
Thoughts about the Twenty-First Century Biotechnology Workforce

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Economic and workforce development are unusual topics for the National Agricultural Biotechnology Council. I will discuss aspects of the workforce in general and the biotechnology workforce in specific. First are some thought-provoking views about changing demographics and global competition; second is information on skills needed in the twenty-first century workplace and the mindset of the current generation; and third is one California educational institution's approach to dealing with these changes to provide a well-trained biotechnology workforce to serve business and industry.

TECHNOLOGY, DEMOGRAPHICS AND GLOBAL COMPETITION

The effects of technology upon the current generation are significant. According to Martin Beam (personal communication, 2006), college students today rate their iPods of more importance than beer. Instruction is available electronically through distance-learning, blogs (or Web logs), and World Wide Web sites. These new sources of learning widen the gap between the generations. Technology-savvy youngsters plunge in readily with electronic devices whereas oldsters, many of whom are unable to turn on a computer, hold the view that formal education is available only outside the home.

Noticeable also are changes in ethnic background of students. In California, there is no longer an ethnic majority. Although only California statistics are included in this article, California can be considered a microcosm of the United States regarding the trends that these statistics imply. In California, the demand for highly educated workers combined with the loss of retiring highly educated workers is equal to more than 3 million, equal to the combined populations of the cities of San Diego, San Jose and San Francisco (Campaign for College Opportunity, 2006).

Below is a summary of a landmark study by researchers at UC Berkeley—*Return on Investment: Educational Choices and Demographic Change in California's Future*—of the state's demographic future and the return on investment for expanding college opportunity.

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The study finds that for every dollar spent increasing the number of students attending college and completing degrees, the state gets three dollars in net return on that investment. The report also provides critical demographic projections for the State's future population. During the 1990s, California became a minority-majority state as the non-Hispanic White population fell below 50%. By 2000, the population of California was 47% non-Hispanic Whites, 32% Latino, 12% Asian, and 7% African American. The California population is expected to grow to 43 million by the year 2020 and to 55 million by the year 2050, with most of this growth driven by increases in minority populations.

[Here are] a few quick snapshots at some of the trends in the African American, Latino and the Asian Pacific Islander population. For more detailed snapshots for each of these ethnic groups, visit our website at www.collegecampaign.org.

Key Findings

- Among 18–24 year olds, 28% of African Americans lack a high school diploma and only 40% report any college attendance. Although African Americans have college-going rates comparable to non-Hispanic Whites, they have extremely high drop out rates from college as a group and earn Baccalaureate degrees at one of the lowest rates amongst all ethnic groups. Only 45% of 18 year-old African Americans are expected to go to a public college in California, only 19% will reach a public 4-year university and only 9% earn a Baccalaureate Degree there.
- Latinos are the fastest growing population, growing by more than two-thirds from 2000–2020. Growth in the Latino population is striking for all age groups in the state, but this growth is particularly critical among the college-going age group (18–24 year olds). In this age group, Latinos are most likely to have no high school diploma and least likely to have entered college. Less than one third of 18 year-old Latinos are expected to go to a public college in California, only 15% will enter a public 4-year university and only 10% will earn a Baccalaureate Degree there.
- The Asian and Pacific Islander population has grown tremendously in the past few decades. Their levels of college-going and rates of degree completion are the highest amongst all ethnic groups, including non-Hispanic Whites. Nearly 80% of 18-year old Asians are expected to go to a public college and nearly 43% will earn a Baccalaureate Degree there.

Conclusion

The study makes it clear that the return on investment is very positive for the state. For every dollar spent increasing the number of students attending college and completing degrees, the state gets three dollars in net return on that investment. This snapshot provides sobering information to focus attention on encouraging higher rates of high school graduation for Latinos and African Americans, and improving the success of those who do graduate from high school and enroll in college. We must continue to encourage and support college participation and success amongst Whites and Asian/Pacific Islanders and we must increase college participation and success amongst all our young adults. Given what we know about the positive return on investment, the future workforce needs and the growing number of young adults, this information is a call to action." (Brady *et al.*, 2005)

A sobering report from the National Association of Manufacturers points out global competition issues and that the current US workforce is unprepared.

