



The CCP Report

The Community College Program @ BIO2013

O C T O B E R 2 0 1 3

Biotechnology professionals converged along Chicago's lakefront this year, flocking to the enormous McCormick Convention Center for BIO, the annual global biotechnology industry convention.

At the same time, panels of educators and industry professionals convened to commence the 10th Annual Community College Program.

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NSF DUE Award
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Keynote Address from Duncan McBride

Duncan McBride, Program Director and Section Head of the Division of Undergraduate Education (DUE) at the National Science Foundation (NSF), had the honor of delivering the keynote address to the CCP audience. In his talk, McBride focused on the importance of the Advanced Technological Education (ATE) centers in training technicians for high technology fields, such as biotechnology.

McBride opened his talk with a challenge to the audience. "I'd like to call your attention to seven new to ATE projects. Are we networking with them? Are we mentoring them? Do we know about them? I hope they can become involved with this group, please welcome them into your community."



Duncan McBride at the 10th Annual Community College Program

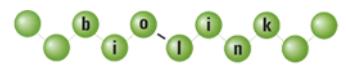
McBride then transitioned to discussing the importance of securing grant funds to support workforce training programs. "One way we're going to get more biotech grants is to get more—good—biotech proposals. Proposals need good ideas, good science, good technology and capable people. That is the essential part of this whole business of getting good proposals." According to McBride, a good proposal builds on what other people have done; a good proposal will describe how the grant funds will be allocated to build on the past in order to move into the future. Additionally, proposal writers must remember that details are important. Explain how a project will be structured, who is going to do it, where it's going to lead.

There is also an emphasis on establishing relationships with industry partners to provide support and jobs. "We would like specific roles for companies, making specific commitments to provide expertise and prospects for jobs. It doesn't have to be complete and sealed and signed before the proposal comes in. But it really would be nice to have a few letters in the supporting section from companies."

Another important detail to consider, said McBride, is the amount of money requested in a proposal. "The project should be appropriate for the money requested. Don't start with the number and work into it. Start with a project and what you need to do it. Also, get support from the college. Get the dean to write a letter putting the proposed project into the context of the college."

All NSF ATE proposals are peer reviewed. A biotech proposal will have reviewers from two year colleges, four year colleges, from industry, and sometimes from secondary schools. Reviewers of any NSF proposal reflect the community to which it speaks in the large sense. Diversity is important when potentially awarding large sums of funding.

"We've gotten proposals from people we know are good, and from regions we know need programs, but have had to turn them down. We would like to fund more but we can't without good proposals," concluded McBride, to a round of applause from the audience.



Developing Successful Industry-Community College Relationships



With biotechnology industry leaders from around the world gathering at the Chicago BIO conference, Community College Program panelists discussed tapping into the current dynamic growth in the biotechnology industry. Industry leaders told the crowd that companies' increasing growth in biomanufacturing, in medical devices, tissue fabrication, antibody engineering and other advanced products, increases their need for appropriately trained technicians. The panelists focused on active relationships with community colleges, which are crucial to meeting workforce demands. Moderator Deborah Sullivan-Davis, a biology instructor at Bluegrass Community and Technical College in Lexington, Kentucky, introduced the panel.

Transposagen Partners with Bluegrass Community and Technical College

From left: Jo-Ann Hongo, Senior Scientific Manager, Genentech; Eric Ostertag, M.D., Ph.D., CEO, Transposagen Biopharmaceuticals, Lexington, KY; Ayla Annac, Ph.D., CEO, In Vivo Sciences, Madison, WI; Kenneth Miller, Ph.D., Chair, Anatomy & Cell Biology, Oklahoma State University, Tulsa, OK; David St. John, Director, Human Resources, Cook Pharmica, Bloomington, IN; Deborah Sullivan-Davis, Bluegrass Community and Technical College, Lexington, KY

Transposagen is focused on one of the fundamentals in pharmaceutical industry research: the \$1.2 billion annual market in rodents used for research. The rodent model market is experiencing double digit annual growth.

