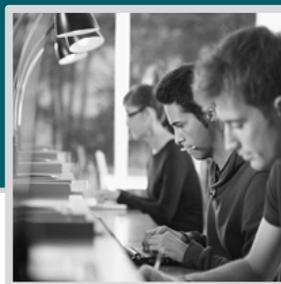
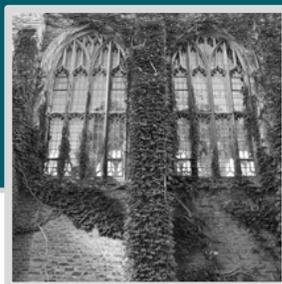


# Encouraging Students to Embrace STEM Programs

October 2014



In the following report, Hanover Research discusses how community colleges can encourage student participation in STEM programs. The report outlines best practices in outreach, recruitment, and retention for such programs.

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# EXECUTIVE SUMMARY AND KEY FINDINGS

## INTRODUCTION

The following report identifies effective ways for community colleges to attract students to STEM programs, and to ensure students are subsequently retained once they have enrolled. The report focuses on how community colleges can overcome the typical barriers STEM degrees present for students by discussing successful outreach, recruitment, and retention strategies.

## KEY FINDINGS

- **Community college students often lack important information about STEM majors and how they translate to careers.** To remedy this, institutions can create targeted outreach efforts, exposing students to STEM occupations before they take their first math or science course. For instance, Cabrillo Community College offers introductory “exploratory” courses for incoming first-year students which combine career-relevant material with active learning. These classes allow students to learn about various STEM majors without having to take pre-requisite coursework first.
- **Recruitment initiatives combining two or more strategies are often more successful than strategies implemented in isolation.** For instance, bridge programs can be combined with scholarships, or learning cohorts combined with peer drop-in tutoring. Colleges may also wish to create a centralized center, such as MESA at Cabrillo College which coordinates tutoring, field trips, clubs, and professional mentoring for all STEM students.
- **Among the most useful outreach strategies is “word of mouth” communication through peers, instructors, or counselors; among the least is high school recruiting events.** Surveying students who actually enroll in target STEM classes can be a powerful tool for institutions to evaluate and possibly shift their recruitment strategies.
- **Colleges should create clear pathways, accompanied by financial incentives, for STEM students to easily transition from high school to community college to four-year universities.** This may be achieved through dual-enrollment programs with high schools or bridge programs with universities. Bridge scholarships for STEM students transitioning to four-year programs have been found to be more effective than scholarships offered to entering first-year students.
- **Role models can be effective for motivating students and engendering initial interest in STEM careers.** Institutions should choose role models with similar backgrounds to target students (e.g., college alumni, same race or gender) to whom they can relate. Colleges have utilized role models on program flyers, website profiles, and as part of panel discussions or orientations. Similarly, mentoring programs contribute to student persistence in STEM majors and are most useful during transition points, such as before starting college or before declaring a major.

Examples of successful peer-mentoring models employed by community colleges include: developmental bridge programs, learning communities, and scholar cohorts.

- **Community colleges should prioritize not only enrolling more STEM majors, but retaining them as well – 69 percent of students who enter STEM fields at the associate’s degree level fail to complete their course of study.** Best practices in retention include: redesigning the curricula of introductory classes, creating opportunities for research and internships, providing academic support for STEM pre-requisites, and providing mentorship at transition points.
- **Community colleges should consider innovative ways of offering STEM pre-requisite courses with the highest failure rates, such as introductory chemistry and mathematics.** Successful strategies implemented by Kingsborough Community College include: offering “immersion” courses in which STEM students have the option to take difficult pre-requisites during shorter, more intense semesters; providing flexible drop-in tutoring; and breaking off into smaller peer-led discussion groups. Colleges may also choose to compress remedial-level coursework or alter major requirements.
- **By making STEM courses more interesting and career-relevant, institutions can give students a greater sense of confidence, motivation, and professional identification in pursuing a STEM career.** This can include tweaking course design to incorporate more active learning strategies, aligning coursework with local employer needs, or creating opportunities for undergraduate research and internships.

## SECTION I: STRATEGIES TO ATTRACT STEM STUDENTS

In the following section, Hanover Research provides information on strategies community colleges can adopt in order to increase the number of students enrolling, persisting, and graduating as STEM majors. Increasing the number of STEM (science, technology, engineering, and math) graduates is a national priority, as concern grows over labor shortages in these fields. Georgetown University's Center on Education and the Workforce predicts that 35 percent of STEM jobs will require a certificate or associate's degree (as opposed to a bachelor's degree or high school diploma) by the year 2018.<sup>1</sup> In addition, jobs requiring at least an associate's degree are projected to grow twice as fast as those requiring no post-secondary experience.<sup>2</sup>

**Yet, reports have noted that community colleges are not producing enough STEM graduates to meet work-force demand.**<sup>3</sup> Indeed, according to a recent analysis by the U.S. Education Department's National Center for Education Statistics, 20 percent of associate's degree candidates - compared to 28 percent of bachelor's degree candidates - declare STEM majors. Of students who do enter STEM fields at the associate's degree level, 69 percent fail to complete their course of study - compared to 48 percent of bachelor's degree candidates. Roughly half of these students switch to non-STEM majors, while the other half drop out.<sup>4</sup> Moreover, as institutions that disproportionately serve populations underrepresented in the mathematics and science disciplines (including women, African Americans, Hispanics, and Native Americans), community colleges are uniquely positioned to address this shortage of qualified STEM graduates.<sup>5</sup>

### OBSTACLES PREVENTING STUDENTS FROM ENROLLING IN STEM MAJORS

Low academic success rates combined with high attrition rates across means community colleges face a particularly difficult challenge in attracting students to and ensuring persistence in STEM fields. Indeed, when asked to identify the greatest challenge facing their work in STEM education, participants in the 2012 Community Colleges in the Evolving STEM Education Landscape Summit most frequently cited "recruitment and retention."<sup>6</sup>

<sup>1</sup> Mangan, K. "Work-Force Demand for STEM Students Spurs Efforts at Community Colleges." *The Chronicle of Higher Education*. February 11, 2013. <http://chronicle.com/article/Community-Colleges-Respond-to/137231/>

<sup>2</sup> "Introduction." *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012)*. The National Academy of Sciences, 2014. p.10. [http://www.nap.edu/openbook.php?record\\_id=13399&page=1](http://www.nap.edu/openbook.php?record_id=13399&page=1)

<sup>3</sup> Mangan, Op. cit.

