Catalyzing Innovation

Putting Life to Work: Tales of Community and Collaboration in Industrial Biotechnician Education

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Introduction

"Putting life to work" is a double entendre that captures the ethos of a community college program engaged in biotechnology technician education. Biotechnology, as an industry, is defined as taking what we know about biology (life) and doing something useful with it. Community college programs engaged in biotechnology education are largely vocational in nature. Our programs take students (lives) and prepare them for careers in this auspicious industry.

''Community'' is a key modifier for the scores of local institutions of higher education distributed across the United States. A hallmark of these institutions is the open access to the people in their community; we often say that community colleges accept 100% of the people that apply. These colleges typically have a responsibility to provide transfer education, which is the classic pattern of coursework needed in the lower division of a four-year Bachelor's degree. A lesser known mandate among these colleges is the charge for economic and workforce development, as is true for California community colleges. The intent here is to ensure that sufficient resources are available to support and meet the workforce needs for local industry sectors. Biotechnology is one of these supported industries because it offers high-wage and high-growth positions for employees. Community colleges, therefore, are not only uniquely enabled, but also fully resolved in their mission to create educational programs that are responsive to industry needs.

These programs, by design, meet the often-varied needs of local industry partners through collaborative curriculum development. They are borne of the relationship with local industry and, indeed, educators that have similar programs near and far. Further, the curriculum demands on resources are not slight; these programs require expensive equipment, instruments, and supplies to offer meaningful educational experiences to their students. All of this begs strong institutional commitment and strong industry engagement to promote local career opportunities to graduates. This article captures the story of one such program, which has leveraged these themes of community and collaboration to build a vital and viable educational program in bioprocess technology.

One Node in the Network

MiraCosta College first offered biotechnology classes in 1990, taught by experienced faculty and industry experts. In response to community needs, the coursework initially focused on research techniques and bench-scale efforts, and since its inception, the program has consistently offered hands-on, lab-based coursework in biotechnology. Besides working with industry partners, the college began to build a regional presence through a California Bioscience Initiative that created a Southern California Biotechnology Center, housed at MiraCosta from 1996 to 2001. As part of this effort, the college developed new curricula, accepted donations from industry on behalf of the region, performed outreach to local high schools, and coordinated with local and statewide initiatives related to biotechnology workforce development.

The success of the program attracted the attention of IDEC Pharmaceuticals in 2002 as it was beginning green-field work on a massive new biologics production facility just a few miles from the MiraCosta campus in Oceanside, CA. IDEC had a vision for a homegrown workforce for the facility and sought to assist in the development of a new educational program that would address the unique needs of large-scale, Food and Drug Administration (FDA)-regulated biopharmaceutical production. In this way, a new connection for the program was made.

Biomanufacturing was a skill-set largely underdeveloped in San Diego County, where the industry was rooted in research and was transitioning to later stages of product development. With the support of the college and key leadership at IDEC, a new curriculum in Bioprocess Technology was developed that offered an educational experience unlike any other in the region. (Corporate ownership of the IDEC facility eventually transitioned to Biogen Idec (Weston, MA) and then, and currently, to Genentech, South San Francisco, CA.)

A Versatile and Varied Curriculum

The curriculum was a natural evolution of the existing research-based program. The bioprocessing program took existing fundamental techniques and viewed them through a prism of compliance, process control, and scale. It was not all wholly unique; there was clearly a foundation that was similar to the research program. The foundation comprised two classes: ''Basic Techniques in Biotechnology'' and ''Business and Regulatory Practices in Biotechnology.'' The former was the first lab-based experience, and the latter provided an overview of the industry, how products were developed, and how companies remain compliant with regulatory agencies. From these classes, students

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can build on additional advanced coursework in specialized topics that lead to several degree and certificate outcomes. The features of these two programs and the scope of certificates offered are summarized in *Table 1* and *Table 2*, respectively.