"We now have the cheapest, easiest, fastest way to induce pluripotent stem cells and grow a human organ in a rat. Companies can test how a drug will perform in a rat with a human liver," Dr. Eric Ostertag, M.D., Ph.D. told the audience. He founded Transposagen while he was still in medical school, basing it on work he did as a graduate student using "mobile DNA."

Transposagen now has the industry's most versatile collection of technologies for production of genetically engineered rodents and provides off-the-shelf and custom rat models to more than fifty companies and institutions around the world.

The relationship with Bluegrass Community and Technical College started in 2010. "We've hired multiple grads and interns; we have a few working with us right now. The community college is a partner with us."

Ostertag told stories of students' success in his company, and explained future plans for the development of a new facility with the goal of training large numbers of students each year. "We're doing other projects from our new headquarters in Lexington. We are planning a life sciences Collaborative Educational Learning Lab (CELL) that will train up to 50-60 scientists per year. It will have a contract research organization function. We'd like to have an incubator for biotech in Lexington—put all these things in same building. We can provide discounts for biotech companies; share equipment, share conference rooms. This is where students help can really make a difference. They can do actual, profitable projects and can get themselves hired."

In Vivo Sciences Seeks Relationships with Local Colleges

Ayla Annac, Ph.D., CEO of In Vivo Sciences in Madison, Wisconsin, described her tissue engineering company's position in the \$12 billion global market, expected to exceed \$30 billion by 2018. Her company uses highly technical processes to manufacture and deliver advanced products that are much needed in this rapidly growing market. Using human cells, including elements derived from induced pluripotent stem cells, In Vivo Sciences produces living, engineered tissues. "We are in the business of fabrication of tissues; we do three dimensional engineered tissues," Annac told the CCP audience. "We work with partners in many areas: pharmaceuticals, cosmetics, academia, and biodefense."

Annac credited her partnership with the local community colleges for providing a trained and

capable workforce. "I'm very pleased and excited to be here and partnering with the community colleges. My relationship started in Madison when I first learned there was a group of students at a nearby community college that was learning how to deal with cells, stem cells - how to manipulate them, how to be able to treat them. I was very thrilled to know this because we need people who know how to handle cells. We need technicians who can really work, in a fast and efficient manner, with the cells that we will take into the tissues."

"We need a workforce that can use tissues and the community college produces them. We hire their graduates, they are very skillful people. And we give feedback to the colleges to help them to continue developing the training."

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Cook Pharmica Connects with Ivy Tech Community College

Cook Pharmica, a contract development and biologics manufacturing organization with more than 450 employees, started in 2004. As David St. John, Director of Human Resources explained, "We are a subsidiary of Cook Medical, which is the largest privately held medical device company in the world; it has \$2 billion in sales in 135 countries, involved in 43 disciplines of medicine. This year it's been in business for fifty years." The advanced bioscience company's partnership with nearby Ivy Tech Community College, began, at its inception.

"Cook Pharmica and Ivy Tech's biotechnology program were both established at the same time. The Ivy Tech campus is not far away from us. We've built understanding in the development of our mutually beneficial partnership. They help meet our workforce development needs. We hire interns, technicians, and operators through Ivy Tech's education programs. Plus we have a tuition reimbursement program."

According to St. John, the hands-on learning experience provided by community colleges make their graduates attractive candidates. "We've had 35 interns since 2006 and hired 30 of them," said St. John. He elaborated on the positive effects of the internship program: "It's a great experience because in three months they get a sense of the environment, they can tell whether they'll like it or not. In three months we get a great experience of somebody's performance. You can learn a lot about someone after working three months in an internship. And you can tell someone who doesn't get it."

He concluded with more praise for Ivy Tech. "As we've grown, as the demand has grown, it's getting more difficult to find people in our backyard. There has to be a way to grow our own talent. This is why the relationship with Ivy Tech Community College is so great. Our hires from there stay with us in our community. And we offer career advancement opportunities."

Genentech Encourages Local Collaboration

The biotechnology industry pioneer and leader, Genentech, was represented by Jo-Anne Hongo, Senior Scientific Manager of the Department of Antibody Engineering. She helps bridge the company's twenty-year-long partnership with the City College of San Francisco by working as an active adjunct faculty member in the Biotechnology Program and playing a key role in the Genentech's outreach to the community.