<sup>4</sup> Rogers, M. "STEM-ming the Tide." *Inside Higher Ed*. November 27, 2013. <https://www.insidehighered.com/news/2013/11/27/study-tracks-attrition-rates-stem-majors>

<sup>5</sup> "U.S. Must Involve Underrepresented Minorities in Science and Engineering to Maintain Competitive Edge." The National Academies. September 30, 2010. <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12984>

<sup>6</sup> "Introduction." *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012)*. p.8. Op. cit.

This is because community college students face several unique barriers, which may dissuade them from even considering a STEM major or prevent them from graduating once enrolled. Some of the most common barriers include:<sup>7</sup>

#### **Barriers for Community College STEM Students**

- Limited knowledge about college navigation
- Financial—both time and cost
- Academic preparation in math and science; need for developmental courses
- Misalignment of core courses across community colleges and four-year schools
- Delayed, inconsistent advising, orientation, and mentoring
- Constraints affecting the academic and social integration of working students
- Self-doubt regarding capabilities
- Cultural fit with professional identity or four-year institution
- Limited sustainability of programs designed to improve recruitment and retention

Some of these barriers (limited knowledge of college navigation, self-doubt regarding capabilities, cultural fit with professional identity) can be overcome through exemplary outreach strategies, designed to ignite initial interest in STEM pathways. Others barriers (financial strain, insufficient academic preparation, misalignment of core courses, lack of mentoring) can be overcome through recruitment and retention strategies, designed to sustain this initial interest from declaring to completing a STEM major.

### **OUTREACH STRATEGIES**

Many community college students, particularly first-generation and low-income students, never enroll in STEM courses because they lack access to information about STEM pathways and how they might translate to careers. STEM courses can also have an “image” problem, with some potential students seeing math and science as “fields for nerds,” or believing that STEM programs are more time consuming and difficult than others. The latter concern is especially problematic for community college students, who may be juggling work and family responsibilities along with their studies. For others, particularly female and underrepresented minority students, stereotypes about STEM careers dissuade them from taking a first course.<sup>8</sup>

<sup>7</sup> Quoted verbatim from: Packard, B.W. “Effective Outreach, Recruitment, and Mentoring into STEM Pathways: Strengthening Partnerships with Community Colleges.” Prepared for The Summit on Community Colleges in the Evolving STEM Education Landscape. December 15, 2011, p.7. [http://nas-sites.org/communitycollegessummit/files/2011/12/NAS\\_Packard\\_Mentoring\\_toupload-2.pdf](http://nas-sites.org/communitycollegessummit/files/2011/12/NAS_Packard_Mentoring_toupload-2.pdf)

<sup>8</sup> Mangan, Op. cit.

Consequently, it is vital that institutions have effective outreach strategy for their STEM programs. As defined by Becky Packard, Professor of Psychology and Education at Mount Holyoke College, outreach refers to “any initiative designed to inform or invite students into STEM pathways.”<sup>9</sup> **The primary goal of outreach is to spark an initial interest in STEM courses or majors, particularly for students underrepresented in these fields.** Outreach aims to erase STEM stereotypes and fill the information gap by exposing students (either during high school or their first year of college) to STEM occupations and how their degrees might translate to careers. Packard has identified these best practices for encouraging students to pursue STEM coursework:<sup>10</sup>

#### Outreach Strategies

- Implement information campaigns to inform students and their families about educational pathways to STEM careers.
- Select compelling role models who are a step-ahead - either as peer students or professionals in STEM fields.
- Embed community colleges and four-year institutions into communities by working closely with high schools and sending united messages about access. Colleges can work to embed themselves within their local communities and high schools so that people in those communities see an open door to higher education.

#### INFORMATION CAMPAIGNS

Community college students, who are often the first in their families to attend college, generally lack the necessary information about STEM majors and how they translate to careers. For instance, most students do not know the difference between a technical degree from a career institute and a community college transfer pathway to a four-year STEM degree.<sup>11</sup> Complicating matters, many have received inadequate math/science education in high school and do not know of anyone who works in a STEM field.<sup>12</sup>

The first step in outreach is to inform students of STEM jobs potentially available to them, and the coursework they require. Potential recruits should be exposed to STEM occupations early - before even enrolling in a math or science course.<sup>13</sup> **Particularly at community colleges, where many students may already be working or caring for families, it is**

<sup>9</sup> Packard, Op. cit. p. 7

<sup>10</sup> “Outreach, Recruitment, and Mentoring.” Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012). The National Academy of Sciences, 2014. pp., 23,26.  
[http://www.nap.edu/openbook.php?record\\_id=13399&page=23](http://www.nap.edu/openbook.php?record_id=13399&page=23)

<sup>11</sup> Ibid. p. 24

<sup>12</sup> Jaschik, S. “Beyond ‘Drill and Kill.’” *Inside Higher Ed.* March 19, 2009.  
<https://www.insidehighered.com/news/2009/03/19/pathways>

<sup>13</sup> Packard, Op. cit. pp. 7-8

**important for students to see how STEM degrees will translate to careers.** Since STEM jobs are in such demand, merely providing students with this information is a powerful tool institutions can use to boost enrollment numbers.

Exposure is particularly important for underrepresented minority students, who complete STEM degrees in lower numbers, and who can face cultural or socioeconomic biases which may serve as deterrents against pursuing STEM degrees. Information campaigns should be focused on women in particular, who earn the majority of associate's degrees within community colleges yet are still outnumbered by men in STEM majors at a ratio of three to one.<sup>14</sup>

The CalWomenTech Project, an initiative of the Institute for Women in Trades, Technology & Science (IWITTS) to increase the number of female students entering technology programs at eight California community colleges, offers specific outreach strategies for boosting enrollments. Participating institutions, by actively recruiting women for targeted technology classes, achieved 10-15 percent increases in the number of female enrollments in a little over a year.