Biogen Idec also recognized the need to have a dedicated and immersive environment to conduct the training necessary for the new bioprocessing curriculum. The company donated almost $400,000 to MiraCosta to support the remodel of a new facility and to attract a lead faculty member. In partnership with many local biotechnology industry veterans, including McGraw/Baldwin Architects, DPR Construction, and other members of the International Society for Pharmaceutical Engineering (ISPE), the facility was designed, constructed, and opened to classes in November 2005. To date, the Bioprocess Technology program continues to find a major partner in Genentech, which contributes annually toward student scholarships, equipment donations, and employee expertise in the classroom and seminars.

Scaling-Up Community and Collaboration

Around the time that the fruits of the IDEC/Biogen Idec/Genentech collaboration were realized, in 2004, MiraCosta was invited to join an educational consortium called the National Center for the Biotechnology Workforce, which was funded by the United States Department of Labor. Connections again multiplied in this national effort. For its role, MiraCosta was named a Center of Excellence in Bioprocessing. Shortly thereafter, the program also received grants from the State of California in 2005 and 2006 to engage and promote biotechnology career pathways to high school students and to build further the community within North County San Diego.

With a strong network that had scaled from a local to a regional and then a national scope, new opportunities also multiplied. MiraCosta joined the Northeast Biomanufacturing Center and Collaborative (NBC^2) in 2009, a National Science Foundation (NSF)-funded center focused on the development and dissemination of educational materials related to biomanufacturing.[1] As the Western Hub director, MiraCosta has several roles, not the least of which is helping colleges develop biomanufacturing programs in locales that beg for such workforce development.

The college also partnered with California State University at San Marcos (CSUSM) and Miramar College to apply for funding from the California Institute for Regenerative Medicine (CIRM) to support a *Bridges to Stem Cell Research* program. CIRM was developed with Proposition 71 monies, from which Californians approved $3 billion for stem cell research. CIRM recognized that this new stem cell economy would not exclusively employ highly educated researchers; rather, a keen demand would develop for technicians to carry out much of these research efforts. The award to this partnership was largely for direct support of interns to take on a year-long, full-time internship in high-level stem cell research. To date, MiraCosta has placed 16 students in this program, with total student support of $608,000. Outcomes have been impressive, with many student interns gaining employment in labs at institutions such as University of California San Diego, The Salk Institute for Biological Studies (San Diego), The Scripps Research Institute (La Jolla, CA), Sanford-Burnham Medical Research Institute (La Jolla), and Life Technologies (Carlsbad, CA). Much of this research is translational in nature, which is a natural bridge to product development and production.

It was, however, the connection with NBC^2 that opened the door for the next significant opportunity. In a leadership meeting in 2009, NBC^2 agreed to fund the development of a short course in biofuels production and analysis. The leadership team saw biofuels as a natural extension of biomanufacturing, in which cells producing proteins were replaced with cells producing oils. MiraCosta associate faculty member Dr. Elmar Schmid created a laboratory manual and textbook to support this new short course, and MiraCosta offered the class for the first time in 2010 (*Fig. 1*).

Good news traveled fast, as an emerging collaborative effort in San Diego was working to scale-up biofuels education and training. The San Diego Biofuels Initiative was formed, made up of a group of forward-looking policy

Table 1. MiraCosta Biotechnology Program Curriculum

	Basic Techniques in Biotechnology	Business and Regulatory Practices in Biotechnology
Foundational Courses and Major Course Topics	• Solution preparation • Aseptic technique and cell growth • Assays • Chromatography • Separation by electrophoresis • Directed project in recombinant DNA and heterologous protein production	• History of regulation in the United States of drugs intended for human use • Business practices related to the development of a model human therapeutic • Regulatory requirements related to the development of a model human therapeutic • Quality systems • Process control for human therapeutics • Intellectual property • Inspections and audits • Organizational operations
Advanced Program Coursework	• Biostatistics • Advanced cell culture • Techniques in DNA amplification • Recombinant DNA • Principles of separation and HPLC • Techniques in immunochemistry and ELISA	• Data analysis with Excel • Technical writing for regulated environments • Bioprocessing: Cell culture and scale-up • Bioprocessing: Large scale purification • Techniques in biofuels production and analysis • Internship studies
Program Outcomes	• Associate of Arts in *Research and Development* • Certificate of Achievement in *Research and Development* • Certificate of Achievement in *Bioprocess Technology* • Certificate of Proficiency in *Laboratory Skills*	