"Genentech takes great pride in its scholarship program. The company reaches out to talented technology and biology students annually. There are not only monetary awards but internships at Genentech as well. We have internships and cooperative programs. We like to have fun with and we're proud when we're giving tours to student groups. Our employees who were students on tour once themselves are very happy to meet them."

Partnership Possibilities at Four-Year Colleges

Beneficial workforce development partnerships are not limited to industry and community colleges. Take the partnership between Oklahoma State University and Tulsa Community College.

Kenneth Miller, Ph.D., Chair of Anatomy and Cell Biology at Oklahoma State University in Tulsa, Oklahoma, began his presentation by describing the impressive program at Tulsa Community College.

"Diana Spencer's students there are learning molecular biology techniques, cell culture techniques, general biology. The stated purpose of the TCC biotechnology department is to 'create an infrastructure to support the feeding, fueling, healing, and cleaning of the world.'" Miller explained that his relationship with Spencer has been highly beneficial to their respective programs throughout the years. "I hired the first graduate from the TCC biotech program as my research laboratory assistant at Oklahoma State in 2009. Now he runs my lab."

DEVELOPING SUCCESSFUL INDUSTRY-COMMUNITY COLLEGE RELATIONSHIPS

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From left: Michael Ayers, **Dean of Math, Science and Technology at Forsyth Community Technical College, Winston Salem, NC, Learning Skills Hub Director;** Senyong Lee, Ph.D., **Faculty, Ivy Tech, Medical Devices Hub Director;** Sonia Wallman, Ph.D., **Executive Director and Principal Investigator, NBC2, Biomanufacturing Hub Director;** Russ Read, **Executive Director, National Center For The Biotechnology Workforce, TAA c3bc Project Director;** Elaine Johnson, **Executive Director, Bio-Link, Lab Skills Hub Director.**

Community Colleges Work to Develop a New Bioscience Credential System for Core Skills

Forsyth Technical Community College was awarded a Department of Labor (DOL) TAA CCCT grant of just under \$15 million to create the Community College Consortium for Bioscience Credentials (c3bc), led by Russ Read, Executive Director of the National Center for Biotechnology Workforce. The DOL Trade Adjustment Assistance for Workers (TAA) is a program for those who've lost their jobs due to foreign competition. The Community College and Career Training (CCCT) program directs federal resources to the nation's network of community colleges to help displaced workers gain new skills. Twelve high-performing community colleges are working together to make improvements in bioscience worker training, develop industry-recognized credentials, and accelerate the completion times for training programs and getting back to work.

As he opened the panel, Read told attendees: "There's a need for the Biosciences Consortium. There is no national program for the acquisition of an industry-recognized credential associated with core skills. No good pathways for people to get good jobs. The public workforce systems are simply not geared toward matching skills and preparation with previous training and industry experience here." In January 2013, the Consortium started its work with 45 bioscience companies and other stake holding partners. c3bc will leverage national resources to develop four quadrant hubs: biomanufacturing skills; lab skills; biomedical device skills and learning skills to produce an overall c3bc Core Bioscience Skills Standard.

Before introducing the panel, which consisted of the representative partners in the grant, Read concluded, "Moving forward with technician training, we expect more than 25 new courses or credentials will be developed in the Biosciences. We will also improve with focused and accessible online learning opportunities... game-like applications for training or re-training bioscience workers."

Elaine Johnson, Bio-Link Executive Director and laboratory skills hub director for the new Biosciences Consortium, began her presentation by reflecting on the past. "When we started this work with community colleges in 1998, we didn't know where the programs were, we weren't working together, we were in isolation." She continued with an optimistic view of the future: "We are not isolated anymore. In fact we've formed all sorts of relationships with the National Science Foundation and we continue developing relationships through the DOL and the many industry groups."

Johnson described some of the challenges involved in training the biotechnology workforce: no industry recognized credentials, no unified system for remote learning, no tracking system for following those who complete programs, and no universal public workforce system for biotechnology.