The program was so successful it was recently scaled up by the National Science Foundation to share its core activities and research with education practitioners (see Appendix A).<sup>15</sup> Although, these recruiting strategies were designed specifically for female students, many translate to men as well. In fact, completions in target courses increased among both female and male students.<sup>16</sup>

The IWITTS's specific outreach strategies are outlined below:<sup>17</sup>

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<sup>14</sup> Espinosa, L.L. "Pipelines and pathways: women of color in undergraduate STEM majors and the college experiences that contribute to persistence." *Harvard Educational Review*, p.209-240

<sup>15</sup> "The CalWomenTech Scale Up Project." Award Abstract, National Science Foundation. June 13, 2011. [http://www.nsf.gov/awardsearch/showAward?AWD\\_ID=1102996](http://www.nsf.gov/awardsearch/showAward?AWD_ID=1102996)

<sup>16</sup> Milgram, D. "CalWomenTech Project: Increasing Recruitment & Retention of Female College Students in Technology Courses". Conference Proceedings of WEPAN 2009 Center Stage: Effective Strategies for Recruitment and Talent Development. 2009. <http://www.iwitts.org/proven-practices/topics/recruitment/529-calwomentech-increasing-female-students-in-tech-wepan>

<sup>17</sup> Ibid. p. 1

### CalWomenTech Outreach Strategies

- Printing and distributing posters featuring role models in the college's occupational areas who were program graduates.
- Training college faculty and staff to design career development events that would attract women using social media to spread the news about STEM course offerings.
- Creating a website devoted to recruiting women into the college's targeted program with role model, program, and labor market information and links to women in technology associations.
- Printing and distributing tear-off flyers with program contact information and a link to the website.
- Printing and distributing a tri-fold brochure highlighting role model graduates, and program and labor market information.

Because women are traditionally underrepresented in STEM majors at community colleges, information campaigns are especially useful when targeted towards them. According to Donna Milgram, executive director of IWITTS and principal investigator of the CalWomenTech Project:<sup>18</sup>

*Women need proactive personal encouragement and positive media messages to counteract the status quo at many community colleges, where few or no women are in STEM classrooms or appear on marketing materials for STEM programs... it is essential for women to get an accurate picture in their minds about what STEM involves. They need to understand what kind of jobs they can get and what kind of career pathway there is from the field.*

Specifically, Milgram recommends targeting already enrolled female students who have not yet declared a major. The same lessons apply to ethnic minority groups, such as African Americans and Latinos, which are also traditionally underrepresented in STEM fields. The types of recruitment strategies employed by the CalWomenTech project aim to break the subtle social stereotypes and biases influencing such students by creating targeted information campaigns to provide information about career possibilities and role models with similar backgrounds to target students.<sup>19</sup>

By tracking project outcomes, through surveying students who enrolled in target STEM courses, the CalWomenTech project also provides some useful strategies for what recruitment strategies work best. The results provided by student surveys often contradicted the preconceived notions held by school leadership – in some cases causing

<sup>18</sup> Quoted verbatim from: "Recruiting women for STEM careers isn't rocket science." *Community College Daily*. May 11, 2012. <http://www.ccdaily.com/Pages/Academic-Programs/Recruiting-women-for-STEM-careers-isnt-rocket-science.aspx>

<sup>19</sup> Ibid.

institutions to alter their recruitment plans. Thus, surveying students who actually enroll in target STEM classes can be a powerful tool for institutions to evaluate and possibly shift their recruitment strategies.

The survey results across seven participating colleges indicate **that “word of mouth” was the most effective strategy for initially recruiting students into target technology programs.** Eighty-nine percent of female students said one way they heard about the program was through a peer, instructor, or counselor. As a result, several participating institutions came up with their own internal word of mouth strategies, such as encouraging female STEM students to recommend the program to a friend or posting recruitment messages on social media. Survey results also indicated what strategies were least helpful. For instance, two percent of students who attended a recruiting event during high school actually enrolled in technology courses.<sup>20</sup> Recognizing which strategies are ineffective in this area thus allows institutions to re-prioritize and maximize the use of their resources during outreach campaigns.

### *ROLE MODELS*

Another powerful tool to engender student interest in STEM careers is the use of role models. These can range in nature, from current STEM students to alumni successfully employed in STEM fields to local scientists. **Each type of role model exposes students to people with similar backgrounds to themselves who have successfully pursued STEM pathways.**

Effective role models not only provide information about their careers, but also share with students the challenges they had to overcome along the way. Such individuals are most effective for motivating students and getting them initially interested in STEM careers.<sup>21</sup> By informing students about what they can do with STEM degrees, role models can also help students define career pathways early on. Students can then work with academic advisors to develop course plans that will put them on the right path to their chosen career.<sup>22</sup>

Role models may also be successful professionals that fit the demographics of students the college is targeting. For instance, the CalWomenTech project specifically showcases females in technology careers on its posters, brochures, flyers, and websites. Eighteen percent of students who ended up enrolling in a technology course at partner institutions said the role model posters helped inform them about the program.<sup>23</sup> Similarly, La Guardia Community College is launching a program open to all community colleges in New York City which features panel discussions with successful female health and science professionals to give

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<sup>20</sup> Milgram, D., and Severs, D. “CalWomenTech Project: Recruiting and Retaining Women in Technology Programs.” American Society for Engineering Education, 2010. p. 8. <http://www.iwitts.org/proven-practices/topics/recruitment/520-calwomentech-project-recruiting-and-retaining-women-in-technology-programs>

<sup>21</sup> Packard, Op. cit. p. 7

<sup>22</sup> “Outreach, Recruitment, and Mentoring.” Op. cit. p. 26

<sup>23</sup> Ibid. p. 5,8

students real-world examples of women in STEM careers. The goal is to expose potential students to career pathways early on as the first two years of college usually predict whether students will go on to pursue STEM majors.<sup>24</sup>

### *COMMUNITY LINKAGES AND DUAL-ENROLLMENT PROGRAMS*

Research has suggested that STEM recruitment strategies should be embedded into local communities and high schools. For instance, institutions might expand STEM-specific dual enrollment programs, which allow high school students to take coursework at local community colleges.<sup>25</sup> **Dual-enrollment can provide both financial and academic motivation for students considering STEM degrees.** By completing some pre-requisite coursework while still in high school, dual-enrollment students are able to complete STEM degrees faster than their peers once in college, saving time and money. Additionally, students are often better prepared for college-level math and science coursework.

Recent research within the New York and Florida school systems suggests that offering dual enrollment courses to students with lower grade point averages (e.g. students who would not typically consider pursuing higher education at a typical four-year institution) could help produce students who are “more motivated to persist in college as a result of gaining college credit while in high school.”<sup>26</sup>

Other common community outreach strategies, which can spark students’ interest in the STEM fields prior to college, include:<sup>27</sup>

- Offering summer enrichment programs, where students participate in hands-on lab experiments on a college campus.
- Building a network of math and science teachers at local high schools as partners.
- Disseminating STEM specific college access information to families (e.g. at doctors’ offices, workplaces, etc.)

Although such outreach strategies may effectively spark students’ interest in STEM pathways, they do not necessarily translate to increased enrollments and completions in STEM majors. The following section will discuss effective strategies for STEM recruitment and retention.

