Unchartered Territory:  
Highlights from an Exploration of Transfer Pathways in Emerging Disciplines 

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Introduction

How are community colleges developing transfer pathways in emerging disciplines (e.g., biotechnology, digital media and green technologies) that set students on a course toward completing the baccalaureate degrees required to enter some high-growth sectors? How does pathway creation in these newer programs compare to transfer path development in most established disciplines?

These questions drove a preliminary exploration performed by the RP Group through its Student Transfer in Professional Pathways Project (STP3)—a multi-year examination of how students prepare for transfer in career majors such as accounting, engineering, administration of justice, nursing and teacher education and what factors impact their journey to a bachelor’s degree. The RP Group specifically looked at three emerging disciplines—biotechnology, digital media and green technologies—given their expected potential to generate high-skill employment and economic growth.1 STP3 conducted this exploration through (1) conversations with 17 faculty and administrative leaders involved in implementing these programs at community college programs across the state, (2) a review of existing labor market data and reports and (3) an examination of related program and enrollment information available through the State Chancellor’s Office.

This brief summary is designed primarily for community college practitioners and intends to:

- Highlight themes from this initial investigation of transfer pathways in three emerging disciplines (see Key Themes, p. 2)
- Promote discussion about how educational pathways can be most effectively structured in these areas of study (see Discussion Questions, p. 7)
Key Themes

This preliminary investigation generally revealed that workforce demand and requirements are difficult to define in these emerging sectors. In turn, community colleges are attempting to respond to employer needs with the educational tools they have readily available—establishing certificates or associate’s degrees and/or tweaking existing transfer paths (rather than creating new formal arrangements with university partners). That said, students are not necessarily pursuing the traditional “2+2” transfer path—rather, they are moving through and between community colleges and universities in nonlinear, multi-directional ways to get the preparation employers require. We expand on these themes below, summarizing information from community college educators and a review of relevant documents and reports.

Workforce demand and requirements for educational preparation are difficult to define in these rapidly evolving sectors.

Initial research indicates that biotechnology, digital media and green technologies all represent relatively new sectors that include occupational opportunities ranging from those that require short-term training to those that demand more advanced education. These newer sectors are often driven by technology that can create rapid change in how they are defined, the kind of workforce they need and the preparation required to enter employment. Moreover, as they include emergent occupations, labor market data produced by federal and state agencies do not always reflect the breadth of jobs in these industries, making it difficult for community colleges to pin down specific labor market needs. Conversations with key educators and a review of related industry reports generated the following basic information on how each sector is defined, what occupations it includes and what is known about the demand for baccalaureate-prepared workers.

Biotechnology. Of all emerging sectors studied, biotechnology appears the most defined in terms of the types of job opportunities available and the preparation required. California Biomedical Industry 2012 Report, prepared by PricewaterhouseCooper in collaboration with BayBIO and CHI-California Healthcare Institute, states that California is currently home to more than 2,300 biotechnology companies employing nearly 270,000 people. This report indicates that the biotechnology sector includes biopharmaceutical, biotechnology research, wholesale trade, laboratory services and medical devices, instruments and diagnostics companies. Projections from US Department of Labor’s Occupational Information Network (O*NET) show that biotechnology occupations with the largest number of job openings between 2010 and 2020 will include biochemists, biophysicists, biomedical engineers, bioinformatics scientists and technicians, geneticists, biostatisticians, medical equipment repairers, computer engineers, medical research associates and scientists.

Discussions with key community college educators and a review of the California Biomedical Industry 2012 Report indicated that some entry-level positions in the field require baccalaureate-level preparation in engineering, biology and/or chemistry, particularly for opportunities in product research and development. Other entry-level positions call for sub-baccalaureate training including strong laboratory skills and knowledge of (but not a degree in) science. Regardless of
the position, interviewees reported that employers need individuals with soft skills such as the ability to communicate and work as part of a team.