The c3bc grant addresses ways to overcome these barriers. A key tactic involves standardizing skills. Johnson discussed current efforts underway. "We've organized a publication called 'Common Core Technical Skills.' It's available online. This is the document we will circulate and use as we harmonize. It's not final but it's a start. Now it's organized in a way that can really be shared."

As skill standards are revised as needed, Johnson told the crowd, resulting core competencies will help contribute to creating portable credentials that can be stacked and latticed. "We can develop different types of courses and certificates: shorter, bridge, post-baccalaureate, that can help participants get good jobs."

"There's a need for the Biosciences Consortium. There is no national program for the acquisition of an industry-recognized credential associated with core skills."

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As biomanufacturing hub director and Co-PI for the c3bc, Sonia Wallman brings strong resources and experiences to the goals of establishing skill standards. As Executive Director of the Northeast Biomanufacturing Center and Collaborative (NBC2), her work includes years spent harmonizing biomanufacturing skills standards with industry, academic, and community partners. "In 2007 we had a skills standard meeting with many diverse partners—Ireland came as a global partner—to harmonize the existing biomanufacturing skills. These are being updated with the help of current biomanufacturing technicians and will be used to build the bioscience core credential.

"With our Hub partners, we are building biomanufacturing suites housing up-to-date equipment. We're all buying from a single list and will collaboratively write new equipment and process SOPs." These advances, coupled with other updates will provide stacked and latticed credentials as part of the biotechnology programs at LA Valley, Bucks and Montgomery County community colleges.

Sengyong Lee, c3bc hub director for medical devices, organized the first National Medical Devices Skill Set Harmonization Meeting in March 2013. Before describing this groundbreaking event, Lee outlined the situation. "The medical devices industry started a little later so we don't have standard skills sets, yet. We don't have harmonized curricula, yet."

One of the few American manufacturing industries that consistently exports more than it imports, 32 of the 46 medical device companies with more than \$1 billion in annual revenue world-wide are based in the United States. The industry employs more than 400,000 Americans directly. "Companies have various jobs, ranging from simple ones like assembler, which may not require more than a high school degree, all the way up to Ph.D. in R&D. There are also jobs in the interface with regulatory guidelines, and in quality control positions. So there are various career opportunities that require workers with a diverse education background."

A strong network of partners has emerged in the medical devices division of the grant in recent months. "Currently we have eight college partners across six states. We all share the same vision and goals," explained Lee. Working together since the grant was awarded last fall, Lee discussed how the first harmonization meeting was created. "Each partner college established relationships with their own regional industry partners to collect information on entry-level jobs, tasks, and skills."

Lee provided a detailed vision of the work of the medical device hub. "Once we're done identifying nationally harmonized skill sets for the medical devices jobs, we can align ours with similar results from the biomanufacturing hub and the lab skills hub. This will identify the core Bioscience Skills. These will become the basis for industry recognized Bioscience Core Credential. That is our overall goal."

Wrapping up the panel was Michael Ayers, Dean, Math Science and Technologies, at Forsyth Tech and the learning skills hub director. "One of key pieces of the TAA c3bc grant is that we want students to progress very quickly through the training so they can get a good-paying job. But we don't want to compromise learning; we want to keep our standards," Ayers said. "So part of what we've done is hire a whole team of instructional designers who create some really cool stuff that help people learn more effectively. We're building curriculum to support the biotechnology degrees and certificates we're offering."

Ayers is dedicated to creating a modular system for learning. Developing this type of learning system will help accelerate course completion. "We want to build our program to make it easier for students to learn. And we are very sensitive to different ways people learn so it will be appealing to each learner." Ayers emphasized that the curriculum design team charged with the development of these modules is dedicated to working with industry recruiters to ensure that the necessary skills are taught and retained.

"...there are various career opportunities that require workers with a diverse education background."