<sup>24</sup> “Motivating women to enter STEM careers.” *Community College Daily*. February 6, 2014.

<http://www.ccdaily.com/Pages/Campus-Issues/Motivating-women-to-enter-STEM-majors.aspx>

<sup>25</sup> Packard, Op. cit. p. 9

<sup>26</sup> Ibid. p. 14

<sup>27</sup> Ibid. p. 10

## SECTION II: STRATEGIES TO RECRUIT AND RETAIN STEM MAJORS

The following sections elaborate on the most common and effective strategies for boosting STEM enrollment and graduation rates at community colleges. Recruiting students to STEM programs goes “beyond sparking an interest or expanding career knowledge; the goal (now) is to enroll students in their first course or to pursue a STEM major.”<sup>28</sup> **Recruitment aims to ensure interested students can successfully complete all pre-requisite coursework and retain the motivation to continue down their selected STEM pathway.**

Moreover, as discussed in Part I, the attrition rates for associate’s degree STEM candidates are higher than at the bachelor’s degree level; 69 percent of associate’s degree students who declare a STEM major fail to graduate as a STEM major.<sup>29</sup> Further, underrepresented minority students face even larger barriers in actual degree attainment. Although they declare STEM majors in equal proportions to their peers, only 20 percent of underrepresented minority students actually complete degrees in STEM fields.<sup>30</sup>

The following are common best practices for recruiting and retaining community college students in STEM majors:

### Recruitment & Retention Strategies

- Re-design curricula to make STEM courses more interesting and career relevant. This can include tweaking course design to incorporate more active learning strategies or aligning coursework with local employer needs. Create more opportunities for undergraduate research and internships.
- Provide better academic preparation and support systems for “gateway” STEM courses, such as remedial mathematics or general chemistry. Strategies may include: requiring fewer pre-requisites, providing refresher courses, creating more concentrated course schedules, or providing flexible tutoring.
- Provide mentorship to STEM students, particularly at transition points in their academic career (prior to declaring a STEM major, during pre-requisite coursework, etc.)
- Create bridge programs and scholarships with local universities to help STEM students easily transition to four-year degrees.

These recruitment and retention strategies are meant to ensure STEM students have both the ability (academic preparation, financial means) as well as the motivation (can see link to

<sup>28</sup> Packard, Op. cit. p. 16

<sup>29</sup> Rogers, Op. cit.

<sup>30</sup> Hrabowski, F. “A Time of Urgency.” *Inside Higher Ed*. November 8, 2010.  
<https://www.insidehighered.com/views/2010/11/08/hrabowski>

career, interest in course material) to either graduate with an associate's degree in a STEM field or transfer to a 4-year college as a STEM major.

## CAREER-RELEVANT AND INTERESTING CURRICULA

Once students have successfully been recruited into STEM majors, it is equally important for institutions to help them stay motivated through graduation. As discussed in Section I, there are several reasons why community college students may be dissuaded from majoring in STEM subjects. By altering curricula, particularly for introductory courses, institutions can help give students a greater sense of confidence, motivation, and professional identification in pursuing a STEM career.<sup>31</sup>

### COURSE DESIGN

Many STEM students become disillusioned by introductory math and science classes because they cannot see how such abstract concepts will translate to their career goals. Moreover, STEM students pursuing associate's science degrees are generally more interested in becoming allied health professionals, such as nurses or physical therapists, rather than doctors or researchers. When students perceive a disconnection between course material and career goals, they tend to have more trouble staying motivated over time.<sup>32</sup>

One way community colleges can recruit and retain STEM students is through revamping introductory courses to make them more interesting and career-relevant. **Strategies include interdisciplinary course design, a mixture of collaborative and competitive activities, active-learning, and contextual examples.** For example, the National Science Foundation and the Museum of Science in Boston have a program that incorporates engineering and technology concepts into core introductory science courses at community colleges.<sup>33</sup> Math pre-requisites should also be taught in the context of being "a necessary tool to solve interesting and complex problems in a variety of industries and STEM application areas."<sup>34</sup>

Another strategy community colleges may employ is creating STEM courses aligned with local labor market demand. For instance, Valencia College in Florida was able to increase the number of STEM associate's degree graduates rate by 60 percent within five years by creating highly targeted programs, such as laser photonics, aligned with the needs of a local aerospace and defense company. However, diversifying such partnerships is also important.

<sup>31</sup> Marsteller, P. "STEPping into the Future White Paper Thread: High Impact Practices and Under Represented Minorities." STEP Central. <http://stepcentral.net/groups/posts/1191/#.VDWbBvldWCI>

<sup>32</sup> Eckhardt, R. and Lloyd, P. "Strategies for Improving Retention of Community College Students in the Sciences." *Science Education*. Spring 2010, p. 35. <http://files.eric.ed.gov/fulltext/EJ874152.pdf>

<sup>33</sup> Packard, W.B. "Appendix B." *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012)*. The National Academy of Sciences, 2014. p.65. [http://www.nap.edu/openbook.php?record\\_id=13399&page=57](http://www.nap.edu/openbook.php?record_id=13399&page=57)

<sup>34</sup> Jeanette Mowry, Madison Area Technical College quoted in "The Two Year Curriculum in Mathematics," Chapter 5," *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012)*. The National Academy of Sciences, 2014. p.33. [http://www.nap.edu/openbook.php?record\\_id=13399&page=33](http://www.nap.edu/openbook.php?record_id=13399&page=33)

In the case of Valencia, when defense cuts caused their partner company to lay off workers, their graduates were among the first to lose their jobs.<sup>35</sup>

### *RESEARCH AND INTERNSHIPS*

In a report entitled “What Matters in College for Retaining Aspiring Scientists and Engineers,” researchers summarized several best practices for recruiting and retaining under-represented minority students in STEM majors. Although the lessons are geared towards four-year universities, many of the lessons apply to community college students who tend to share similar backgrounds. For instance, offering students research opportunities not only attracts and retains STEM majors, but may also improve classroom performance. By increasing students’ tendencies to feel, think, behave, and be recognized by faculty role models as a ‘science person,’ undergraduate research means underrepresented minority students are more likely to identify with a STEM field and view it as an important aspect of their self-identity, which should in the long run enhance their chances of persisting.<sup>36</sup>

The importance of research opportunities was a concept reiterated in discussion at the 2012 Summit on Community Colleges in the Evolving STEM Education Landscape where participants noted community colleges face unique difficulties in supporting research (limited lab resources, professors’ time, etc.). Participants also noted STEM faculty can incorporate research into class time, citing the example of DNA sequencing, which has even been done at the high school level.<sup>37</sup>

As discussed above, students are also more likely to persist in STEM majors if they can see how their coursework will translate to future careers. Because community college students in particular are more likely to work while attending school, colleges can try to make these work experiences career-relevant, either by way of paid internships or work-study programs.<sup>38</sup>

### **RETAINING STEM STUDENTS BEYOND “GATEKEEPER” COURSES**

One of the major barriers to community college students enrolling and persisting in STEM programs is inadequate academic preparation. Many students have not taken advanced level mathematics or science coursework in high school, which means they enter college without the baseline skills required for all STEM majors. Such students either become disillusioned and never even enroll in a STEM course or get bogged down by all of the remedial coursework they must now take.

