order to validate the relevance of the skills being taught. Over the years, CCSF’s biotech program has grown to include a number of certificate programs, several short courses in specific lab-related skills, and more than 20 experienced instructors on staff.\(^2\)

Industry board members can also provide valuable networks for community college biotech programs. Josie Sette, of Ohlone College, speaks of the value this “multiplier effect” has had on the College’s biotech program: “Without being asked, board members have told their colleagues about our program. When I ask someone how they heard about us, they often tell me that so-and-so on our board recommended us to them.” This has helped facilitate direct equipment donations and the involvement of other industry professionals in the College’s biotech program.

Also worth mentioning is Ohlone and Merritt Colleges’ inclusion of students and graduates in advisory board meetings. Gisele Giorgi, director of the Certificate in Bioscience Microscopy Program at Merritt College, states that students meet and network with advisory board members and practice their “elevator speeches” at the board meetings: “These students are our own best ambassadors. They are the ones who are changing the attitudes of industry. They are very enthusiastic and far more skilled than our industry partners had anticipated.”

The inclusion of the Consortium Advisory Group for the Learning Alliance for Bioscience (LAB) Program (representing over 10 high schools that have articulation agreements with Ohlone College) in Ohlone’s advisory board meetings ensures that these high schools are also well attuned to industry needs.

Whether they have formal advisory boards or not, many biotech programs in the region receive feedback from industry through other means, such as through adjunct faculty and colleagues from industry. In the Bridge to Biotech/Lab Assistant Certificate program at City College of San Francisco, staff and faculty receive ongoing feedback on students and the program through regular site visits at internship sites and in on-line student and program evaluations. These frequent face-to-face conversations have helped the Lab Assistant Certificate program bolster its curriculum and program design. Similarly, a consultant and former employee of Bayer offers curriculum input to the College’s Biomanufacturing Certificate program.

\(^2\) These include the nationally-recognized Bridge to Biotech/Laboratory Assistant Certificate program, which serves individuals who are just beginning or returning to college-level study, often from socioeconomic backgrounds that are underrepresented in the industry, and the more advanced certificate programs, which also prepare students for entry-level work in the field: the Biomanufacturing, Stem Cell Research, Genomics, and Biotechnician certificates.
Hands on Learning with Industry Professionals

Opportunities for students and faculty to interact with industry professionals in the classroom or at their work sites provide a powerful teaching tool, tangibly demonstrating what a career entails and the characteristics needed to be successful in a given profession. Several biotechnology programs in the region have employed a number of different industry “interactions” in an effort to provide this very real learning experience.

Instructors/Guest Lecturers

One of the most obvious and best ways to bring industry-relevant knowledge to students is by having life science professionals serve as (adjunct) faculty or guest lecturers. Nearly every community college in the region has hired professionals and researchers from the industry to serve as faculty.

These instructors bring a strong sense of the overarching skill sets needed to be competitive in the job market. Corporate employers of adjunct faculty/guest lecturers likewise benefit by acquiring a detailed understanding of the programs, and often create special relationships with the colleges with the aim of harvesting outstanding graduates.

Industry input was key to the development of the “short course” or “module”, reports Celeste Carter, former head of Foothill College’s Biotechnology Lab Technician program, who developed the concept. Now widely adopted by many community colleges, the short courses bring in industry representatives to design and teach modules on specific laboratory techniques and processes. At Contra Costa College, for instance, four of the specialized biotech courses are taught by industry representatives: PCR (Bio-Rad), Protein Purification (Bayer), GMP/GLP (Bayer, Novartis), and ELISA (Genentech). This model, replicated throughout the region, keeps students (including students who are already working in industry) up to date on key skills and techniques that are in high demand.

Nearly all of these programs also bring in industry professionals to give guest lectures or presentations on their area of research, their own career trajectories, and to offer insights into career success (see Industry Involvement in Career Readiness, page 10). At Foothill College, for instance, representatives from Genentech and Genencor were brought in to offer “reverse site visits” of their companies for students.

When we hired instructors and lecturers from industry, our goal was not only to bring industry expertise into the curriculum, but also to help change the industry’s perception of community college biotech programs as ‘high school’. We wanted them to see what our students are capable of.

Philip Jardim, Co-Founder of City College of San Francisco’s Biotechnology Program
As Phil Jardim of CCSF points out, there is another motivation for bringing in adjunct faculty and guest lecturers from industry: “When we hired instructors and lecturers from industry, our goal was not only to bring industry expertise into the curriculum, but also to help change the industry’s perception of community college biotech programs as ‘high school.’ We wanted them to see what our students are capable of.”

Industry can also gain from participating as guest or adjunct instructors, and not only from the possibility of identifying talented students. The Certificate in Microscopy Bioscience Program at Merritt College taps microscope equipment sales representatives, for instance, to offer technical content-based lectures and to assemble and demonstrate the scopes. As Giselle Giorgi points out, it is in their interest to teach students – and future microscopy professionals - how to use the equipment, since the burden of training falls to the sales reps once a sale is made. (The program also brings in researchers and other professionals to discuss their career path and other career options in the field).

Contra Costa College also demonstrates how industry guest instructors can take their experiences with students back to their companies, especially those companies that have a vested interest in secondary and community college biotech education and products that are marketed to them. As a tech support specialist for Bio-Rad’s popular Biotechnology Explorer products, the College’s adjunct faculty member from Bio-Rad, David Palmer, has been able to trouble-shoot and beta-test new applications and extensions of the Biotechnology Explorer™ products with students.

More importantly, Palmer has been able to develop and fine-tune educational materials needed to support new Bio-Rad products intended for the university research/industrial market associated with Biotechnology Explorer™. In spring of 2007, he developed, trouble-shot, and tested instructional materials for users of Bio-Rad’s real-time PCR products with students. These materials are currently being marketed by Bio-Rad. As Contra Costa College’s Kate Levine states, “I totally support this use of his time as he teaches our students, because he is providing them with learning opportunities not available anywhere else. I was

3 Bio-Rad’s Biotechnology Explorer™ kits connect science in the classroom to topical applications and issues in the real world. The kits and curriculum are designed by teachers and scientists working together to integrate real-world biology topics and activities into existing biology curricula. Through practical, hands-on activities, students at multiple grade levels are given the opportunity to explore the fundamental techniques of genetic engineering, DNA fingerprinting, DNA amplification, protein expression and analysis, and the creation of genetically modified organisms.

The collaboration between community colleges and industry can have very real benefits, and I’m really happy to be a part of it!

David Palmer, Bio-Rad
What Genentech did was invaluable – providing us with the expertise we needed. When we started, there were no programs in the country that emphasized biomanufacturing.

James DeKloe, Director, Industrial Biotechnology Program, Solano Community College and Bio-Link Regional Director

a participant in this class, and I marveled at the quality and utility of the training our students received – at $26/unit for a 1-unit course! These companies would otherwise need to charge several thousand dollars to test and develop the same educational materials.”

The benefits of such collaborations extend beyond the College and company. According to Palmer: “The [Biotechnology Explorer™] kit has become a real-time application note and a product of its own, and has been used by a number of other educators already. We have even had a researcher who is just getting started in an epidemic analysis use the kit developed with Contra Costa College as a way to learn real-time PCR. The collaboration between community colleges and industry can have very real benefits, and I’m really happy to be a part of it!”

Faculty Internships

While most of the programs in the region have hired faculty directly from industry, another mechanism for informing program design and keeping curriculum relevant is through faculty internships with industry. In 1996, prior to creating the biotech program at Solano College, James DeKloe participated in a one-year internship at Genentech in South San Francisco: “What Genentech did was invaluable – providing us with the expertise we needed. When we started, there were no programs in the country that emphasized biomanufacturing. The experience that I obtained on sabbatical, coupled with Genentech’s advice, allowed us to invent a biomanufacturing curriculum.”