The Community College Program at BIO 2013 was organized by a group of biotechnology workforce development leaders: (from left) Duncan McBride, Program Director and Section Head in the Division of Undergraduate Education, National Science Foundation; Elaine Johnson, Executive Director, Bio-Link, National Science Foundation Advanced Technological Education Center; Sonia Wallman, Ph.D., Executive Director and Principal Investigator, NBC2, National Science Foundation Advanced Technological Education Biomanufacturing Center and Collaborative; Russ Read, Executive Director, National Center For The Biotechnology Workforce, TAA c3bc Project Director, DOL TAA Community College and Career Training Program

COMMUNITY COLLEGES WORK TO DEVELOP A NEW BIOSCIENCE CREDENTIAL SYSTEM FOR CORE SKILLS

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ACES OF SUCCESS

Community college students who complete biotech programs and gain successful positions in the industry are the Faces of Success at the annual Community College Program. These individuals share their career pathways to rewarding high-skill, high-wage positions in the biotechnology, biomanufacturing and medical device industries.

Cagney Coomer, Research Technician

Advanced Genetic Technology Center, University of Kentucky

Graduate of Bluegrass Community Technical College

"I did my undergraduate degree in biology and chemistry, and graduated cum laude, but I had no real working experience. I thought I'd get a job right away. I was intelligent but having no experience closes doors," Coomer told the CCP attendees. As she searched for a job in vain, she described her thought process: "How do I get experience if no one will give me a chance? Where do I go? That was my dilemma." To remedy the situation, Coomer began her search for a training program. Bluegrass Community and Technical College (BCTC) was at the forefront. She felt that BCTC was concerned about her abilities to get a job. "They were showing me why I needed to learn. They could give me hands-on tools." Coomer made an important connection with a mentor at BCTC. "He helped me find my job at the Advanced Genetic Technology Center of the University of Kentucky doing DNA next generation sequencing. At the same time I was also doing cloning, getting the DNA ready for sequencing. All the skills I use at my job I learned at BCTC."

While working at the University of Kentucky, Coomer returned to BCTC to take another nucleic acid class. "The class tied everything I was doing at work together," raved Coomer. "I became ten times better at my job than I was at the beginning of the semester. All this has made a difference in my life and my career. Currently, I'm doing research at my school on aloe. These are real life experiences. The work, it's up to me but I have deadlines. It has a lot of potential. I'm extracting DNA, extracting RNA, doing cell culture... I feel real proud of all my skills."

Terence Ho, Research Associate

Genentech

Graduate of City College of San Francisco

"In 2000, I started at UC Berkeley studying molecular and cell biology. This provided me with a very good theoretical and conceptual foundation. But I knew I needed additional skills to fit into a research environment. That requires a high level of technical and laboratory equipment experience." Where to find actual industry experience became Terence Ho's question. "In 2002, the City College of San Francisco Biotech Program came to the rescue! I could take evening courses and gain hands-on training. CCSF provided a broad range of practical and hands-on experiences. Plus the evening biotechnology and stem cell courses offer flexibility."

Ho praised CCSF's welcoming environment and dedicated faculty. He even recounted a time when power was lost in the lab and his instructor provided the flashlights necessary to conclude a three-day series of experiments in the dark. "CCSF prepared me for working in the real world. The core skills I learned there prepared me for my research position. That learning helped me make the transition very smooth." Ho concluded his presentation with a quick account of his professional experiences: "In 2008 I was promoted as site manager at UCSF. In 2012, I was hired at Genentech in the FACS lab—fluorescence activated cell sorting."

Now well-positioned, Ho also wants to give back. "I host lab tours when students come through. I like sharing experiences. I'd like to help more people make the transition to a good job."

Tony Roberts, Purification Process Development Scientist

Cook Pharmacia

Graduate of Ivy Tech Community College

"My parents worked long careers and retired from GE, so I had a good way in there. I worked at GE from 1989 to 2005." Unfortunately, Tony Roberts was laid off. Luckily, the workforce development folks set up meetings with program directors at Ivy Tech Community College to discuss re-training opportunities. At that time biotech was still in its infancy. Roberts was one of six people who signed up for the biotechnology program. "So I started taking courses at Ivy Tech. People ask me, 'why'd you choose that?' Why? Well, the government's Trade Readjustment Act paid for me to go to school and, and, along with unemployment, I never had to pay a dime. It did take two, dedicated years of my life. I graduated in 2007."