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<sup>35</sup> Mangan. Op. cit.

<sup>36</sup> Chang, M et al. “What Matters in College for Retaining Aspiring Scientists and Engineers.” The University of California Los Angeles, 2010. <http://www.heri.ucla.edu/nih/downloads/AERA2010-What-Matters-in-College-for-Retaining-Aspiring-Scientists-and-Engineers.pdf>

<sup>37</sup> “General Discussion.” Chapter 7, Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit (2012). The National Academy of Sciences, 2014. p.44  
[http://www.nap.edu/openbook.php?record\\_id=13399&page=41](http://www.nap.edu/openbook.php?record_id=13399&page=41)

<sup>38</sup> “Appendix B.” Op. cit. p.65

This poses two problems: firstly, Students wishing to complete a STEM degree require more time (and money) to graduate because they need to complete remedial level coursework first, and, secondly, STEM students fail or drop out of pre-requisite (“gatekeeper” or “gateway”) coursework before they can get to the specialized classes within their major. There are several strategies community colleges can employ to help prospective STEM majors overcome these barriers, which can be divided into two categories: altering the pre-requisite course requirements for STEM programs, and improving academic success and retention in gateway STEM courses.

### *COURSE REQUIREMENTS*

By waving the requirements on specific pre-requisites or re-structuring remedial course structure (when appropriate), community colleges may encourage more students to pursue science or technology pathways. For example, one way of ensuring that neither financial nor academic matters prohibit STEM program completion among community college students is to compress graduation requirements - particularly in remedial level courses. **By combining two or more remedial courses into one course, community colleges can help to reduce time-to-completion for STEM degrees - a strategy which may help attract students who view STEM disciplines as being too time and cost prohibitive.** Dual-enrollment programs with high schools, discussed in Part I, can also serve a similar purpose.<sup>39</sup>

South Texas College, for example, has compressed arithmetic, introductory algebra, and intermediate algebra into two courses instead of three. The courses require more in-class and computer lab time, but reduce total academic time spent on remedial mathematics. Similarly, the Community College of Denver offers a FastStart option that allows students to take two remedial courses in a single semester, and also offers a self-paced, computer-based class that students can complete over the course of more than one semester.<sup>40</sup>

Another potential solution is to change pre-requisite requirements for certain STEM majors. Carl Wieman, former associate director for science in the White House Office of Science and Technology Policy, has questioned the reliance on diagnostic testing and sorting in mathematics pre-requisites. By sorting students into “remedial” versus “college-ready” categories, testing may deter less prepared students from attempting STEM majors. An alternative approach might be to offer short refresher mathematics courses before students take the placement exams, as a way to decrease the number of students in remedial courses. Other experts question whether some technical occupations even require advanced mathematics pre-requisites, such as trigonometry or calculus, which college counselors and test makers often require of STEM students.<sup>41</sup>

<sup>39</sup> “Outreach, Recruitment, and Mentoring.” Op. cit. p. 23

<sup>40</sup> “For Community College Students who Struggle with Arithmetic, Some Solutions.” *The Chronicle of Higher Education*. June 6, 2010. <http://chronicle.com/article/For-Community-College-Students/65770/>

<sup>41</sup> “The Two Year Curriculum in Mathematics.” Chapter 5, *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit* (2012). The National Academy of Sciences, 2014. p.33

### *IMPROVING PERFORMANCE IN GATEKEEPER COURSES*

Math, the “backbone of the STEM pipeline,” proves particularly difficult for students – many of whom enter college without a strong background in quantitative reasoning. 57 percent of associate’s degree students are enrolled in mathematics courses at the pre-college or non-credit level. Furthermore, very few students actually pass these remedial level courses. Only 31 percent of community college students enrolled in remedial level math courses ever move beyond them.<sup>42</sup> At the New York City College of Technology, for instance, about 20 percent of students pass low level remedial math and many withdraw before the end of the semester. Oftentimes, these pre-requisite courses serve as not just “gatekeepers” for aspiring STEM majors but “firing squads.”<sup>43</sup>

Strategies for improving passing rates in math pre-requisites vary from offering additional class time for the lowest pre-test scorers to creating more flexible systems for evaluation.<sup>44</sup> Other recommendations include: applying math concepts to STEM fields, teaching basic study skills (such as note taking), and varying instructional methods to match different learning styles.<sup>45</sup> Regardless of the specific strategies used, **community colleges should require all remedial level math coursework to be of high quality, taught by capable instructors.**

Notoriously difficult pre-requisite courses, such as advanced algebra and general chemistry, which STEM majors must usually take to advance to more specialized subjects, also serve as huge barriers for community college students. For instance, general chemistry – where failure and attrition rates are traditionally high – can prevent Biology or Engineering majors from advancing in their field of study. CUNY Kingsborough Community College in New York (profiled at the end of this section) found that even students who had done well in prior mathematics and preparatory courses, still failed general chemistry. This may suggest that prior preparation and quantitative reasoning skills are not the only stumbling blocks for aspiring STEM majors. For many students, general chemistry is the first course to demand a high level of quantitative reasoning applied to a scientific field, which can be overwhelming for students with limited background in math and science.<sup>46</sup>

Below are some strategies community colleges have successfully implemented to increase the pass rates (and retention in STEM fields) for traditionally difficult science and math pre-requisites:<sup>47 48</sup>

<sup>42</sup> “For Community College Students who Struggle with Arithmetic, Some Solutions.” Op. cit.

<sup>43</sup> “The Two Year Curriculum in Mathematics.”p.32

<sup>44</sup> “For Community College Students who Struggle with Arithmetic, Some Solutions.” Op. cit.

<sup>45</sup> “100% Math Initiative- Building a Foundation for Student Success in Developmental Mathematics.” Massachusetts Community Colleges Executive Office. 2006.