Skyline College’s Nickolas Kapp interned at Genentech during the highly recognized Biotechnology Pharmaceutical Technician Program and oversaw student interns in production. Kate Levine, at Contra Costa College, completed research internships at UC Berkeley and the National Institutes of Health. A faculty internship at Lawrence Berkeley Labs, where he worked on the Human Genome Project mapping Chromosome 5, informed Phil Jardim’s development of CCSF’s biotech programs.

Several years later, faculty internships at the Gladstone Institutes (Carin Zimmerman, working with embryonic stem cells) and UCSF (Shane Oram, using adult stem cells, and Golnar Ashfar, working with mouse embryonic stem cells) provided invaluable experience for developing the College’s Stem Cell Certificate program.

Student Internships

One of the most effective ways to expose students to the field, build industry expertise and develop job ready skills is through internships with industry. While some community colleges provide informal assistance to students seeking an internship, other community colleges have made this a formal, and in some cases mandatory, part of their biotech programs.

One notable Bay Area internship program took displaced workers from the airline and travel industries, post 9/11, and retrained
them for entry-level biomanufacturing positions at Genentech. The three-month intensive Biopharmaceutical Manufacturing Certificate program at Skyline and Ohlone Colleges paid students $12 per hour while they interned at Genentech, with the company guaranteeing each intern an interview. This successful collaboration – which included two Workforce Investment Boards and a Labor Council, in addition to the two community colleges and Genentech - yielded a 95 percent placement rate for students in positions paying $35,000 per year in its first cycle (see Multi-stakeholder Partnerships, Part II, page 24).

Though funding for the Biopharmaceutical Manufacturing program has ended, Ohlone biotech students currently compete for available internships, many of which take place at small start-ups, for which they receive college credit. The College has negotiated current internship programs with Mendel and Diagnostic Biosystems. If companies are unable to provide internships, program coordinators ask them to provide job shadowing opportunities.

Both Foothill and Merritt Colleges have required students in their respective Lab Tech and Microscopy programs to complete internships. At Foothill, students in the program were required to complete 264 internship hours. Students found their own internships with coaching and assistance from faculty, many of them at Stanford University. Merritt’s program requires students to do a summer internship; many intern at the UCSF-affiliated Gallo Center or at UC Berkeley, UCSF, Stanford or Touro Universities. Students have also interned abroad at McGill University in Canada, Okolabs in Italy, Tirimbina Research Center in Costa Rica, and the University of Helsinki in Finland.

Internships have been central to CCSF’s Lab Assistant and Stem Cell Certificate programs. The former includes a 180-hour internship during the second semester, pays students $9 per hour and allows them to accrue two units of credit. The College has formal agreements with UCSF and with the U.S. Department of Agriculture’s (USDA) Western Regional Research Center (WRRC) to facilitate the internship component, exposing students to sophisticated laboratory techniques such as protein purification, DNA sequencing and PCR. As the employer of record, CCSF eliminates employer liability concerns.

CCSF’s Stem Cell program was originally funded by the California Governor’s Growth Industries – High Wage, High Skill Job Training category. The two-year grant enabled City College to create a Stem Cell Research Technician Certificate program. Included in this grant were funds for $15 per hour internships during the program’s first two years, and in the following years, students were able to participate in a three-day training course working with human embryonic stem cells through a collaboration with Susan Fisher’s UCSF laboratory. As an area of anticipated growing demand, the College is looking for additional funds to support internships in cell culture and stem cell research.

An important element of the community college internship programs is their treatment of internships as “jobs,” enabling students to develop solid job search skills and workplace professionalism. Candidates and accepted students in the Skyline/Ohlone Biopharmaceutical Manufacturing programs worked with their respective County One-Stops to create resumes, practice interviewing, and bolster workplace retention skills. Students
in CCSF’s Lab Assistant Certificate program formally apply with resumes and cover letters to three-to-four internship postings before interviewing with prospective internship supervisors. Once selected, interns develop agreements on responsibilities and three-to-four learning objectives with their supervisors. Over the course of the internship, they enter their hours worked and the lab skills they have learned each week on-line (which is monitored by supervisors). In addition to mid-term evaluations with internship supervisors and program staff, interns work with their supervisors at the conclusion to incorporate new skill sets into revised resumes and to secure mentors as possible references. As in many of the community college internship programs, interns are often offered full- or part-time positions, even as they continue their bioscience educations.

While internships provide students with valuable exposure to the industry and an opportunity to develop relevant technical and professional skills, interns can also serve as ambassadors for the community college programs by demonstrating their high caliber. CCSF’s James Lewis points to a related bonus of the internship among intern hosts who want to “flex their teaching muscle.” “By framing the supervision of interns as an opportunity to gain teaching experience, the Lab Assistant Certificate Program increases the buy-in of industry professionals needed to improve the program.” Interested lab supervisors are invited to provide a two-hour module in the program’s internship class.

Site Visits/Company Tours/Job Shadowing

Though not as in-depth as an internship experience, site visits, company tours, and job shadowing opportunities – particularly if they allow students to handle equipment and speak with scientific and other staff – can be a valuable way of accelerating students’ understanding of and interest in possible life science careers. Community colleges in the Bay Area and surrounding counties have been fortunate to draw on multiple private companies, as well as research institutes, such as Gallo, the Department of Energy Joint Genome Institute (DOE-JGI), and the United States Department of Agriculture-Western Regional Research Center (USDA-WRRC), to expose students to different life science workplaces.

Ohlone College arranges company tours at Amgen, Genencor, and previously at Cell Genesys, for both College and high school students.

By framing the supervision of interns as an opportunity to gain teaching experience, the Lab Assistant Certificate Program increases the buy-in of industry professionals needed to improve the program.

James Lewis, Coordinator, Bridge to Biotech/Lab Assistant Certificate Program, City College of San Francisco
students. Students get the opportunity to meet with science and other staff, gown-up and tour the facilities. Metabolex hosts a “Mentoring Day” for the College, during which students spend an entire day meeting with different scientific and non-scientific staff, have lunch, and learn about the different types of jobs they can find in a biotech company. These companies – which Ohlone’s Josie Sette describes as “incredible!” - are playing a valuable role in exposing students to a variety of career opportunities in the life sciences.

Industry Involvement in Career Readiness

Several of the regional community college biotech programs have been significantly enhanced by their emphasis on preparing students to enter the job market and their involvement of industry in these efforts. This is achieved by having industry professionals give lectures about what they are looking for in employees, having them review resumes and conduct mock interview with students, and encouraging them to provide networking opportunities for students.

In the Skyline and Ohlone Biopharmaceutical Technician program, for instance, Genentech hiring managers conducted mock interviews with students. Representatives from industry and staffing agencies also visited classes and told students what they were looking for in successful job candidates.

A faculty member at City College San Francisco, who is also an employee at Genentech, hands out sample interview questions and resumes to students. Other faculty have brought in representatives from Lab Support (a staffing agency for the life science industry) to review resumes and mock interview with students.

Ohlone students in the College’s current biotechnology program can take a credit course on “Biotechnology Careers,” to which biotech company human resource managers and other personnel are invited to guest lecture. Students have also attended a “lunch and chat with industry” that allowed them to speak to and ask questions of Genencor staff about what makes a successful job candidate. Industry involvement in the College’s annual career fair helps students demonstrate and hone their job seeking skills. Representatives from industry are also active participants in the College’s annual Biotechnology Fair (a life science information fair open to Ohlone students, high school students and the public) as speakers, panelists, exhibitors, and judges for student presentations.