The hands-on training Roberts gained at Ivy Tech's state-of-the-art facilities strengthen his position today, working at the world-class, cell culture biologics giant Cook Pharmica. "Ivy Tech prepared me really well. For all the four-year degree people who come into our department, I've had to train every one of them. Some don't even have basic knowledge in the use of a pipette. I've trained people with master's degrees and even one Ph.D." Roberts continues to learn while on the job. "My boss is Cook Pharmacia's senior scientist. He knows more about purification than I'll ever know. I will keep taking advantage of his knowledge as long as I can."

Elizabeth Neuman, Research Assistant

QualTek Molecular Laboratories

Graduate of Montgomery County Community College

"Many ask me, 'why did you go to community college?' Being a young mother changed the equation. I had to attend community college. First, I needed to work. The college has flexibility; I could go at different hours. I could take courses from 7a.m. to 7 p.m. plus on weekends," said Elizabeth Neuman. "Montgomery County Community College is affordable. Its courses are rigorous, they're comparable to four year college course, but at a fraction of cost." On a whim, Neuman enrolled in a biotechnology course, and after two weeks she was hooked. "I took my first biotech lecture course just to see where it would take me. After the first two weeks I was so excited I changed my major and signed up for every science magazine I could get my hands on."

After completing her A.A.S. degree, Neuman went on to complete her bachelor's degree at Delaware Valley College before she was hired at QualTek Molecular Laboratories. "QualTek is a small contract research organization that works with pharmaceutical companies across the world. We specialize in custom services for immunohistochemistry. "My day-to-day duties include assisting project managers. I manage my own small studies. I do shipping/receiving, inventory management, quality control of reagents, accessing clinical samples, and finally, routine maintenance and cleaning of the laboratory."

Neuman hopes to continue to grow in her career; she has her sights set on a lab manager position. With the training she received at MCCC, the future looks bright and promising, a fact that is not lost on Neuman. "I like giving back to Montgomery County Community College. I like to come in and talk with students about my career. Pass along job openings. I'm speaking at upcoming career fairs."

Jeanne Wendtland, DNA Technician

University of Wisconsin Biotech Center

Graduate of Madison Area Technical College (now Madison College)

Presenting a slide of herself bumping down a fairly steep mountain trail on her backside, Wendtland began her talk. "I was hiking. It was steep. At the time I had fibromyalgia. I had to do it the only way I could. This is what I've had to do, this is my story: I just do what it takes to get it done."

Wendtland chose to return to school after her oldest son graduated from high school. "My first class at technical college was on weather. I found a brochure on the biotech program. Once I talked to Jeannette Mowery at Madison Area Technical College I went ahead and signed up." Wendtland recounted her initial difficulties with the biotechnology curriculum. "I took microbiology and told the instructor, 'when I was in high school, we never talked about DNA.' All these kids in the class had already learned a lot about it. I remember when they started talking about a 'DNA fingerprint' I thought it was in your finger," said Wendtland, causing chuckles from the crowd.

She talked about the hours she logged with instructors to ensure that she was prepared to enter the workforce. "It took me seven years to get through the two year program. And all the instructors gave me encouragement." Today Wendtland works as a DNA lab technician. She also gives back to her community. "I do go visit classes, tell my story, give tours. My dad asked me to give a talk to the Rotary."



From left: Elaine Johnson, Executive Director, Bio-Link, moderator; Jeanne Wendtland, DNA Technician, University of Wisconsin Biotech Center, Madison Area Technical College; Elizabeth Neuman, Research Assistant, QualTek Molecular Laboratories, Montgomery County Community College; Terence Ho, Research Associate, Genentech, City College of San Francisco; Tony Roberts, Purification Process Development Scientist, Cook Pharmaica, Ivy Tech; Jo-Anne Hongo, Senior Scientific Manager, Genentech; Cagney Coomer, Research Technician, Advanced Genetic Technology Center, University of Kentucky, Bluegrass Community and Technical College.

Technicians' Role in Growing the Bioeconomy

A diverse panel of experts focused on the role of technicians and effective training.