**Digital media.** This sector appears to be the most dynamic and rapidly changing of the three investigated, and therefore the hardest to define. Digital media skills are in demand across a broad range of industries and include the ability to create interactive content forms such as animation, game design and development, interactive design, social media and mobile computing. Reports from the California Community Colleges Centers of Excellence on trends in gaming (2008), information and communications technologies (2011) and mobile media (2011) surfaced common themes. Demand for individuals with these skills is high. For example, *Information and Communications Technologies in California: Educational Program Input* indicates high growth in industries involving digital media skills, stating about one in 20 private sector jobs in the state are in the information and communication technologies fields and predicting strong growth and high wages from 2011-13 (Centers of Excellence, 2011).

At the same time, the employment landscape is chaotic, where job titles, descriptions and expected preparation are inconsistent across employers. While employers surveyed through the abovementioned reports seemed unclear about what level of postsecondary education is required to enter digital media positions, they did generally indicate that specialists and those seeking advancement opportunities would benefit from baccalaureate or master's level training. Regardless of the position, digital media employers reported a strong desire for those with practical, demonstrable experience.

**Green technologies.** This sector includes the “greening” of some existing occupations and the development of new opportunities, along with the creation and implementation of related technologies, making the determination of the specific workforce need particularly elusive. In a 2009 report titled *Greening of the World of Work: Implications for O*NET®-SOC and New and Emerging Occupations*, O*NET defined the green economy as:

> [encompassing] the economic activity related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy (Dierdorff, et al, 2009, p. 3).

O*NET further identified a broad range of employment opportunities spanning the breadth of this economy, from retrofitting buildings to producing energy-efficient automobiles.

Several statewide efforts have been made to better define California’s green technology workforce, with different initiatives attempting to categorize the types of opportunities and the level of preparation required. The findings from these studies are presented in reports developed by the Centers of Excellence (2009), the Workforce Information Council’s (WIC) Green Jobs Study Group (2010) and the Employment Development Department (EDD) (2011). This latest EDD study indicated that roughly 8% of the state’s businesses employ green workers, including nearly 433,000 employees performing some green-related work. Like the WIC report before it, this study also indicated that most workers (nearly 80%) were trained on the job while a much smaller faction had college preparation (at either the associate’s or bachelor’s degree levels).
Community colleges are using existing structures to respond programmatically.

Given their continuous and rapid adaptation, these three sectors are highly complex in their workforce needs. At present, employers appear to lack a coherent and clear demand for baccalaureate-trained workers. In turn, community colleges across the state are using existing programmatic structures to respond to the occupational needs that employers have articulated. Many colleges are launching new community college certificates and associate’s degrees and/or revising established transfer paths to prepare students to enter or advance in these emergent fields. By contrast, few appear to be forging new transfer structures or partnerships to address the unique and nontraditional nature of these sectors.

Since colleges often create a local response to workforce demands and because they might establish new educational offerings under different Taxonomy of Programs (TOP) codes, it is difficult to measure the number of programs developed and awards given in each of these sectors. The following section offers a brief outline of what this preliminary research did reveal about the community college response in each sector, drawing primarily from data available through the California Community Colleges Chancellor’s Office (CCCCO). “Forging New Paths: Sample Transfer Pathways in Emerging Disciplines” (p. 5) also offers examples of how three colleges are approaching pathway development in these emerging areas of study.

**Biotechnology.** As this sector appears to be the more mature of the three studied, the educational paths seem most defined in biotechnology. Interviews and a review of the CCCCO program inventory shows that over the last decade, more than 30 of the state’s community colleges have established certificates and/or associate’s degrees under the Biotechnology and Biomedical Technology (0430) and Biomedical Instrumentation (0934.60) TOP codes as well as transfer options in engineering or biology.

Interviewees reported that certificates and associate’s degrees tend to prepare students for entry-level technician and lab assistance positions, manufacturing assistant or technician jobs or instrumentation technician opportunities. Program titles include (but are not limited to) Biotechnology, Biological Technician and Biomedical Electronics Technology. Community college educators also stated that some related transfer pathways exist. These pathways position students to transition to traditional university-level engineering or biology degree programs that may offer students some of the skills and knowledge required to work in biotechnology research and product development.