In addition to applying and interviewing for internships with potential industry hosts, students in CCSF’s Lab Assistant Certificate program conduct poster presentations, in which internship supervisors and other industry representatives are invited to participate. The poster presentations not only refine student presentation skills, but also help with the recruitment of new lab partners who often agree to become intern hosts once they witness the caliber of students.

Students in Merritt College’s Certificate in Bioscience Microscopy Program participate in career readiness and networking opportunities with industry and other professionals. A former executive and current business owner teaches “The Business of Biotech” course during which students prepare resumes, conduct mock
interviews, and develop “elevator speeches” about their qualifications and interests. In addition, they participate in the American Society for Cell Biology conference, where they interact with scientists, get free training from vendors, give out business cards and network. Students also chair panels and present posters at the Advances in Imaging and Microscopy conference hosted by UC Berkeley’s Molecular Imaging Center.

While the development of technical skills is essential in preparing students for life science careers, many students stumble in their efforts to secure employment by failing to present themselves well and by not developing the strategies necessary to compete in the job market. The value of enhancing students’ career readiness skills thus should not be underestimated, particularly when life science professionals participate in the process.

Equipment and Supply Donations
Industry has played a key role, sometimes overlooked by programs and institutions, in supporting community college biotech programs through donations of equipment, supplies, software licenses and, in the case of CCSF’s stem cell program, cell lines. Nearly all of the community colleges in the region have had items donated to their programs from industry. While most of Merritt College’s $11 million worth of equipment comes from a recent voter-ratified bond measure, the College has received several microscopes (valued at approximately $150,000) from Bayer. (The College’s ‘mentor’ program at San Joaquin Delta College has had much of its equipment donated through graduates of its Microscopy program who are now working in industry).

Seventeen years ago, CCSF’s Phil Jardim got a call from Berlex, which was relocating, and became the recipient of approximately fifteen-to-twenty loads of supplies and some equipment, which he shared with local high schools. Genentech also allowed Jardim to acquire discarded supplies from several of its labs for the College’s biotech program.

Today this type of arrangement has been formalized in an innovative partnership between industry and education called the Bio-Link Equipment Depot.
The Bio-Link Equipment Depot

The Depot has operated since 2002 when Genentech provided funding for Bio-Link to set up a donation center. The Depot accepts high caliber equipment and supplies from companies and has made them available to over 200 teachers and 85,000 students in Northern California schools, community colleges, and universities. The approximate street value of these donations exceeds $2.5 million.

As biotech companies restructure, move or upgrade their equipment and supplies, the Depot is a compelling alternative to the auction house or landfill. Donated equipment is tax deductible and has created a lifeline for cash- and equipment-starved science classrooms throughout the region. Interested donors arrange with the Depot to have their items picked up, regardless of size or quantity, and give them a second life in needy classrooms. The Depot ensures that donors’ contributions are known by recipients and acknowledgements of contributing companies are posted on its website.

In addition to donating items, industry has played an important role at the Depot by encouraging their employees to volunteer to sort, inventory, build shelves, and organize equipment and supplies. Life science professionals are not the only recipients of this valuable team-building opportunity. The Depot also offers important networking opportunities for instructor volunteers. Teacher volunteers staff the Depot Open Houses, which occur multiple times throughout the year. These and other occasions allow science and biotech teachers to learn about each others’ successes and challenges, and to gather ideas for effective science instruction.

To get a sense of the Depot’s impact on a single classroom, Dave Menshew (the 2009 recipient of the National Teacher of the Year award) estimates that the Depot has provided his students with supplies, equipment and materials “totaling over $123,000 in full retail value.” He adds, “Even at a discounted rate for those items that were previously used, it is our belief that [these assets are] valued at over $75,000 in the open market.”

Equipped facilities that mirror the biotech industry and allow students to master usage and technique are crucial for teachers and faculty tasked with developing the science workforce of tomorrow. The Depot is funded by the National Science Foundation and Genentech.4 It is supported by Bio-Link, City College of San Francisco, and the Center for Applied Competitive Technologies,5 and relies heavily on its partnership with the Bay Area Biotechnology Education Consortium (BABEC)6 for outreach to teachers, and to the BayBio Institute for its many industry connections. There is current interest from New Jersey and Texas in replicating the Depot.

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4 Genentech made an additional grant to the Depot in 2009.
5 Co-located at 12 community colleges across the state, the Centers for Applied Competitive Technologies (CACT) offer technology education, manufacturing training, and consulting services that contribute to continuous workforce development, technology deployment and business development in growth industries. The CACT is another initiative of the California Community Colleges Economic and Workforce Development program.
6 The Bay Area Biotechnology Education Consortium (BABEC) is a regional network of local science education organizations based in the Northern California Bay Area, which is dedicated to improving science education and awareness for students and helping teachers bring relevant, thought-provoking, hands-on activities into the classroom.
Other parts of the country that do not have a mature bioscience cluster are more hard-pressed to secure donated equipment, supplies, or even mobile laboratories. Such programs are hoping to raise awareness within industry of the significant impact this type of support can create with just a small percentage of their corporate giving budgets.

Other Success Factors

Many of the community colleges in the region have designed their programs in such a way that individuals working in industry can participate to upgrade their skills. Short, topic-specific classes (i.e., PCR, HPLC, GMP/GLP, QA/QC, Writing SOPs) offered during evenings and/or weekends have brought industry professionals into several of these classrooms as students. This not only helps market the caliber of these programs, but enables students to make connections with classmates who work in industry.

A few programs have developed workshops specifically geared towards industry, including American River College, which is taking its one-day Bioinformatics class to various sites in the region, as well as offering much of its courseware on-line. Ohlone College has trained over one thousand employees from start-ups and large companies in the Bay Area over the last four years through short, hands-on, one-to-three-day workshops.

These examples from the Bay Area and surrounding regions demonstrate many of the high returns yielded from such industry and education partnerships. These collaborations are allowing for a number of high-quality interactions between students, faculty and life science professionals.

The following section goes more in-depth with a few case studies from across the country that further illustrate the mutual gains that successful collaborations between industry, education and other stakeholders are bringing to one another.

Ohlone College has trained over one thousand employees from start-ups and large companies in the Bay Area over the last four years through short, hands-on, one-to-three-day workshops.
PART II: INNOVATIVE MODELS of INDUSTRY ENGAGEMENT

Not all regions in the country are home to large biotech clusters that local community colleges can easily draw upon to augment their biotech programs. From regions with large rural communities to those with one community college in the entire state, these programs have come up with innovative ways of working with and serving the sector to create fertile learning opportunities for students.

Creating Learning Experiences through Contracted Research, Equipment, or Lab Space

A number of innovative community college programs around the country are providing practical educational experiences for students – and in some cases are generating revenue – by contracting with industry to provide valuable services, equipment, space and/or highly qualified talent.

Contracting Research: InnovaBio - Salt Lake Community College (SLCC), Salt Lake City, UT

The desire to provide students in Salt Lake Community College’s Biotechnology program with quality internships - an objective made difficult by the small number of biotech companies in the region – inspired the creation of InnovaBio. In June of 2005, Tami Goetz – then Director of the SLCC Biotechnology program - received a three-year $700,000 grant from the NSF to create InnovaBio, a contract research organization (CRO), at Salt Lake Community College and the Jordan Applied Technology Center (JATC). Two scientists (a PhD and Masters-level) were brought in to manage InnovaBio with the aim of providing biotech companies with robust research while offering students concrete, hands-on learning. Research that companies don’t have time for

InnovaBio’s successful outreach to companies is based on what former Director and current Department Chair, Craig Caldwell, calls the “cluttered basement model.” In this model, InnovaBio approaches companies asking them about the “basement” projects that have never gotten “out of the box” and proposes that student interns carry out the research. Participating companies contract with InnovaBio to outsource some of their basic biotechnology research, which helps cover some of the program’s overhead costs.