Developing New Curricula

Kicking off the discussions, Linnea Fletcher, Department Chair of Biotechnology at Austin Community College and Co-PI of Bio-Link, brought forward a standards-based curriculum development project her college is working on with the Texas Skill Standards Board. This partnership employs many resources to develop and implement biomanufacturing skill standards so more Texas community college biotechnology programs can develop quickly and as needed. Six colleges with biotechnology A.A.S. programs are currently recognized by the state for adopting the skill standards. "Take any student who graduates in biotech from these colleges with those standards and you know exactly what they can do, and they know what they can do, and industry employers also know exactly what they can do," said Fletcher. "Plus these six now work together to solve problems. Brainpower behind six is better than working alone. It's much easier to share assessments and best practices."

Engaging the crowd with specifics, Fletcher portrayed how the process moves. "First we described what the worker must know and to what level he or she must perform the work. These are then broken down into critical work functions. What is a biomanufacturing technician's work day like? What do they do all day? Then we collate these into key

activities - the major tasks required. Performance criteria is also important. All of this sounds really dry but if you're trying to develop standards that any community college in the state of Texas could adopt, and you want to make sure that you train students to the same level no matter what program it is, you have to have this kind of detail."

"One thing we're seeing is how a lot of the skills associated with biomanufacturing process development are moving further into research"

Fletcher emphasized the importance of hands-on learning experiences. "Every program, every student, has to do an internship. And if we run out of space, if there are no industry positions available, our programs have set up informal contract research that we do in our own labs as a way to do the internships."

As for challenges ahead, Fletcher pointed to articulation. "We want to make it easy to articulate. We're looking for universal four-year articulation. We're working to make our credentials stackable, further developing the overall entry-level bioscience skills based on core competencies."

Teaching Basic Equipment Operation

A specialist in bioreactor model development and small-scale technologies, Wesley D. Marner II, Ph.D., Manager of Small-Scale Technologies at Applikon Biotechnology Inc., discussed the use of these systems. Despite the diversity of products, many of the same fundamental concepts apply in the operation and experimental use of all bioreactors. Marner outlined bioreactor operation, including seed culture manipulation for upstream growth, startup, operation, controls and typical parameters.

"One thing we're seeing is how a lot of the skills associated with biomanufacturing process development are moving further into research," said Marner. "Engineers in early cell line development roles, doing screening, doing nucleic acid manipulation, are now taking in basic principles of how bioreactors perform. By understanding biomanufacturing from beginning to end, they can make well informed decisions during the

development of the cell line, what is the best way to mimic that rising scale."

The complicated, demanding processes involved include various cell culture modes (batch, fed-batch, continuous); cell culture kinetics (growth, nutrient uptake, product formation); and bioengineering basics (gas transfer and mixing). "These are specialized tools, it's best to understand how to use them. Early stage 'winners' here can lock in the route of development work during scale up to production," said Marner.

"Another thing is shrinking the bioreactor at early stages gets a lot more done. It yields a lot more data and kinds of data. Bioprocessing and biomanufacturing is much more commonly being done at smaller scales. It's better for presenting data, analyzing data and making decisions for upstream development than in the past."

Integrating Similar Training Programs

Michael Pishko, Director of the National Center for Therapeutics Manufacturing (NCTM), began by showing slides of his Center's dramatic glass tower and building. This state-of-the art biologics production facility operating on the campus of Texas A&M University also develops biopharmaceutical workforce training and education programs. To combine bioprocess engineering, modern manufacturing science and regulatory affairs, the NCTM partners with a consortium of educators, including Blinn College in nearby Bryan, TX.

"It's really an integrated effort not only between a community college and a four year, research intensive university, we're also involved with two different state agencies in workforce development," said Pishko. "Our mission is to provide training in manufacturing therapeutics. When I say therapeutics we're primarily talking about biologics, proteins and DNA vaccines. The idea is to create an educated workforce in this area and for the nation."

Learning by doing is not a problem in this active production facility. "The Center serves two purposes. One is workforce training and education. The other is contract manufacturing in support of the development of biologics within the state of Texas. You might think these two are different but they are actually quite synergistic. The contract manufacturing side is of primary interest to our students. And those who work there, engineers from industry, serve as instructors and in advisory roles for our students."