Yet below the seemingly calm surface [of rising productivity in the US] an undercurrent of uncertainty is roiling the emotional waters for American workers. Rapid changes in technology and intense global competition—particularly from Asia—have fomented a gnawing anxiety about the future. If we are to alleviate this anxiety, keep our economy strong and successfully compete in the fiercely competitive international race to the top, we must recommit our nation to innovation and the concerted development of a more highly educated and skilled workforce.

Indeed, the world has changed over the past decade. In 1993, the United States alone accounted for 29 percent of global production. The 10 largest economies accounted for three-quarters of the world economic output and, among these top-ten, the only developing nations, Brazil and India, ranked 9 and 10, respectively. Fast forward ten years to 2003: the United States remained the largest economy, but its share of global output had fallen to 21 percent. The 10 largest economies accounted for just two-thirds of the world economy and, with China and Russia supplanting Canada and Spain, just six of the top 10 countries were traditional industrialized democracies. Today the global economy is more competitive across a broader number of nations. Faster growth in the developing world has spilled over into global trade...

A more integrated global economy, with more import competition and more export opportunities, offers both new challenges and opportunities to the United States and its workforce. To succeed, it is essential that the U.S. maintain its position as the world's leading innovator.

Looking back over the 20th century, American ingenuity has been truly incredible... Going forward, new innovations will continue to be critical, both in maintaining a solid industrial base and increasing our standard of living. In short:

Innovation leads to new products and processes that sustain our industrial base.

1. Innovation leads to new products and processes that sustain our industrial base.
2. Innovation depends on a solid knowledge base in math, science and engineering.
3. Without this knowledge base, innovation as well as our industrial base will erode.

Our economy's ability to compete in the 21st century will not be influenced by past performance. Success or failure will be determined primarily by our capacity to invent and innovate. Unfortunately, there are troubling signs that the American workforce is not ready to meet innovation's challenge, and our position as leader of the global economy is threatened." (Labor Day Report, 2005, pages 1 and 2)

SKILLS AND MINDSET CHANGES

Skills

Workplace competency and technical skills sets have changed, as outlined in Table 1. For instance, computer literacy was not a required workplace skill in the twentieth century, whereas, in this century, not only do workers need to know how to operate a computer, they need advanced computer literacy to function as a bank teller, auto mechanic, nano-technology specialist, scientist, delivery truck driver, or quality-control specialist.

**TABLE 1. DIFFERENCES IN WORKPLACE SKILLS AND COMPETENCIES:
TWENTIETH VS. TWENTY-FIRST CENTURY (KOEHLER, 2006).**

Twentieth century	Twenty-first century
General literacy	Science literacy
Arithmetic literacy	Math literacy, equations
No computer literacy	Advanced computer literacy
Basic shop equipment	Scientific laboratory equipment
Conversational English	Specialized technical English
Follow instructions	Innovation and problem-solving
No writing and analysis	Technical report preparation and interpretation
Individual job responsibility	Capacity to form and innovate in mixed groups
One-time learning of advanced competencies	Life-long learning of different advanced competencies

In biotechnology, including agricultural biotechnology, skills sets include the technical aspects. However, rated more important by employers are the so-called “soft” skills, which are actually sometimes more difficult than technical skills: working in teams, communicating in written and verbal English, presenting data to groups, getting to work on time, putting in a full day of work, and having competency with a computer (Koehler and Koehler-Jones, 2006). These “soft” skills are also named workplace competency skills.