Contracts include provisions for protecting the intellectual property of clients, experimental outcomes, projected timelines, and cost estimates. Students conduct research and take part in the final report and presentation to contracting companies. Examples of contracts include identifying and quantitating active compounds in herbals, developing reagents for lab diagnostic test kits, conducting tests to help validate proprietary drugs, and cloning and expressing genes, to name a few. While the focus of contracts has thus far been on research and development, InnovaBio is planning to develop manufacturing contracts – building kits and packaging and selling them to high schools at cost - and expects its first products to be made available to high school partners in Spring 2010.

Partners rather than clients

InnovaBio’s partnering companies have included ZARS, Pharamex, Spendlove Research Foundation, Lifespan Technologies, Sorenson Genomics, ACME Biotechnology, Echelon Biosciences, and Neuroadjuvants. Caldwell refers to his contractors as “partners” rather
than “clients,” noting that personal connections have been key in bringing industry collaborators on board. While the goal of the partnership is to provide a quality research outcome, the real focus should be on developing top-notch employees. “The director has to be able to inspire confidence in the contracting company that the work can get done, while at the same time setting the expectation that it is primarily an educational opportunity,” states Caldwell, “In our case, our expectation is that we will get data and will deliver it to our client. It will likely take longer than a for-profit CRO, since education is the goal, but we will have a report for our client at the end of the day.”

**IP and confidentiality**

Another key to this successful industry-education collaboration is that it is “IP-free.” The program does not make any claims on anything it produces or discovers. Craig believes that this is very important to drive home with partner companies: “We don’t want intellectual property, we want a learning experience.” On the other hand, InnovaBio also puts it back on company partners to protect proprietary information. Since many participants in the program are minors, they cannot sign binding nondisclosure agreements, nor are they necessarily able to discriminate as to what is and what is not proprietary.

**Sustainability**

A key challenge for InnovaBio has been to develop a sustainable revenue model. The initial thought was that revenues from contracted research would help sustain the program. In order to do so, the program would have to generate a number of very large contracts to support itself. InnovaBio’s capacity to take on projects is limited, however, by the fixed number of supervisory personnel that can be dedicated to project oversight. Also, because it is one of the smallest – and most expensive - programs at SLCC, it has also been the most vulnerable to cuts.7

7  Caldwell has thoughts for how such challenges might be addressed in replicating entities: “Perhaps faculty could be tasked with coming up with plans for sustainability. This would have the added benefit of keeping faculty in touch with industry and its latest technologies and trends, an important component of technician programs. Colleges could also consider funding a summer-only program for a faculty or adjunct from industry with the specific purpose of having an industry professional supervise a project from his or her company. The adjunct would be substantially less expensive than full-time faculty or staff and carry the additional benefit of instant expertise and credibility.” Noting that the concept suffers from companies’ limited ability to give much release time to scientific personnel who are needed on flagship projects, Craig still believes that solutions could be found, such as in “… giving an adjunct access to space or equipment they wouldn’t ordinarily have as part of the deal, or having the college lease space to a start-up in return for mentoring students in their work.” (see Contracting Lab “Incubator” Space, page 17).

The director has to be able to inspire confidence in the contracting company that the work can get done, while at the same time setting the expectation that it is primarily an educational opportunity.

Craig Caldwell, Department Chair, Salt Lake Community College’s Biotechnology Program
Fortunately, for InnovaBio, the perfect storm arrived in 2007, just as the NSF grant was concluding. Utah’s economy was booming, unemployment was exceedingly low and the state was experiencing a surplus year. The Biotech department at SLCC was granted a line item in the state budget to expand its Biotechnology program, including support for the InnovaBio program, enabling the latter to rely on its contract-generated revenue predominantly for consumables.

The importance of tracking

While student internship evaluations consistently demonstrate high regard for the program, Caldwell suggests that replicating entities would benefit by tracking student outcomes and documenting employer satisfaction from the outset, an area InnovaBio has admittedly not focused on in a systematic way. That said, the staff know anecdotally that many students have gone on to four-year programs and that many others are employed in industry. They also know that employer partners have been very satisfied with the program, but agree that concrete longitudinal data would bolster this assessment.8

Program successes

InnovaBio’s successes far outweigh its other challenges. The program enables students to gain industry-level research experience before entering the job market, while at the same time earning college credit. Equally important, students are able to gain other “soft skills” – oral and written communication, teamwork, time management, reliability and accountability. Students are also able to stay apprised of emerging trends in the industry, and therefore become marketable sooner. In addition, secure funding has allowed for the emergence of an entrepreneurial culture at InnovaBio. Students and faculty brainstorm new projects, thus not relying exclusively on contract-driven research. This encourages students to think entrepreneurially, to imagine products and services that they might develop themselves.

8 Russ Read, Executive Director of the National Center for the Biotechnology Workforce (representing the North Carolina Community College System BioNetwork) and William Woodruff, the Department Head of the Biology Department at Alamance Community College (and the SE Regional Director for Bio-Link) have conducted a preliminary study aimed at tracking the biotech graduates of the BioNetwork’s community colleges. Concluding that tracking must be initiated prior to graduation, the duo have come up with a list of alumni services that draw on industry professionals for mentorships, networking events, and support for continuing education. Such career-focused support and opportunities are a considerable draw for program graduates who are thus incentivized to maintain contact with their community college program (www.biotechworkforce.org).
SLCC students are not the only ones that benefit from the program. The College’s relationship with other educational institutions means that high school students can receive college credit through concurrent enrollment in SLCC, and both community college and university students can receive internship credit if they are working in InnovaBio at least 15 hours per week during the semester.

Companies gain from the opportunity to provide a valuable learning experience and reap the benefits of preparing the future science workforce, while also receiving valuable data. Anecdotally, partner companies report the high caliber of students who are able to “hit the ground running” upon hire. Many of the students in the program have been hired by industry before completion.

Salt Lake Community College and the Jordan Applied Technology Center gain prestige from the program as well as sustainability. InnovaBio’s success is leading community colleges in St. Louis, Missouri, and Hagerstown, Maryland, to replicate the model.

Other Contract Research Programs

Other innovative collaborations – which could be compelling for cash-strapped, risk-averse start-ups and research labs - allow industry labs to “outsource” research projects to community college bioscience programs.

Students in City College of San Francisco’s Biomanufacturing Program make protein for a research institution in exchange for inclusion of their names on a scientific publication. Similarly, in the fall of 2008 and spring 2009, students in the college’s Biotech 101 course worked on production of a drug target from the human pathogen Trichomonas vaginalis. In both semesters, students not only explored the underlying science that formed the basis of the research, but also gained the technical skills of biomanufacturing a protein needed for further characterization as a potential alternative to chemotherapy.

A new collaboration in fall of 2009 has students in CCSF’s nascent Genomics Certificate program “adopting a microbe” for the Department of Energy’s Joint Genome Project, helping the institute with annotation of large volumes of sequence data.

These exciting collaborations are some of the first of an anticipated many that are providing “proof of concept” that research institutions or industry labs can successfully outsource their projects and obtain a high quality product.

Contracting Lab “Incubator” Space: Austin Community College, Austin, TX

In another variation of the contract research model, Linnea Fletcher, chairman of the Biotechnology Department at Austin
Community College offered to share laboratory space and instruments as an “incubator” site for a small start-up company. A rapidly growing but cash-poor company seized the opportunity and made an arrangement with the College to use the space for work on developing a commercial diagnostic kit for the aquaculture industry, which was based on a PCR assay. The College hired the company researcher as an adjunct faculty, who then worked the assay process into an existing course, brought in the consumable supplies required to do the work, and directed student interns to work on the project.