<http://www.masscc.org/sites/masscc.drupalgardens.com/files/mathinitiativefinal.pdf>

<sup>46</sup> Eckhardt, R. and Lloyd, P. Op. cit. p.34-35

<sup>47</sup> Ibid.

<sup>48</sup> “Forming the Complete Picture,” Op. cit.

### Strategies for Improving Academic Performance and Retention in “Gatekeeper” STEM Courses

- Create “immersion” courses in which STEM students have the option to take difficult pre-requisites during shorter, more intense semesters. By allowing students to focus on fewer courses, they may have more time to devote to the subject.
- Introduce discussion groups in which students break off into smaller sub-sections where either a step-ahead peer or faculty member lead workshops designed to develop independent problem solving and a deeper understanding of course material outside of lectures.
- Provide flexible drop-in tutoring that accommodates students’ busy schedules.
- Integrate “building block” skills into introductory STEM courses, such as teaching math and science in the context of STEM workplace activities. This strategy is particularly useful for students with limited background in their area of study. For instance, teaching special reasoning has been proven to significantly increase the retention of women in introductory engineering courses.

## MENTORING

Mentoring is another important tool that community colleges can employ to encourage both enrollment and persistence in STEM majors. According to certain analysts, mentoring is most effective when students have a “constellation mentoring strategy”: multiple mentors that can provide guidance across a variety of different areas. Thus, students are more likely to continue as STEM majors when they experience both: Socio-economic Mentoring, which involves encouragement and emotional support, and Instrumental Mentoring, which involves academic support, college navigation, and career coaching.<sup>49</sup>

Research has found mentoring is most useful at transition points; for instance, before a student selects a major or after transitioning to a four-year college. Thus, mentoring can be a useful strategy for outreach, recruitment, *and* retention. **Successful mentoring programs are those that cater to student needs at different transition points and are accessible to target students.** For instance, if the majority of students work year round or do not have access to reliable transportation, then a summer mentoring program will probably fail to make a large impact. Additionally, informal faculty mentoring and advising should be a component of all STEM courses, not just supplemental programs.<sup>50</sup> Below is a more detailed discussion of transition programs, which employ same-stage peer mentoring to encourage student enrollment and persistence in STEM majors.<sup>51</sup>

<sup>49</sup> Packard, W.B. Op. cit. p.16

<sup>50</sup> Ibid. p,17

<sup>51</sup> Organizational structure adapted from: “Mentoring Comprehensive Networks at Transition Points.” Packard, W.B. Op. cit. p. 16-22

### *DEVELOPMENTAL BRIDGE PROGRAMS*

Developmental bridge programs are designed to build the academic and social skills necessary for college success before students officially begin their first year. Research analyzing eight different developmental bridge programs at colleges in Texas, found participants attained greater academic success in math courses and were also more likely to enroll in such courses once the school year began. The programs involved a combination of academic instruction, college success advising, and mentoring from upper-level students.<sup>52</sup> Less-expensive alternatives to comprehensive bridge programs may include extended orientation programs for incoming STEM students or pre-college STEM coursework. For instance, Cabrillo Community College in California offers a summer Pre-calculus Preparedness Seminar for incoming math and science students.

### *LEARNING COMMUNITIES AND FIRST-YEAR SEMINARS*

In learning communities and first-year seminars new STEM students are placed in small course sections with common advising hours. The two methods are identical, except in learning communities, the same cohort of students are enrolled in multiple introductory courses simultaneously.<sup>53</sup> Research suggests that learning communities can improve student attitudes towards learning, enhance the overall learning experience, and significantly increase student motivation in STEM courses.<sup>54</sup> Learning communities can also help promote the formation of self-supporting groups, more active involvement in class, and higher persistence rates for participating students when compared to their peers.<sup>55</sup>

### *SCHOLAR COHORT PROGRAMS*

Like learning communities, scholar cohort programs take advantage of same-stage peer mentoring by enrolling small student groups in the same set of introductory STEM courses for their first year of college. However, in this model students are selected for their high academic performance or leadership potential. **Science scholar cohorts in particular have been shown to encourage persistence in STEM majors, particularly among first-generation and low-income college students.**<sup>56</sup>

*What we know from examining research and best practice is that many different kinds of mentoring relationships contribute to persistence in college and within STEM specifically.*

<sup>52</sup> Packard, Op. cit. p. 18-19

<sup>53</sup> Ibid. p.19

<sup>54</sup> Freeman, K. E., Alston, S. Winborne, D.G. "Do Learning Communities Enhance the Quality of Students' Learning and Motivation in STEM?" *The Journal of Negro Education*, 2008.

<sup>55</sup> Olds, B.M., Miller, R.L. "The Effect of First-Year Integrated Engineering Curriculum on Graduation Rates and Student Satisfaction." *Journal of Engineering Education*. January 2004.

<sup>56</sup> Packard, Op. cit. p.20

An example of a successful STEM scholar cohort program design for community colleges is the Meyerhoff Scholars Program at the University of Maryland at Baltimore County. The program, which specifically targeted African American students, combined a rigorous selection process and free tuition for selected students. In addition to the financial aid, students cited the summer bridge program, use of study groups, shared residential location, professional mentoring, and formation of a ‘Meyerhoff identity’ as important parts of the program. As a result, Meyerhoff Scholars were more likely than their peers to persist in STEM majors, attain high grades, and continue on to graduate schools in STEM fields.<sup>57</sup>

## BRIDGE PROGRAMS AND SCHOLARSHIPS WITH FOUR-YEAR UNIVERSITIES

Many community colleges have adopted bridge programs, which facilitate student transfers from community colleges to four-year institutions. Such programs are designed to ensure that STEM students continue work in their discipline beyond the initial two years of community college.<sup>58</sup> Additionally, these programs generally include scholarship components which provide students with financial support necessary for pursuing longer programs of study at four-year institutions.<sup>59</sup>

In order for bridge programs to be effective, community colleges must engage in significant high school and community outreach. These outreach efforts serve to not only spark interest in STEM programs, but also to emphasize pathways and career options within STEM fields. **Colleges should create clear pathways, accompanied by financial incentives, for STEM students to easily transition from high school to community college to four-year universities.** This includes setting up easy credit transfer systems and aligning curricula.<sup>60</sup>

In addition, it is important for institutions to examine the needs and incentives of their students. For instance, scholarships which require students to take full course loads may be unrealistic for community college students who often have families or full-time jobs. Evidence has also suggested providing incoming college freshman with scholarships is not only expensive, but also ineffective at increasing the numbers of STEM graduates. Instead, it may be more effective for community colleges to award “bridge scholarships” offered to students within a certain number of credits of completing their associate’s degree to continue their STEM studies at a four-year partner university.<sup>61</sup>