Basic technical skills in biotechnology include:

- Mathematical competency for understanding several procedures: dilutions, solution making, pH calculations, buffers, and other related procedures;
- Understanding what pH is and why it is crucial: for instance, knowing that an excursion from pH 7 to pH 9 could potentially kill the cells with which you are working;
- Understanding molarity and using it for solution making;
- Basic cellular biology;
- Basic molecular biology;
- Basic chemistry;
- Basic microbiology;
- Sterile technique.

Advanced skills, too numerous to list, are expansions of the above, with specialized training provided either on the job by the employer for unique requirements, or by an institution of advanced learning that collaborates with companies to provide needed skills.

Mindset

Attitudes to work alter from one generation to the next. The veteran generation—born between 1920 and 1942—are seen as mentors who understood their obligations to family and country. Baby boomers—born between 1943 and 1965—are now the older worker pioneers. Generation Xers—born between 1966 and 1979—are considered cautious and self-reliant skeptics. For this generation in the United States, international competition is noteworthy: issuance of 14 million college degrees is expected in the United States in 2010 (41% to women), and 16 million will be issued in China.

The Net generation—born between 1980 and 1995—is eager to innovate and change the world. They expect good wages, are nationalistic and have strong cultural values (*e.g.* Latinos are family-oriented), have high-tech skills which could widen the digital divide, they expect to have multiple jobs and careers, want a balanced life, do not consider baby boomers as role models, and they consider gender equality to be a given.

Another factor worthy of consideration is the mindset of the current generation. An informative source on this subject is the Beloit College Mindset List® (<http://www.beloit.edu/~pubaff/mindset/>), a gathering of ideas to prevent “hardening of the references,” according to authors Tom McBride and Ron Nief.

Summer 2005. In the coming weeks, millions of students will be entering college for the first time. On average, these members of the Class of 2009 will be 18 years old, which means they were born in 1987. Starbucks, souped-up car stereos, telephone voicemail systems, and Bill Gates have always been a part of their lives.

Each August, as students start to arrive, Beloit College releases the Beloit College Mindset List, which offers a world view of today’s entering college students. It is the creation of Beloit’s Keefer Professor of the Humanities Tom McBride and Director of Public Affairs Ron Nief.

McBride, who directs Beloit's First Year Initiatives (FYI) program for entering students, notes that "This year's entering students have grown up in a country where the main business has become business, and where terrorism, from obscure beginnings, has built up slowly but surely to become the threat it is today. Cable channels have become as mainstream as the 'Big 3' used to be, formality in dress has become more quaint than ever, and Aretha Franklin, Kermit the Frog and Jimmy Carter have become old-timers."

The list is distributed to faculty on campus during the New Students Days orientation. According to McBride, "It is an important reminder, as faculty start to show signs of 'hardening of the references,' that we think about the touchstones and benchmarks of a generation that has grown up with CNN, home computers, AIDS awareness, and digital cameras...these students missed out on the pleasures of being tossed in the back of a station wagon with a bunch of friends and told to keep the noise down, walking in the woods without fearing Lyme Disease, or setting out to try all of the 28 ice cream flavors at Howard Johnson's."

According to Nief, "This is not serious in-depth research. It is meant to be thought-provoking and fun, yet accurate. It is as relevant as possible, given the broad social and geographic diversity of our students, who are drawn from every state and 50 countries. It is always open to challenge, which has an additional benefit in that it reminds us of students' varied backgrounds."

BELOIT COLLEGE'S MINDSET LIST®

Most students entering college in the fall of 2005 were born in 1987.