This collaboration allowed the College to accommodate interns in-house without creating additional teaching responsibilities for faculty or requiring the purchase of additional supplies. The students participated in the partnership under the supervision of an industry researcher and benefited from the convenience of being able to work on campus while attending classes. The diagnostic kit that students worked on was quickly developed and put on the market within a year. The rapid success of the project created expansion in the company, for which the interns were optimally prepared.

This innovative alliance was a win-win-win for the company, students and College. In exchange for allowing students to participate in a current research and development project, with a significant donation of consumable supplies to the College, the company received the research space and student talent needed to conduct the research and development. As a consequence, student interns were well prepared for the job market and were absorbed by the growing company where they continue to collaborate with each other on new research and development projects.

The partnership worked so well that Austin Community College is pursing a more formal arrangement to continue the incubator. Responding to a great need for wet lab space in Austin, the College has designed greater flexibility within the campus (such as movable benches and more prep rooms) in order to accommodate small start-up companies seeking incubator space by fall of 2010. This space will also contain locked cabinets and drawers and provide greater security for incubated companies, enabling them to rent out space and share instruments in a separate instrument room without disrupting classes.

Contracting Equipment: Merritt College, Peralta District, Oakland, CA

Merritt College’s Certificate in Bioscience Microscopy Program is attempting a similar type of win-win exchange with industry. Because students must train to particular jobs for which there are no internal training documents or formalized curriculum, the College plans to let industry use its over $11 million in scopes (which includes every brand and four different levels of equipment complexity, from simple widefield to top of the line confocal) in exchange for training or providing internships for its students.

By helping to meet a particular industry need, these community college programs are providing pragmatic and concrete learning opportunities for students who might not otherwise be able to gain such practical experience prior to entering the job market.
Bringing Classrooms to Industry: Biogen Idec Community Labs

The following case study illustrates how a biotech company responded to a public official’s request for help in attracting more students into the life sciences. While the example does not involve a community college biotech program, it nevertheless highlights a successful industry and educational partnership that could serve as inspiration for the development of similar collaborations in other locales, particularly where public leaders are willing to ask industry to provide on-site learning for students.

In 2001, then-Cambridge (MA) Mayor Anthony Galluccio and Biogen Idec CEO Jim Mullen discussed ways the company could support efforts to encourage local students to pursue careers in the biosciences. Both agreed it was important for students to learn what happens inside a biotech company and to gain real world, hands-on experience. It was out of this meeting that Biogen Idec decided to create the Biogen Idec Community Lab. The first lab opened in Cambridge in 2002, followed by the San Diego (CA) Community Lab in 2005.

Teacher input into program development

Prior to developing the program, high school teachers near the company headquarters in Cambridge and nearby Somerville, and in San Diego County near the company’s corporate campus, were asked to provide feedback about a laboratory program that would meet the needs of their respective regions. This collaborative approach asked for teacher input at the front end of program development and resulted in two related though slightly different Community Lab programs in Massachusetts and California.

The Community Lab program provides students and teachers from middle and high schools with an opportunity to come on site and work in the company lab with employees of Biogen Idec. Because of the size of the County, San Diego teachers recommended that its program focus exclusively on students in the 7th grade. Two lab choices are offered to 7th grade classrooms throughout San Diego County. The labs are held one-to-two days per week and all labs are taught and assisted by employee volunteers.

Teacher professional development in San Diego

The San Diego campus also participates in a teacher professional development program – the Biotech Bootcamp – in collaboration with the San Diego Workforce Partnership and BioCom, the largest life science industry association serving Southern California. The workshop takes place over three weeks, most of it in Biogen Idec’s Community Lab, with some rotations to other biotech companies. These hands-on labs equip teachers with practical teaching modules to take back to their classrooms. Annie Glidden oversees the San Diego Lab operations.
The Cambridge Community Lab Program

**Summer Community Labs Program.** The Cambridge site offers two summer programs: a one-week laboratory, held twice each summer, with 28 students per session; and a two-week more advanced laboratory program, held once per summer with students who are sophomores or older. Students prepare poster presentations at the conclusion of the summer programs.

**After School Apprenticeship Program.** An after school apprenticeship program (through the national Citizen Schools organization) pairs Callahan and several employee volunteers with ten-to-twelve middle school students for eleven weeks, and culminates in a final project. During the summer, a number of other groups (including high school students and undergraduates) visit the Community Lab for hands-on experience and to interact with employees over lunch.

**Mentor Science Projects Program.** Fifteen students at sophomore year or above may also participate in the Cambridge Community Lab’s science project mentoring program. Students in the program are matched with science mentors and meet with them from October to March. Mentees usually come to the lab one-to-two times per week after school to work on research projects mentored by Biogen Idec’s science staff. Students enter their projects in science fairs at the regional, state, and in some cases, international, levels.

*The Biogen Idec Community Lab Program in Cambridge*

The Cambridge program is open to local middle- and high-school students and teachers in Cambridge and Somerville. It has several two-to-five-hour laboratories to choose from and hosts visiting classrooms almost every weekday during the school year. Dr. Tracy Callahan manages and teaches most of the labs, assisted by employee volunteers.

The enormous value the Community Lab program is bringing to science education lies in its emphasis on hands-on learning, which allows students to apply their science skills using state-of-the-art equipment and to interact directly with scientists. Participatory learning continues to provide immense appeal to students and instructors alike. Students also learn “soft skills” – how to present themselves, work in teams and communicate science concepts. And because other non-science employees also volunteer in the labs, students are exposed to both science and non-science career pathways.

**Onsite employee engagement**

Employees enjoy volunteering, as it provides a connection to young people and the opportunity to talk about the important work they do each day to develop new treatments for patients. Having the Community Lab on site makes it easier for more employees to volunteer with students, and dedicated lab space avoids interrupting work in the research labs.

Nevertheless, it is not always easy for employees to find time to volunteer, and in both San Diego and Cambridge, the company actively raises awareness of and recruits volunteers for the program. Biogen Idec’s corporate culture values and recognizes employees who volunteer in the lab. The company also hosts laboratory workshops for non-science employees in which
they perform the same labs as students. In addition, student success stories are circulated through the company Intranet, and all employees are invited to the student poster sessions.

Bringing classrooms to industry labs provides a powerful teaching tool. In another example, **City College of San Francisco** has students perform sequence analysis at Genentech, after conducting the sequencing reaction at the College. This allows students to compare the facilities and learn what to expect in industry without raising liability issues. Biogen Idec is one of the only biotech companies in the country that actually brings middle and high school students on site into R&D facilities and gives them a laboratory experience with its staff, creating mutual gains for students, employees and their local communities.

**Bringing Laboratories to Classrooms and Industry: Mobile Laboratories**

A number of collaborative industry and education programs around the country are bringing state-of-the-art laboratories and training to schools and industry sites. Most “mobile laboratories” are sponsored by state governments, with industry involvement usually in the form of presentations and/or donations of equipment.

**North Carolina Community College BioNetwork Mobile Laboratory**

The North Carolina Community College System’s (NCCCS) BioNetwork and Mobile Laboratory responded to the needs of the life science industry with a series of multi-million dollar grants aimed at enhancing community college biotechnology programs across the state. The Mobile Laboratory’s founding mission was to bridge the gap between what these new and growing community college programs could not then provide: hands-on training with state-of-the-art equipment found in biotechnology and life science companies across the world. The laboratory broke through county boundaries by travelling from college to college carrying and sharing expensive specialized equipment (such as a microbacterial identifier) and providing students with valuable experience needed to be successful in the life sciences.