In 2012, NCTM started offering A.A.S. degree courses and is developing a post-baccalaureate certification. "We're also very active in STEM outreach. We run summer camps for ninth graders who are interested," said Pishko. "They stay on campus and have an in-depth experience while learning more about careers in research, engineering, and biomanufacturing."

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Implementing Distance Learning Technologies

Ana McClanahan, Dean of the BioNetwork Capstone Center, traced the trends leading to new digital training solutions. "In the 1970s big pharma was offered financial incentives and, attracted by the intellectual capital of North Carolina universities, began to open up in the state, congregate and achieve critical mass. The number of available workers tightened." Prompting a demand for a more concerted, statewide effort in training, this was the start of North Carolina's BioNetwork. "BioNetwork has seven centers, each has different subject matter experts, but all serve the entire state. We were formerly known by individual center names but we've abandoned those designations to become one force, one BioNetwork."

McClanahan spoke about BioNetwork's implementation of distance learning technologies. They have increased access to hands-on manufacturing simulation for students to add teaching capacity. "We need to become better stewards of our commodity—the knowledge industry. We must reach

out, not to an aging population, but to a younger, lower age part of the population. We need to be reaching the digital natives. Every one of us needs to develop digital skills in our faculty. Students today want to see it on the screen, see it on twitter, see it on their cell phones. It's important that we become digitally savvy. We're not there yet, but if we're not looking down this road we will be left behind."

McClanahan invited the CCP crowd to participate. "If you go to www.ncbionetwork.org you'll see all our learning opportunities are open source. Every single one of our E-learning tools is free. You can use them with your students. This approach can serve everyone. It's part of collegiality. It can become a recruiting tool for your own program. We are transferring all our courses to distance learning platform. It's a challenge for us to go back and learn a different way. But we're doing that because we know there is another way to teach."

Connecting Job Seekers and Employers

Los Angeles Valley College partners with employers for contextualized curriculum that's designed to help job seekers bridge skills they already have to the needs of industry. This innovative work force development model achieves results. Lennie Ciupo, Director of Job Training, has guided the program since its inception in 1994. Over the last eighteen years, the college's training efforts have resulted in more than 20,000 jobs for the local community and an upgrading of skills for 16,000 incumbent workers. Ciupo spoke about creating a Biotech Bridge Academy with stackable certificates and educational pathways for the unemployed and dislocated workers looking to move up the ladder in the biomanufacturing industry.

"We take a regional approach that is employer-driven. We do training that results in jobs, utilizing the existing workforce development system. We aim for seamless delivery of training. And we are results-oriented, that is we must see

either new hires or promotions. We keep to this model."

In 2008 bioscience industry leader Baxter decided to expand its operations in Los Angeles. The city offered a lot of things to help them expand, including a pilot training program between Baxter and the college. "With our expert Dr. Chander Arora, we put together a curriculum developed for Baxter. They gave us the topics. We combined biomanufacturing scientific principles, along with attention to soft skills like attitude, integrity, and cultural diversity. We tried to contextualize all of it. The program is not how to be an expert in math, it's about how to do math to be a technician at Baxter."

The Bridge Academy accelerates hiring of candidates. "The key thing is Baxter interviews the group. Then we put them in our academy. This year we've had 21 people selected, 20 completed the Bridge... and we had 20 job offers."

"We need to become better stewards of our commodity—the knowledge industry. We must reach out, not to an aging population, but to a younger, lower age part of the population."



From left: Michael Pishko, Ph.D., Professor II of Biomedical Engineering, Director of the National Center for Therapeutics Manufacturing at Texas A&M University; Lennie Ciupo, Director, Job Training, Los Angeles Valley College; Ana McClanahan, Dean of BioNetwork Capstone Center, North Carolina Community College System; Linnea Fletcher, Ph.D., Department Chair of Biotechnology at Austin Community College, Co-PI of Bio-Link, an ATE Center of Excellence; Wesley D. Marner II, Ph.D., Manager of Small-Scale Technologies, Applikon Biotechnology Inc.; Sonia Wallman, Moderator, Executive Director and Principal Investigator NBC2, NSF ATE Northeast Biomanufacturing Center and Collaborative