1. Andy Warhol, Liberace, Jackie Gleason, and Lee Marvin have always been dead.
2. They don't remember when "cut and paste" involved scissors.
3. Heart-lung transplants have always been possible.
4. Wayne Gretzky never played for Edmonton.
5. Boston has been working on the "The Big Dig" all their lives.
6. With little need to practice, most of them do not know how to tie a tie.
7. Pay-Per-View television has always been an option.
8. They never had the fun of being thrown into the back of a station wagon with six others.
9. Iran and Iraq have never been at war with each other.
10. They are more familiar with Greg Gumbel than with Bryant Gumbel.
11. Philip Morris has always owned Kraft Foods.
12. Al-Qaida has always existed with Osama bin Laden at its head.
13. They learned to count with Lotus 1-2-3.
14. Car stereos have always rivaled home component systems.
15. Jimmy Swaggart and Jim Bakker have never preached on television.
16. Voice mail has always been available.
17. "Whatever" is not part of a question but an expression of sullen rebuke or indifference.
18. The federal budget has always been more than a trillion dollars.

19. Condoms have always been advertised on television.
20. They may have fallen asleep playing with their Gameboys in the crib.
21. They have always had the right to burn the flag.
22. For daily caffeine emergencies, Starbucks has always been around the corner.
23. Ferdinand Marcos has never been in charge of the Philippines.
24. Money put in their savings account the year they were born earned almost 7% interest.
25. Bill Gates has always been worth at least a billion dollars.
26. Dirty dancing has always been acceptable.
27. Southern fried chicken, prepared with a blend of 11 herbs and spices, has always been available in China.
28. Michael Jackson has always been bad, and greed has always been good.
29. The Starship Enterprise has always looked dated.
30. Pixar has always existed.
31. There has never been a "fairness doctrine" at the FCC.
32. Judicial appointments routinely have been "Borked."
33. Aretha Franklin has always been in the Rock and Roll Hall of Fame.
34. There have always been zebra mussels in the Great Lakes.
35. Police have always been able to search garbage without a search warrant.
36. It has always been possible to walk from England to mainland Europe on dry land.
37. They have grown up in a single superpower world.
38. They missed the oat bran diet craze.
39. American Motors has never existed.
40. Scientists have always been able to see supernovas.
41. *Les Miserables* has always been on stage.
42. Halogen lights have always been available at home, with a warning.
43. "Baby M" may be a classmate, and contracts with surrogate mothers have always been legal.
44. RU486 has always been on the market.
45. There has always been a pyramid in front of the Louvre in Paris.
46. British Airways has always been privately owned.
47. Irradiated food has always been available but controversial.
48. Snowboarding has always been a popular winter pastime.
49. Libraries have always been the best centers for computer technology and access to good software.
50. Biosphere 2 has always been trying to create a revolution in the life sciences.
51. The Hubble Telescope has always been focused on new frontiers.
52. Researchers have always been looking for stem cells.
53. They do not remember "a kinder and gentler nation."
54. They never saw the shuttle *Challenger* fly.
55. The TV networks have always had cable partners.

56. Airports have always had upscale shops and restaurants.
57. Black Americans have always been known as African-Americans.
58. They never saw Pat Sajak or Arsenio Hall host a late night television show.
59. Matt Groening has always had a *Life in Hell*.
60. Salman Rushdie has always been watching over his shoulder.
61. Digital cameras have always existed.
62. Tom Landry never coached the Cowboys.
63. Time Life and Warner Communications have always been joined.
64. CNBC has always been on the air.
65. *The Field of Dreams* has always been drawing people to Iowa.
66. They never saw a Howard Johnson's with 28 ice cream flavors.
67. Reindeer at Christmas have always distinguished between secular and religious decorations.
68. *Entertainment Weekly* has always been on the newsstand.
69. Lyme Disease has always been a ticking concern in the woods.
70. Jimmy Carter has always been an elder statesman.
71. Miss Piggy and Kermit have always dwelt in Disneyland.
72. *America's Funniest Home Videos* has always been on television.
73. Their nervous new parents heard C. Everett Koop proclaim nicotine as addictive as heroin.
74. Lever has always been looking for 2000 parts to clean.
75. They have always been challenged to distinguish between news and entertainment on cable TV." (McBride and Nief, 2005)

ONE CALIFORNIA EDUCATIONAL INSTITUTION'S EFFORT TO MEET THE BIOTECHNOLOGY WORKFORCE NEED

One of the most compelling issues about the workforce is its weight in corporate decisions and planning. In a 2002 corporate survey, CEOs were asked to rank factors according to their importance in choosing a business site; availability of skilled labor ranked first, with cost of labor second. The same survey in 2003 saw cost of labor again in second place, while availability of skilled labor came in third, at 89% (Gambale *et al.*, 2003).