<sup>57</sup> Carillo, A., Mariano, R., Stolle-McAllister, K. “The Meyerhoff Way: How the Meyerhoff Scholarship Program Helps Black Students Succeed in the Sciences.” *Journal of Science Education and Technology*. February 2011.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3155774/>

<sup>58</sup> Adam, M. “STEM Advances at Two-Year College, But Gap Still Looms Nationwide.” *The Hispanic Outlook in Higher Education*. January 3, 2011, p.22-24.  
<http://search.proquest.com/socialsciences/docview/833929729/134DD6F7F0444D5798E/9?accountid=132487>

<sup>59</sup> Whissemore, T. “Community colleges’ growing stake in STEM.” *Community College Daily*. December 16, 2011.  
<http://www.ccdaily.com/Pages/Academic-Programs/Community-colleges-growing-stake-in-STEM.aspx>

<sup>60</sup> “Discussion.” Op. cit. p.45

<sup>61</sup> Heidel, J. et. al. “Increasing the Number of Homegrown STEM Majors: What Works and What Doesn’t.” *Science Educator*, Spring 2011. P.49-54.  
<http://search.proquest.com/socialsciences/docview/896624411/134DD212D325DA49194/25>

## SECTION III: CASE STUDIES

The following community colleges are profiled for their successes in significantly boosting graduating rates among STEM majors. All institutions are members of The National Science Foundation’s Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP). STEP provides funds to help two-year and four-year colleges increase the number of STEM graduates in the United States.<sup>62</sup>

The following profiles offer examples of how community colleges can successfully implement several of the recruitment and retention strategies outlined above. Additionally, Hanover notes that **initiatives combining two or more strategies, such as bridge programs combined with scholarships, are often more successful than strategies implemented in isolation.**

### CABRILLO COLLEGE

Cabrillo College, a community college in California, provides an example of how to effectively increase the number of STEM graduates by developing an institutional plan built on coordinated outreach, recruitment, and retention strategies.

Cabrillo received a STEP grant to attract and retain students to STEM fields. The grant encompassed a variety of initiatives, ranging from undergraduate research and internship placement to the creation of a summer Energy Laboratory Academy to additional mentoring and tutoring support. As summarized by STEP:<sup>63</sup>

*The project's intellectual merit stems from the interplay of the many interventions being employed: project based learning, service learning, learning through teaching, intensive cohort experiences, individualized learning, and longitudinal support through established learning communities.*

Cabrillo’s strategies were particularly successful at increasing the percentage of Latino students who declared STEM majors, which increased from 19 percent in 2008 to 34 percent in 2013. The number of STEM majors overall also increased from 17 percent of enrolled students in 2008 to 20 percent in 2013.<sup>64</sup>

Below, Hanover identifies some of Cabrillo’s most innovative strategies:

- **The MESA Center:** Cabrillo was the first community college to create a Mathematics, Engineering and Science Achievement Program (MESA) to provide centralized academic support to academically disadvantaged and under-represented students,

<sup>62</sup> “Our Mission.” STEP Central. <http://stepcentral.net/>

<sup>63</sup> “Science, Technology & Energy: Expanding Potential (STEEP)- Cabrillo College” STEP Central. <http://stepcentral.net/projects/14#.VDb-iORASUI>

<sup>64</sup> “Increase in Latino STEM Majors 2012-2013.” Cabrillo College Annual Report to the Community 2013-2014. p. 7. <http://www.cabrillo.edu/home/documents/2014/annual-report-to-the-community-2014.pdf>

- with the goal of encouraging transfer to four-year programs. MESA supports students through Academic Excellence Workshops, career and financial aid advising, transfer assistance, field trips, and free tutoring. MESA also helps coordinate internship panels featuring alums engaged in STEM fields and houses student groups, such as a Robotics Club and Pre-Med Club.<sup>65</sup>
- **Learning Cohorts for Gateway Courses:** Cabrillo focused its attention on improving academic performance in two gateway classes with high failure rates: Pre-calculus (a pre-requisite for nearly all lower division technical coursework) and Circuits (a pre-requisite for most upper division technical coursework and engineering majors).<sup>66</sup> Cabrillo’s pre-calculus strategy organizes students into learning cohorts. In cohorts, students receive two-weeks of intensive math review before the start of the semester followed by weekly workshops.<sup>67</sup> By relying on the learning cohort model, students benefit from a peer support network, which makes them more successful in the course.<sup>68</sup>
  - **STEM Exploratory Programs:** Cabrillo offers introductory, “exploratory” courses to STEM careers geared towards incoming first-year and high school students. The aim of these classes is to allow students to learn about various STEM majors without having to take pre-requisite coursework first. For instance, the Engineering Department offers “Engineering as a Profession” which allows “students (to) explore the many options of an engineering career through the use of class discussions, videos, tours, design projects, and speakers from industry.”<sup>69</sup> **Unlike introductory courses for STEM majors, which often require difficult pre-requisites like Physics or Chemistry, these exploratory courses allow students to get a sense for potential STEM majors before committing to the program.** By incorporating career-relevant and active learning techniques, students are more likely to consider majoring in a STEM field. The college also offers a Career Planning Course for STEM majors, which meets the first six Fridays of the fall semester. The course is designed for potential majors to learn more about STEM coursework and career opportunities. Students also go on lab tours of different departments and learn from STEM faculty about the different programs the college offers.<sup>70</sup>

<sup>65</sup> “MESA- Mathematics, Engineering and Science Achievement.” Cabrillo College.  
<http://www.cabrillo.edu/services/mesa/>

<sup>66</sup> “Science, Technology & Energy: Expanding Potential (STEEP)- Cabrillo College” Op. cit.

<sup>67</sup> “PREP: Pre-calculus, Readiness, and Excellence Program.” STEEP. Cabrillo College. <http://www.cabrillosteep.org/>

<sup>68</sup> “Cabrillo College- STEEP, Creating a Community of Motivated Learners.” Looking Back Blog Series. STEP.