In addition, the Mobile Laboratory, which accommodates eight-to-twelve people at a time, has also been used to deliver training such as Micropipetting and Environmental Monitoring to incumbent workers at industry sites, thus eliminating employees’ needs to travel for training. Taught by experienced faculty from industry, the Mobile Laboratory has offered hands-on training to over 1500 professionals, including employees of Wyeth Vaccines and Talecris.
Both of these features of the laboratory are helping to prepare a pipeline of workers and maximize the number of qualified employees available to companies throughout the state. In addition, the laboratory also acts as a unique learning environment for the general public. Appearing at state fairs and career fairs, the laboratory introduces the public to careers in biotechnology and the life sciences.

The Mobile Laboratory is a component of the BioNetwork Capstone Center, which is housed at North Carolina State University’s Centennial Campus and hosted by Wake Technical Community College. The building that houses both of these learning institutions is a multimillion dollar high tech facility. By co-locating these entities in the same building, both organizations have the opportunity to learn from each other and to provide information, technology, experience and equipment to students of varying educational backgrounds.

A mobile launch pad for critical science careers

The BioNetwork Mobile Laboratory is funded by the state of North Carolina. With the economic downturn, the Mobile Laboratory has made the strategic decision to scale back in activities and focus on where it can have maximum impact. It is currently redeveloping its mission to focus on more general scientific concepts. The laboratory will now be a mobile launch pad for critical science careers - aerospace, advanced manufacturing, life science, health care, and green technology/energy - and will focus on education and outreach to many North Carolina communities.

A recent grant from the Foundation for the Carolinas-Duke Energy is enabling the mobile laboratory to remain a functioning tool in the scientific pipeline process. The repurposed educational vehicle will visit schools as well as community and economic development events, and provide individuals with information about scientific concepts and careers. This change in focus will allow instructors on the mobile launch pad to bring real life activities, computer simulation programs, industry equipment, scientific expertise and career information to individual students and the public. It will also highlight the advances and support that North Carolina provides to its scientific community. Areas wishing to replicate this model may want to think about diversified funding to support and sustain their mobile laboratory programs. The BioNetwork Mobile Laboratory is part of the Mobile Lab Coalition, http://www.mobilelabcoalition.org.

“Science Express,” St. Cloud State University, St. Cloud, MN

As one of the several planned programs of the Strategic Alliance for Bioscience Research and Education (SABRE), St. Cloud State University has recently launched the “Science Express” for K-12 students and teachers. The mobile laboratory is intended to bring hands on scientific learning to underserved students, initially in the state’s large rural communities with possible expansion to other areas. Over 60 percent of schools in Minnesota have fewer than 100 students in their graduating class, and thus do not have the critical mass to develop scientific laboratories. The “Science Express” is meeting this challenge by bringing sophisticated high-end equipment to schools throughout the state.

9 Sponsored by the Minnesota State Colleges & Universities Bioscience Initiative, SABRE is comprised of St. Cloud State University, Minnesota Community and Technical College, Anoka-Ramsey Community and Technical College and Ridgewater Community College.
Stages in the Development /Evolution of a Mobile Lab Program

**Stage One** (Launch: years 0-2) - typically seed funding from an academic institution (in St. Cloud’s case the Minnesota State Colleges & Universities BioScience Initiative), supplemented with donations from corporate and foundation partners.

**Stage Two** (Transition: years 3-5) - typically funded through a combination of federal grants (i.e., NIH-SEPA grants), a maturing relationship with the institutions that supported stage one, and expansion of the support base.

**Stage Three** (Mature: year 5 and beyond) - by this time, the lab programs have developed a solid support base. Some existing mobile lab programs are intimately connected to economic development organizations (i.e., Maryland); others, to academic/private/corporate support (i.e., Connecticut and Ventner Institute) and some have become a line item in the state budget (i.e., North Carolina though this has been a mixed blessing, as previously discussed).

Bruce Jacobson, Associate Professor, Director of Bioscience Outreach, Department of Biological Sciences, St. Cloud State University

The Science Express was developed through a seed grant from the state Bioscience Initiative and donations from Medtronic (the trailer) and Innovative Laboratory Systems (the lab furniture and benches). The Express includes both conference and lab space that can accommodate up to 36 students. Launched in summer of 2009, the Science Express summer program offered four professional development training workshops for K-12 teachers. The teacher workshops are being used to prioritize scheduling for the school program, which began in September of 2009.

The Science Express includes a staff teacher and a driver who helps set up and take down the labs. The project is hoping to develop a “fellowship program” that will give existing school teachers opportunities to serve as instructors in the mobile laboratory, and also hopes to employ recent science graduates to support both the mobile lab and science classrooms.

As with North Carolina’s Mobile Laboratory, the Science Express is also aimed at creating a broader awareness of life science careers among the general public. Building on an existing partnership between rural schools and community colleges, the mobile laboratory will play a part in supporting community events and activities. Bruce Jacobson, of St. Cloud State University, states that the concept of “invitation” is key. Parents, students and community members who visit the lab will be encouraged to come to bioscience workshops offered at the local community colleges.

Jacobson stresses the need to think about long-term sustainability in putting this together, citing three stages in the development /evolution of a mobile lab program: Launch, Transition, and Mature. “We are pursuing a path consistent with these stages” (see side bar), he continues. “As we enter stage two, we are pursuing both state and federal funding. We also continue to develop and expand our support base.”
Industry Involvement in Multi-Stakeholder Partnerships

Another factor in building the success of community college biotech programs is by linking workforce development with regional economic development. This is best achieved through the involvement of additional stakeholders in the industry and education collaborations.


An excellent example of this type of strategic partnership was the Biopharmaceutical Manufacturing Certificate program, which took place at Skyline and Ohlone colleges in the early part of 2000. After significant lay-offs in the travel and tourism industries in the wake of 9/11, the Colleges were able to put together a short (initially, twelve-week) customized biomanufacturing program that supplemented the technical skills of participants (many of whom had been mechanics, pilots, or maintenance workers from the airline industry with math and reading levels at or above 9th and 10th grade) with biology and chemistry.

The program met both an urgent need among dislocated workers to retrain for high-growth, high wage careers, and within industry in getting its products to market. Genentech, and later Amgen, Bayer, Novartis and their supplier companies, participated in the program.

Clear roles, common vision

The success of the Skyline and Ohlone programs was grounded in their ability to coalesce key stakeholders around a common vision with clearly-defined roles for each. The San Mateo and Alameda Workforce Investment Boards were instrumental in leveraging funds, coordinating partners and managing performance outcomes to help meet a critical economic need. Industry partners determined the desired skill sets, gave input to curriculum, provided internships and career guidance, and hired qualified graduates. Skyline and Ohlone Colleges developed customized industry-relevant pre-employment training that quickly prepared individuals for placement. The county One-Stops recruited, assessed and supported participants through training and placement (including career counseling, resume development, and interviewing techniques) based on employer needs. The San Mateo Central Labor Council gave input into a program design that supported participants during training.

Recognition and reward

Over a three-year period the program graduated 180 students, approximately 90 percent of whom were placed in industry positions, and received the Recognition of Excellence Award from the U.S. Department of Labor in 2005. The program eventually transitioned to a one-semester certificate program. Currently, because the program is attracting younger individuals with fewer technical skills who need more background training, Skyline College is developing a one-year module. In addition, for students at lower skill levels, the College developed a Gateway to Biotechnology that trains students in basic skills before transitioning them to the Certificate program.