Biotechnology and nanotechnology—sets of skills and procedures already used in many businesses—will change how almost everything is manufactured, used, and recycled. Since these technologies are ubiquitous, estimating workforce need is a conundrum. A reasonable guess for the biotechnology industry cluster in California is that this workforce will, by 2010, be in the range of 882,000, including pharmaceuticals, medical and dental labs, measuring and control devices, medical instruments, research and testing, engineering services and management and public relations. This is an increase of nearly 200,000 workers from 2000, *i.e.* about 20,000 per year. (Koehler and Koehler-Jones, 2006)

The executive summary of an eighty-page report, *California's Biotechnology Workforce Training Needs for the 21st Century*, (Koehler and Koehler-Jones, 2006), outlines how to determine workforce needs and how to meet them.

As used in this report, Biotechnology refers to the application of scientific advances in the life sciences to create commercial products and services. The biotechnology industry cluster includes all of the support services and manufacturers of various instruments, reagents and other products that support the research, testing, and manufacturing of biotechnology products. Bioindustry firms can be organized into eight categories based on their end markets: therapeutics, diagnostics, agricultural, bioremediation, energy, materials including chemicals, bioindustry suppliers, and bioinformatics (each sector is defined in the report).

This study forecasts the biotechnology industry's workforce skills training requirements anticipated over the next five years to ten years. The forecast is based on two studies: first, a literature review of anticipated California and global technological and industry developments and of workforce surveys and of training needs identified in various studies; and second, on a Time Structures survey of future training needs of California biotechnology firms.

California Biotechnology Job Growth Means Many Training Opportunities

Today, US biotechnology firms employ between an estimated 146,000 to more than 187,000 workers. By 2015, the industry may employ as many as 250,000 or more, particularly if the specialized research identified below takes off. The job multiplier is about 1.9 for biotechnology, meaning that almost two additional jobs result from every biotechnology job created. US Dept of Labor projects that between 2002 and 2012, US employment in the Life Sciences will grow by 18%. Employment is predicted to grow by 19% for biological scientists, 19% for biological technicians, and 23% for workers in pharmaceutical and medicine manufacturing.

The top five occupations projected to grow in California by the Labor Market Information Division, California Employment Development Department, from 2000–2010 are: Bioinformatics Specialist (99%), Scientific Programmer Analyst (59%), Animal Technician (44%), Microbiologist (41%), and Assay Analyst (35%). A total of 43,600 technicians with AA degrees are projected to be needed in 2010, an increase of 17 percent over 2000. An additional 8,100 technician level positions could open up due to separations and internal promotions. These estimates may be conservative given other industry size estimates by independent groups such as the California Health Care Institute, and by Henry Madrid, (a data analyst specialist examining trends).

Job opportunities requiring familiarity with biotechnology industry operations and processes will develop as companies expand and as the supplier and specialized service provider networks grow. These developments offer additional training opportunities for occupations like regulatory specialists, Intellectual Property attorneys, and clinical trials experts.

The report lists a large number of biotechnology industry and cluster related careers, including level of preparation required. Industry new hire skill preferences are identified. Examples of needed basic and intermediate occupational skills and of technical, laboratory, production, bioinformatics and other higher levels skills are provided. Suggestions are made for training management to better retrain skilled workers.