At the system level, CCCCO’s Economic and Workforce Development division funds four Applied Biotechnology Centers across the state. These centers broker relationships between community colleges and employers and promote industry-specific education, training and services to maintain a skilled and productive workforce.

**Digital media.** Reflective of this sector’s more emergent nature, this research revealed that California’s community colleges have launched a broad range of programs that prepare students for either entry-level digital media positions or advancement in current employment. These options include short- and long-term certificates and associate’s degrees under either the Digital Media (0614) or Graphic Art and Design (1030) TOP codes. Quantifying the number of
California community colleges offering digital media programs is difficult. As of 2010, 11 colleges maintained CCCCO-approved programs (18 units or more) under the Digital Media TOP code and 34 had approved programs in the Multimedia TOP code (0614.10) (according to the program inventory now retired by the CCCCO). It is both challenging and outside the scope of this research to identify those additional programs that either offer lower-unit certificate options in this code or that provide both certificate and degree options under Graphic Art and Design (which would be mixed in with more traditional graphic communications programs).

Further complicating efforts to document the scope of California community college digital media programs is the fact that different institutions house these offerings in different divisions. Accordingly, a digital media program may be found in a college’s division of Business, Arts, Liberal Arts or Computer Science. Program titles range as well and include names like Multimedia Arts and Communication, Interactive Media, Digital Visual Communication and Web Design. While public and private universities across the state also offer an array of related baccalaureate degrees in Graphic Design, Multimedia, Web Design, New Media, Illustration, Motion Graphics and Animation, this research did not identify strong articulation agreements or transfer partnerships between the state’s community colleges and four-year institutions. This wide array of program options and titles can make it difficult for students to navigate this educational pathway and for employers to make meaning out of students’ preparation.

The number of students transferring to four-year institutions in this discipline appears small. One indicator is the limited number found to be transferring into a Multimedia or Graphics Communication major at the CSU level. Transfer data provided by the CCCCO showed that in 2009-10, just 51 community college students transferred to a CSU multimedia program while 189 transferred to a CSU Graphic Design major.

Forging New Paths: Sample Transfer Pathways in Emerging Disciplines

This preliminary research uncovered examples of community colleges that have forged new transfer pathways in these three emerging disciplines.

City College of San Francisco’s Department of Engineering is home to a series of educational options in biotechnology. Offerings start with a Bridge to Biosciences program that prepares students with the math, English, science and college success skills needed for the institution’s five biotechnology certificates and/or its associate degree of science in biotechnology. Students who complete certificate and/or associate degree offerings can leverage a transfer articulation agreement with CSU Fresno’s industrial technology program.

Cabrillo College’s Digital Media Department maintains a range of nested certificate and degree options that ready students for transfer and/or prepare them for entry-level employment in digital media. The college offers nine short-term skill certificates (under 18 units) and four certificates of achievement (18 units or more). Additionally, it has associate of science degrees in digital publishing and web media that can lead to transfer at the upper-division level.

Ohlone College’s Green Academy of Sciences and Technology offers an overall “green umbrella” that brings together the physical and social sciences with related workforce development programming. The college offers environmental science (ES) associate of arts and of sciences degrees designed to prepare students for transfer to ES programs in both the UC and CSU systems.
Green technologies. Despite the lack of clearly defined “green technology” employment paths, California’s community colleges have again been responsive to emerging workforce needs. With the government giving grant priority to entry-level green job training in economically disadvantaged urban centers, community partnerships between educators, community agencies and organizations and employers are forming in some areas. Given the focus on entry-level jobs, training may or may not involve a community college CTE program and may or may not lead to a certificate, let alone transfer.