This strategic partnership has been institutionalized - first in the Bay Area Biotech Consortium, and later as the Biotech Workforce Network - with a mission to respond coherently
and quickly to regional workforce and economic development issues. The partnership included additional pilots that retrained disadvantaged individuals and dislocated engineers for specific biotech careers.11

Industry, Workforce Intermediary, Community Based Organizations and Education: City College of San Francisco’s Bridge to Biotech/Lab Assistant Certificate Program

The Bridge to Biotech/Lab Assistant Certificate program at CCSF was developed principally for working adults who wanted to re-train for careers and ongoing education in the life sciences. The program also sought to increase the numbers of underrepresented individuals in the College’s advanced biotech certificate programs.

As in the previous model, the program was a response to both a critical workforce and economic development need. As the City of San Francisco focused on developing an industry cluster in the Mission Bay area surrounding UCSF, the program responded to the need to develop a local workforce pipeline that would meet industry demand at multiple skill levels.

Initially a partnership with the San Francisco Chamber of Commerce affiliate’s On-Ramp to Biotech, outreach for the program targeted low-income adults from distressed communities with 4th and 5th grade math and reading levels, and later evolved to target individuals at the 7th and 8th grade levels once the program was institutionalized at the College.

Clear roles, common vision

The success of the early program could be attributed in part to a strategic partnership between the College, the Chamber’s workforce intermediary (SF Works), two major research institutions, a community-based organization and a combination of government and philanthropic entities. As in the case of the prior model, the collaboration aligned key partners with clearly defined roles around a common strategic goal.

With the program target in mind, CCSF designed an interdisciplinary program that reinforced students’ basic skills, embedding them in a practical context connected to students’ education and employment goals. In this intensive program, students learn essential laboratory skills while strengthening the math and language aptitude necessary for success in the workplace and in ongoing education. During the second semester, students practice this learning through internships at local research labs or biotech companies. All coursework is credit-bearing and counts toward CCSF’s Biotechnology certificates or A.S. degree.

During the program’s first four years, SF Works partnered with CCSF to raise funds and outreach to potential participants. A community based organization assessed candidates’ skills and preparedness and provided professional development courses and coaching to students throughout each program phase. The workforce intermediary enlisted and managed relations with laboratory employers, coordinated program

www.BiotechWorkforceNetwork.com
12 SF Works was created by the San Francisco Chamber of Commerce, the Committee on Jobs and the United Way of the Bay Area to develop industry-relevant workforce training in growth industries for the City’s low-income residents. It developed the On-Ramp to Biotech program in partnership with CCSF as a feeder program for the Bridge to Biotech program, which was later restructured and absorbed into the Bridge to Biotech/Lab Assistant Certificate Program once the program became institutionalized at CCSF in 2007.
partners, and ensured that performance benchmarks were met.

Industry partners have provided continuous improvement for the program through several feedback mechanisms, while supplying students with critical hands-on skill development and career readiness guidance. Many of them have hired qualified program participants and graduates.

Program success

With this foundation in place, CCSF was able to institutionalize, restructure and bolster the program, transitioning it into a one-year certificate program that enables students to receive concrete on-the-job training and college credit while further developing their skills. Since the program’s inception, a high percentage of students have consistently been hired from their internships – over 75 percent in some cohorts, and nearly all of them while continuing in the College’s additional biotech certificate programs.

Through the strategic collaboration of diverse partners, both the Skyline/Ohlone and CCSF programs have responded to key workforce and economic development needs in their regions, enabling students with limited scientific backgrounds to quickly acquire the hands-on skills needed to respond to industry demand.


Seven years ago, a large foundation invited a group of elected officials, private sector citizens from the Worthington community, and Chamber of Commerce and Economic Development representatives to come up with a strategic economic development project for the region. The foundation agreed to fund the project if it was compelling. The group met with fifteen different stakeholder types, including City Council members, senior citizens, service clubs, and representatives of education, the retail, manufacturing, and health care industries.

The group identified three factors, which it developed into an opportunity statement for promoting biosciences in the region:

1. Two large bioscience (animal vaccine) companies were already located in the region.
2. An additional local animal vaccine company planned to build its corporate headquarters in Worthington.
3. The state had a new governor who wanted to focus on the bioscience sector.

13 Sometimes referred to as a “problem statement,” an opportunity statement describes what a potential investor expects to gain from its investment and includes a designed solution.
The group then began to think about how the bioscience and agricultural sectors could complement one another. They recognized early on that they first needed to come up with a clear definition of “bioscience” and what it meant in the region. In thinking about how to draw on the region’s strengths, all agreed that bioscience could be a growth sector as long as it was tied to the area’s natural resources.

This spawned the development of several innovative bioscience initiatives in the region:

- **Industrial Applied Lab Technology Program** – meeting employer needs for trained Industrial Applied Lab Technicians.
- **Worthington Training & Testing Center** – designed to comingle industry and educational training and entrepreneurship.
- **Science Clubs** – a response to plummeting interest in science careers among Worthington public school students.

The innovations that have emerged out of the Worthington area – a rural region without a large life science cluster – further demonstrate how industry, education and economic development stakeholders can work together to harness a regional strength, providing mutual benefits to students, companies and the local economy.

14 Though meat processing companies had heretofore been perceived as the area’s most significant industry, water deficiency would prevent any serious growth of this sector.
Pioneering collaborations involving industry and education are taking biotech programs beyond traditional classroom learning, creating meaningful interactions with far-reaching impacts on students, faculty, community colleges, life science professionals and companies, and communities. Community colleges throughout the country are finding significant ways to involve industry in their biotech programs, capitalizing on their programmatic strengths in order to create substantive learning experiences for their students. These colleges have learned that there is no substitute for providing students with the opportunity to “try on a career” by working alongside life science professionals - performing research and laboratory tasks and receiving professional feedback on their own career development.

Life science professionals and companies also reap an array of benefits from interactions with biotech students and faculty, including useful assistance with important tasks and the identification and development of key talent.

The challenge now is to expand these college-industry interactions and ensure their sustainability. College and industry leaders must work to grow and institutionalize their cooperative relationships in order to insulate them from changes in institutional landscapes as college faculty or administrators retire, key industry personnel take on new career opportunities, or temporary budget constraints impact college programs or industry participation.

Collaborative industry and education programs are tasked with producing students who possess the interest, motivation, knowledge and hands-on skills they will need to compete and prosper in this innovative industry. By promoting the sharing of best practices and helping to address the challenges these programs face, Bio-Link is seeking to replicate success by promoting a culture and system of mutual learning.

Bio-Link is committed to playing a key role in promoting these efforts and its expanded Next Generation ATE Center for Biotechnology and Life Sciences will work closely with community college biotech programs and industry on issues of sustainability and institutionalization. In particular, Bio-Link will address:
• Strategies for establishing broad company buy-in to partnerships with community college biotech programs, so that collaborative efforts do not suffer when there is turnover in company or college personnel.

• Ways in which biotech faculty can coordinate and manage programs that include a strong component of industry participation.

• Approaches to ensuring the support of community college administrators for in-depth cooperative relationships between their college biotech programs and local life science companies, particularly when the relatively high cost of biotech courses may discourage budget-constrained colleges from offering a broad selection of courses.

• Opportunities for college biotech programs to develop a diversified funding base that can cushion occasional college or industry budget constraints.

• How to advise college programs about industry trends that may require new or modified biotech curricula in order to ensure continuing program relevance to industry needs.