California Biotechnology Industry Growth and Global Competition

Like all manufacturing today, biotechnology is global, involving extended research partnerships, specialized supplies chains, and logistics. Many other countries are

developing highly competitive niche research or manufacturing capabilities. Countries in Europe, Japan, China, Russia/Eastern Europe, Cuba, India, Brazil, Malaysia, Thailand, Korea, Singapore, Israel, Bahrain/Dubai/Middle, South Africa, Canada, and Australia/New Zealand have all established biotechnology clusters. The Asian biotechnology industry is growing rapidly. Global networks will compete with and link these activities to California.

While Biotechnology is growing in the US, it appears to be growing more slowly than in the past and may not show a profit as an industry until 2010 or 2012. On the other hand, the pace of patent applications, and approval of California pharmaceuticals and medical devices has increased. At least 643 new drugs are in the pipeline today. The future issue is how many will actually be manufactured in California.

Mixed signals on manufacturing were detected in the literature review compared to the industry survey. The California Health Care Institute found that "...in 2003, 66% of the surveyed companies grew their manufacturing capacity in California, while 81% expanded manufacturing outside the borders of the California. Over the next two years, 73% of the surveyed companies expect to grow their manufacturing within the state. However 88% anticipate expanding their manufacturing outside of the state."

Biotechnology: Converging Technologies are Creating New Opportunities

A moment's consideration of the biotechnology definition and sectors provided above shows that a convergence of diverse technologies—life sciences, materials sciences like Nanotechnology/MEMS (micro-electronic mechanical systems), and information technology—is taking place. This convergence will produce a unique materials and productivity advantage for California over the next ten to fifteen year. Biotechnology is one technology of a rapidly emerging *group* of technologies that are bringing together a number of previously separated science and production techniques in the state. From this broader perspective, life-science's biologically based engineering represents a collection of technologies that offer multiple life-sciences applications in essentially—by today's way of thinking—non-biologically based industries. This convergence will cause biotechnology workforce training programs to evolve with them.

California Biotechnology Company's Assessment of Future Technologies and Perceptions of Workforce Training Needs

Time Structures interviewed sixteen biotech business executives and seven spokespersons from universities and industry associations. They were interviewed by telephone during autumn 2005, to obtain their perspectives on biotech trends and training needs for the 21st century.

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- 1) fermentation, 2) bioprocessing, 3) biotransformation and
4) biomanufacturing were ranked as evolving the fastest.*
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Fastest Moving Technologies

When asked to evaluate the rate of market development for 19 biotechnologies: 1) fermentation, 2) bioprocessing, 3) biotransformation and 4) biomanufacturing were ranked as evolving the fastest. These market-related technologies are expected to experience significant change within the next one to three years.

Five other market related technologies are expected to undergo similar but slower spurts of growth: 1) advanced drug delivery systems, 2) drug design, 3) culture and manipulation of cells, stem cells, tissues and embryos, 4) diagnostic tests, and 5) nanotechnology.

Protein extraction, purification and separation technologies were the most popular with business respondents. Significant market change—perhaps based on new product development—is expected within the next 1 to 5 years. Markets for cell receptors, cell signaling and signaling pheromone technologies are expected to experience the same rate of growth.

Market change for DNA recombination, DNA sequencing and DNA amplification technologies may be slower due to their maturity as a technology.

Three other technologies were given mixed reviews on their ability to influence market change, partly because of maturity assessments and partly because of ambiguity about whether the question referred to research or application: Peptide and protein sequencing and synthesis; microbiology, virology and microbial ecology; and combinatorial chemistry, 3D molecular modeling, and structural biology all may experience significant long-term change within one to ten years.

While the market may be hot for some of these technologies, public policy issues are viewed as obstructions because of regulatory issues and problems with coordinating different levels of government.

The most requested “skills” are knowledge of biochemistry, molecular biology, cloning and cell culture.