Table 2. MiraCosta Biotechnology Program Certificates

CERTIFICATE	SEMESTER UNITS	LAB HOURS	LECTURE HOURS	TOTAL HOURS
Laboratory Skills	11–12	ca. 131	ca. 147	ca. 278
Bioprocess Technology	12	141	173	314
Research and Development	40–48	ca. 530	ca. 395	ca. 925

makers, experienced life science veterans, world-class researchers, and industry support systems. The group heard of MiraCosta's efforts in biofuels education and needed a partner to create a certificate program related to biofuels production appropriate for community colleges. They proposed the EDGE Initiative (Educating and Developing workers for the Green Economy) with a focus on alternative and renewable fuels and industrial biotechnology. The proposal found funding through California's Green Innovation Challenge in 2010. The partners involved in the EDGE Initiative are noted in *Table 3*. Continuing through 2012, the EDGE Initiative trained and placed hundreds of people in ''green'' companies. Victoria Bradshaw, the former Secretary of California Labor and Workforce Development, concluded, ''EDGE is a great example of a successful public-private partnership, which has created a terrific roadmap helping to produce a qualified and skilled workforce for a very important emerging industry sector, both now and far into the future.''

Now and Into the Future

It would be naïve not to acknowledge the healthy dose of serendipity in these tales. Sometimes it was the right place; at others it was the right time. In all cases it was the right connection, which underscores the major theme in community college program success. We need to seek out and culture these connections and collaborations as, perhaps, our greatest hedge against the probabilistic nature of chance. In doing so, we preserve the ability of the community college to catalyze innovation across these partnerships and keep local high-wage, high-growth positions alive and well. The major milestones in advancing the MiraCosta Biotechnology program are summarized in *Table 4*.

As a community college ''insider,'' it is not surprising to me that President Obama has embraced community colleges as an economic and workforce development resource in his policies on higher education.[2] I have witnessed first-hand the diversity of talent that comes through these programs. While a common preconception is that the students at a community college are in their late teens or early twenties, the reality is that these programs reflect, if only as an approximation, their communities. At MiraCosta, the average age of students in our program is 28 years, with 40% of the students aged 30 or older. In addition, of the students enrolled in the program during 2012–2013, 29% already had a Bachelor's degree. We typically find that about

Table 3. EDGE Initiative by the San Diego Biofuels Initiative

ORGANIZATION TYPE	ORGANIZATION NAME
Private	CleanTECH San Diego
Private	BIOCOM
Private	BIOCOM Institute
Public	San Diego Regional Economic Development Corporation
Public	San Diego Center for Algae Biotechnology
Public	University of California San Diego (UCSD)
Public	UCSD Extension
Public	San Diego State University
Private	University of San Diego
Public	MiraCosta College
Public	San Diego Workforce Partnership

Table 4. Significant Milestones in MiraCosta Biotechnology Program

1990	Biotechnology Program created
1996–2001	Serves as Southern California Biotechnology Center
2002–2004	Partners with IDEC Pharmaceuticals to develop curriculum and with International Society for Pharmaceutical Engineering (ISPE) to design a dedicated educational facility
2004–2008	Named National Center of Excellence in Bioprocessing
2005–2006	State-funded career pathway grants awarded to engage area high schools in biotechnology education
2009–present	Joins California State University San Marcos and Miramar College to identify and prepare technicians for stem cell research
2009–present	Serves as Western Hub for Northeast Biomanufacturing Center and Collaborative (NBC^2)
2010–2012	Joins private-public collaborative for biofuels education development in Educating and Developing workers for the Green Economy (EDGE) Initiative

Fig. 1. Students working with algae cultures as part of a short-course in biofuels production offered at MiraCosta College. Photo credit: Rose Nunes.

20% of the students in the program are already employed in the industry and are taking classes for their own professional development. All of these student attributes, taken together, portray not only a deeply rich learning environment but a confident and competent recruitment pool for local companies to find talent. Ultimately, if we are not putting those lives to work, we have not fulfilled the promise that we have made to the people in our communities.

Acknowledgments

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