In some cases, colleges appear to be developing green technology pathways that include stackable certificates and degrees leading to specific employment. A 2010 California Workforce Investment Board report provides an inventory of green-related courses, programs and degrees at California community colleges. The inventory includes 107 courses, 105 “green” workforce certificates, 102 associate’s degrees and 13 planned programs offered at 92 colleges. Approximately 163 programs or degrees focus on energy efficiency, 52 on renewable energy, 44 on water efficiency and 271 others span a range of disciplines including architecture, construction, landscape and environmental engineering. Similarly, conversations with practitioners revealed that some transfer options exist in traditional pathways such as engineering, architecture, construction management or environmental studies where colleges are “greening” their programs by infusing green technology skills and knowledge into existing majors.

Students are traveling nonlinear, multidirectional paths to get the preparation they need in these sectors.

Practitioners who work in these emerging disciplines and were interviewed for this research indicated that students are not progressing through the state’s community college and four-year systems based on the traditional linear “2+2” transfer model. Rather students are moving in and out of community colleges and between two- and four-year systems in nonlinear and multidirectional ways to get the training they need. They report that many students are career-changers who already have baccalaureate degrees and need retraining to enter their desired occupation. Other students come to their colleges without baccalaureate degrees but with similar motivations to develop the skills and knowledge necessary for entry into these high-growth sectors. These learners may defer setting transfer goals given the generally weak ties between community college and bachelor’s degree programs in these emerging disciplines and the uncertainty that baccalaureate preparation will truly improve their employability.

On top of the evolving nature of these sectors and the lack of clarity from employers about the skills needed to enter their workplaces, these community college practitioners also cited several limitations at the university level that make transfer path development difficult.

First, universities may not have ties to employers that community colleges often maintain and do not necessarily respond at the pace needed to keep up with workforce demand. As an extension on this issue, universities frequently do not offer technically oriented degrees or opportunities for advanced-skill development that allow students to both build on and deepen the preparation they have received at the community college level and make them more competitive for employment. Both biotechnology and green technology programs appear to be particularly stratified in this
respect, offering job-oriented certificate and associate’s degree options on one hand, transfer paths in traditional disciplines on the other and little structured movement between the two.

Additionally, practitioners indicated that many students are returning to the community college system to access career advising, develop soft skills and take part in structured work experiences that make them more attractive to employers. Practitioners reported that students are often unable to find these supports and hands-on opportunities in their four-year experience. Community colleges seem uniquely positioned to provide this preparation to students.

**Discussion Questions**

The RP Group’s STP3 research team found this exploratory research to raise additional questions about how transfer paths can and should be structured to fulfill our dual-client missions of (1) effectively preparing students to access the myriad of opportunities available to them in biotechnology, digital media and green technologies and (2) adequately meeting employer demand across the state. Community college practitioners might consider these questions when working with employers, four-year partners and policymakers to determine the most appropriate educational response in these evolving sectors.

- What opportunities and mechanisms exist to specifically engage employers in these emerging sectors on the issue of transfer and the advanced preparation required for their workplaces?
- Given the broad range of ways community colleges are addressing these emerging sectors, how can institutions help students best navigate their educational options and understand their related employment opportunities?
- If neither California’s community colleges nor its public universities have the appropriate programmatic tools to respond quickly to employers’ changing workforce needs in these sectors, what new structures or arrangements should be explored? What can be learned from community college and applied baccalaureate programs offered in other states or countries?

**For more information...**

For more information on the *Student Transfer in Professional Pathways Project*, visit [http://www.rpgroup.org/stp3.html](http://www.rpgroup.org/stp3.html) or contact Eva Schiorring, Project Director, [eschioring@rpgroup.org](mailto:eschioring@rpgroup.org)
References


**Notes**

1 For a discussion of the research informing the occupational disciplines selected for examination by the *Student Transfer in Professional Pathways Project*, visit http://www.rpgroup.org/content/cte-transfer-workforce-projections.

2 For more information on the California Community College Taxonomy of Programs (TOP) codes, visit: http://www.cccco.edu/Portals/4/TopTax6_rev0909.pdf

3 Inventory retired in 2010; previously available at https://misweb.cccco.edu/webproginv/prod/invmenu.htm.