Technical Workforce Skill Needs

Because the industry is rapidly changing in technology and applications, there is a continuing need for more training in the basics. The most requested “skills” are knowledge of biochemistry, molecular biology, cloning and cell culture. The second most requested skill has to do with the ability to perform basic research. Lab protocols and techniques are needed (such as aseptic techniques), and knowledge of instrumentation and data analysis. Most employers provide in-house training on procedures specific to their activities, but a foundation in practical laboratory procedures is necessary (more detail on skill occupational projections, skills, and business training needs are developed from other surveys and materials and are provided in the report).

Continuing Global Biotechnology Specialization and Diversity will Challenge the Biotechnology Initiative to be Flexible and Agile

Time Structures’ survey identified the need to strengthen existing skills consistent with basic research and manufacturing requirements. Businesses have also identified significant new and evolving technologies that will affect market position. The broader look at industry provided by the literature review indicates that a number of new enabling technologies are on the horizon and are expected to grow in influence. These converging technologies—nanotechnology, information technology, MEMS, and advanced manufacturing technologies—will revolutionize existing industries and produce new sectors and jobs in the next five to fifteen years.

The difficulty is that it is unclear how well California is actually positioned to take advantage of these developments even though many of these technologies are already highly developed in the state. “First move” advantage could be achieved by other developed nations in Europe or East Asia. “Niche” competition from smaller nations could winnow away individual sectors. This suggests a strong need for the Applied Biological Technologies Initiative to monitor promising convergent technology sectors and to firmly reach out to emerging industry sectors.

Biotechnology Workforce Training Opportunities for California’s Community Colleges

California biotechnology businesses and association expressed a desire in the Time Structures survey to have the community colleges communicate and collaborate with them, to keep up with current trends through market and trend research, and to continuously update core programs. Many used the survey opportunity to give accolades to the community colleges saying that the colleges should keep doing what they are already doing because it is being done well and meeting industry needs. Industry also is willing to serve as a resource for training both students and teachers by providing facilities. Many talked about developing internships. They expressed an interest in having trained students introduced to them. Some spoke to the issue of improving the Community Colleges’ course content by strengthening practical lab experience. Interviewees also expressed interest in improving their business’ customer service.

Research for the Biotechnology and other Economic and Workforce Development Programs indicates that it is important to resolve various Community College and system wide policy issues that limit Biotechnology’s and other initiative’s ability to hire instructors, to fund successful centers, and to disburse and/or integrate key programs amongst campuses. Specific options that could improve the Economic and Workforce Development Program’s operations include the following suggestions: 1) complete the removal of the statutory sunset clause from the California Community College’s Economic and Workforce Development Program’s enabling legislation; 2) that the Economic and Workforce Development Program create or facilitate a strategy that will satisfy the Community College system, making possible the rapid hiring of qualified part-time and full-time instructors for the Centers by examining limitations imposed by the “25%/75%” rule on program growth; and 3) that the Economic and Workforce Development Program investigate a strategy and develop options for a plan to facilitate movement of mature programs onto campus throughout the system without losing their essential capacity to generate new curricula in response to changing industry and workforce needs.” (Koehler and Koehler-Jones, 2006)

The only constant is change—learn to embrace it.

“THE ONLY CONSTANT IS CHANGE—LEARN TO EMBRACE IT”

—MALCOLM W. GRAHAM

We have an opportunity to embrace these changes. Global development affects workers and skills needed in the workplace, which in turn affect how well this and other nations

compete and thrive. The United States is no longer outpacing its competitors as it did 40 to 50 years ago. Global competition is nipping at US heels. The Net generation expects good wages, which may be in jeopardy due to lower cost of living in other countries. Currently, many workers do not have the skills to meet the new needs in the workplace, and incoming workers often do not recognize the need for innovation as the driver for the US economy. They also may not realize that such innovation relies on workers having scientific, mathematical and technical skills, alongside workplace competency skills. The California Community College Economic and Workforce Development Program (<http://www.cccewd.net/>) is one attempt in California to gather together these facts and apply them to meeting workforce needs for the biotechnology industry.

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