Bio-Link will also continue to work directly with life science companies, institutes and trade associations in order to raise industry awareness about the value and relevance of community college biotech programs and the important ways in which industry can benefit from engagement with these programs as education partners.
APPENDIX

Biotech Programs by Institution
Contacted for this Report

**American River College**
Ken Kubo
Professor of Biology
kubok@arc.losrios.edu
Sacramento, CA

**Austin Community College**
Patricia Phelps, Chair, Biotechnology Dept.
trish_phelps@yahoo.com
Linnea Fletcher
daughter53@aol.com
Austin, TX

**Bio-Link**
Elaine Johnson, PI/Executive Director
ejohnson@biolink.ucsf.edu
San Francisco, CA

**Biogen Idec Community Lab**
Tracy Calahan, Director
tracy.callahan@biogenidec.com
Cambridge, MA

**California Applied Biotech Centers**
*(Cal ABC)*
Jeffery O’Neal, State Director
Dean, American River College
onealji@arc.losrios.edu
http://cccbiotech.org/iist.html
Sacramento, CA

**CalABC, Bay Area**
at City College of San Francisco
Nora Lem, Director
nlem@ccsf.edu
San Francisco, CA

**CalABC for Silicon, San Joaquin**
*and Central Valleys*
at Ohlone College
Josie Sette, Director
jsette@ohlone.edu
Fremont, CA

**City College of San Francisco**
James Lewis, Bridge to Biotech/Lab Assistant
Certificate Program
jlewis@ccsf.edu
Edie Kaeuper, Bridge to Biotech/Biomanufacturing
Certificate Program
ekaueper@ccsf.edu
Philip Jardim, Biotechnician Certificate Program
pjardim@ccsf.edu
Carin Zimmerman, Stem Cell and Genomics
Certificate Programs,
czimmerman@ccsf.edu
San Francisco, CA

**Contra Costa Community College**
Kate Levine, Professor of Biological Sciences
KLlevine@contracosta.edu
Katie Krolikowski, Asst. Professor of Biology
and Biotechnology
kkrolikowski@contracosta.edu
San Pablo, CA

**Foothill College**
V. Celeste Carter, former Director Biotechnology
and Bioinformatics Programs
Division of Biological and Health Sciences
vcelestecarter@gmail.com
Los Altos Hills, CA
National Center Biotechnology Workforce
Russ H. Read
Executive Director
Forsyth Tech Community College
rread@forsythtech.edu
www.biotechworkforce.org
Winston-Salem, NC

North Carolina Community College BioNetwork Mobile Laboratory
Lisa Richman, Instructor, Mobile Lab
Capstone Center – WTCC/BTEC, NCSU
Centennial Campus
imrichman@waketech.edu
http://www.ncbionetwork.org
Raleigh, NC

Ohlone College
Ron Quinta, Dean, Science, Engineering and Technology
rquinta@ohlone.edu
Fremont, CA

Peralta District: Merritt College
Gisele Giorgi, Director, Certificate of Bioscience Microscopy Program
Merritt College Microscopy Program
ggiorgi@peralta.edu
Oakland, CA

Salt Lake Community College, InnovaBio
Craig Caldwell, former Director, current Department Chair
Craig.Caldwell@slcc.edu
Salt Lake City, UT

Skyline College
Nickolas Kapp, Professor, Biotechnology
kapp@smccd.edu
Melissa Michelitsch, Professor, Biology
michelitschm@smccd.edu
San Bruno, CA

St. Cloud State University
Bruce Jacobson, Associate Professor, Director of Bioscience Outreach, Dept of Biological Sciences
bljacobson@stcloudstate.edu
St. Cloud, MN

Solano Community College
James DeKloed
Director, Industrial Biotechnology Program
jdekloe@solano.edu
Fairfield, CA

Worthington Regional Economic Development Corporation
Glenn Thuringer, Manager
gred@frontiernet.net
Worthington, MN
Bio-Link’s mission is to strengthen and expand biotechnology technician education at community and technical colleges throughout the nation. The Center seeks to increase the number and diversity of well-trained technicians in the workforce, meet the needs of industry for appropriately trained technicians, and help community colleges develop effective educational practices. Bio-Link seeks to achieve four broad goals in pursuit of this mission: 1) Provide support for students and technicians, 2) Improve instruction and learning, 3) Share information and resources, and 4) Foster collaborations and partnerships.

Bio-Link has played a critical role in supporting biotechnology program and enrollment growth at the nation’s community and technical colleges and has made essential contributions to ensuring that some 100 biotechnology programs at these colleges deliver high-quality education and training. The Center serves as a resource for colleges seeking to develop new biotechnology programs and has worked with existing programs to help them bolster their courses, strengthen student recruitment and retention, and facilitate student career development. Bio-Link pursues five broad types of mutually reinforcing activities in order to produce these results:

1. **Building national collaborative networks of educators, industry, and community members.**
   The Center has been instrumental in the development of nation-wide connections among biotechnology educators and in helping educators make essential links to the biotechnology industry. These national collaborative networks have become a productive means for encouraging and facilitating biotechnology program growth across the country. Once these links are forged, curriculum and instructional approaches are shared, strategies to improve and expand biotechnology programs exchanged, and programs may begin to work together to raise funds and develop connections to industry.

2. **Supporting community college and high school instruction.**
   Bio-Link directly supports instruction by providing professional development through annual Summer Fellows Forums. The five-day programs provide community college and high school educators from across the country with a series of substantive workshops and presentations aimed at enhancing their knowledge and strengthening their teaching of life science concepts. More than 500 instructors and administrators have attended these workshops. Together with other professional development workshops conducted by the National and Regional Centers, the Forum has made a substantial impact on the quality of biotechnology instruction across the country, as instructors who have participated in the Forum over the years currently teach more than 40,000 students per year.

   Another way in which Bio-Link directly supports instruction is through the **Clearinghouse of Curriculum and Instructional Resources for Biotechnology Technician Education.** The Clearinghouse provides not-previously published college and high school curriculum and instructional materials, developed by faculty and curriculum development specialists from across the country, and makes these materials available to qualified professionals at no cost. The Clearinghouse currently has over 2,400 registered subscribers.

3. **Involving industry in biotechnology education.**
   By involving industry in community and technical college biotechnology programs, Bio-Link is able to: secure internships for students and faculty; provide information to industry about the merits of community/technical college biotechnology programs and graduates; secure industry help with recruiting and motivating students to pursue careers in biotechnology; identify future workforce needs and the technical skills that workers should bring to the job market; involve industry in college efforts to improve instruction and learning, and: obtain direct
support from industry for specific Bio-Link initiatives. The Center works with local, regional and national industry organizations and provides models of biotechnology program-industry collaboration in its newsletter, at site visits to community colleges, and at meetings and presentations around the country. Bio-Link’s Regional Centers also actively cultivate industry connections and participation in local programs.

4. Disseminating information. Encouraging and facilitating biotechnology programs to learn from one another is a central component of Bio-Link’s mission. Bio-Link disseminates information mainly through its website (www.bio-link.org), its bi-annual newsletter, and presentations at conferences and meetings. The website maintains a host of features for students, faculty and industry, including a listing of employment opportunities by state, links to student internship and faculty professional development opportunities, an online discussion group, resume postings, and links to the Regional Centers and to Bio-Link newsletters, among other features. The website is currently being enhanced to include more in-depth career knowledge for students, social networking and information-sharing opportunities, and additional resources for life science teachers.

5. Institutionalizing biotechnology programs at schools and colleges. Bio-Link works to institutionalize biotechnology programs by providing direct consulting assistance to programs and community colleges across the nation. Advice covers a wide range of issues, including professional development, instructor evaluation, student assessment, curriculum development, recommendations for instructional materials, student recruitment, internship programs, assistance with grant proposals, and community college articulation with high schools or four-year institutions. It has also addressed broader issues, such as how to plan and implement a new biotechnology education program. Since Bio-Link’s inception, the National and Regional Centers have provided this kind of direct assistance to well over 100 biotechnology programs and educational institutions. In providing this advice, Bio-Link has particularly emphasized ways for programs to recruit and assist underrepresented students.