[http://stepcentral.net/blog/cabrillo-college-steep-creating-community-motivated-learners/#.VDb\\_-KRASUk](http://stepcentral.net/blog/cabrillo-college-steep-creating-community-motivated-learners/#.VDb_-KRASUk)

<sup>69</sup> “Curious about a Career in Engineering?” Engineering Department, Cabrillo College.  
<http://www.cabrillo.edu/academics/engineering/>

<sup>70</sup> “How to Decide if STEM is Right for You.” STEM@Cabrillo, Cabrillo College.  
[http://www.cabrillo.edu/services/stem/explore\\_STEM.html](http://www.cabrillo.edu/services/stem/explore_STEM.html)

## KINGSBOROUGH COMMUNITY COLLEGE: ACADEMIC SUPPORT FOR GATEWAY COURSES

As part of a STEP grant to improve undergraduate student retention in STEM subjects, Kingsborough Community College (Kingsborough), which forms part of the City University of New York (CUNY), piloted an immersion course in general chemistry during six-week winter and summer sessions. Previously, the course had been offered in a 12-week format. Traditionally, the course had a pass rate of around 50%, and served as a major barrier for students interested in STEM majors. Kingsborough administrators theorized that students might better focus on their studies during these six-week sessions because they would be enrolled in fewer courses during this time. Instructors, too, would be able to devote more time to the students, as they would have a smaller course load. The faculty members leading the course also increased their advising and mentoring availability for the duration of the program by limiting their research hours.<sup>71</sup>

Below are the major components of what the institution dubbed the “Brooklyn Gateway Project”:<sup>72, 73</sup>

### Components of the Brooklyn Gateway Project

- Pre-requisite STEM courses feature the same lecture and laboratory components, but are now offered during an intensive 6-week, as opposed to 12-week period.
- Mandatory peer-led team learning (PLTL) sessions are held in addition to regularly scheduled lecture and laboratory time.
- The provision of flexible one-on-one and online tutoring.
- A stipend of \$300 is provided to cover the cost of books and transportation. Financial support is only offered during the winter and summer modules as an inducement to concentrate exclusively on science studies for the 6-week period.
- Students are given the opportunity to take part in ongoing research programs under the supervision of faculty members after successfully completing a Gateway Course.
- Every semester includes at least one seminar presented by a professional research scientist or trip to a science museum.

Two major aspects of the program – peer-led team learning and drop-in tutoring – distinguish this chemistry immersion course from traditional courses in the field. In the PLTL component of the program, students who were previously been successful in the course lead groups of six to eight current students through faculty-designed workshops “designed to promote exploration of

<sup>71</sup> Eckhardt, R. and Lloyd, P. Op. cit. p. 37

<sup>72</sup> “Brooklyn Gateway- Project Description.” Kingsborough Community College.

<http://www.kbcc.cuny.edu/academicdepartments/bio/brooklyngateway0506/webpages/Pages/ProjDesc.aspx>

<sup>73</sup> “Student Support Activities,” The Brooklyn Gateway- Kingsborough Community College.

<http://www.kbcc.cuny.edu/academicdepartments/bio/brooklyngateway0506/webpages/Pages/StudSup.aspx>

the course material outside the traditional lecture environment.”<sup>74</sup> In this way, the program shifts the course focus away from traditional education and toward more active student learning and problem solving. One of the main benefits of this learning approach is that students develop superior critical thinking skills, which may ultimately help minimize “transfer shock” upon transfer to a four-year college.<sup>75</sup>

The course’s second distinguishing characteristic—drop-in tutoring—also has a positive impact on student achievement. Throughout the course, students are encouraged to attend after-class drop-in tutoring sessions with course faculty or PLTL leaders. Immersion course participants attend tutoring sessions at a higher rate than their peers in traditional courses. Additionally, the highest attendance for tutoring sessions was found when the tutors also served as PLTL leaders, indicating that “tutoring is more important to students when it is connected to other components of the course.”<sup>76</sup>

Kingsborough administrators found that student passing rates in the immersion chemistry courses were higher than in the traditional twelve-week sections. Interestingly, “the percentage of students receiving a letter grade A was not significantly higher for students in the immersion groups,” suggesting that “the program has a particular effect on students at risk of failing the course.”<sup>77</sup>

Finally, the number of students who eventually attained STEM degrees was nearly twice as high in the immersion group as in the traditional group (38 percent versus 19 percent). Researchers Patrick Lloyd and Ronald Eckhardt theorize that the greater graduation rate among the immersion students is likely due to the fact that general chemistry is the terminal chemistry requirement for biology majors at BCC, and that “by increasing the pass rates in general chemistry, [the college] may have eliminated the major barrier to graduation for the majority of [biology] students.”<sup>78</sup>

Due to the success of the six-week course in general chemistry, Kingsborough has since extended the winter and summer module immersion programs to include introductory Biology and Physics pre-requisites. After passing a course during the winter or summer immersion program, students can then move onto the next science course in the sequence. Students who earn a grade of ‘A’ in a Gateway course can then apply to become PLTL leaders.<sup>79</sup>

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<sup>74</sup> Eckhardt, R. and Lloyd, P. Op. cit. p.6

<sup>75</sup> “The Brooklyn Gateway – The Peer-Led Team Learning (PLTL) Model.” Kingsborough Community College. <http://www.kbcc.cuny.edu/academicdepartments/bio/brooklyngateway0506/webpages/Pages/PLTL.aspx>

<sup>76</sup> Eckhardt, R. and Lloyd, P. Op. cit. p.7

<sup>77</sup> Ibid. p.5

<sup>78</sup> Ibid. p.6

<sup>79</sup> “The Brooklyn Gateway – Project Description.” Op. cit.

## UNIVERSITY OF NEBRASKA AT OMAHA AND METROPOLITAN COMMUNITY COLLEGE: BRIDGE PROGRAMS

The University of Nebraska at Omaha (UNO) and Metropolitan Community College (MCC) received a STEP grant from 2004-2009 to develop a “collaborative effort to increase associate’s and bachelor’s degrees in the STEM areas.”<sup>80</sup> Over the course of five years, the number of UNO STEM graduates increased at a higher rate than the number of total university graduates (38 percent as compared to 32 percent) and the number of MCC students transferring into UNO as STEM majors also increased. Gains were made primarily in biology, followed by chemistry and mathematics.<sup>81</sup>

As part of the STEP grant, UNO and MCC formed an articulation agreement that allowed students to transfer all academic courses from one institution to the other. MCC created six new pre-STEM associate’s degrees, and students who were within 50 hours of completing the associate’s degree could apply for an UNO Bridge Scholarship (\$500 per quarter at MCC and \$1,000 per semester at UNO) if they transferred to a STEM major at UNO.

The program produced impressive results in terms of both enrolling and graduating more STEM students. By publicizing the new pre-STEM degree offerings and Bridge Scholarships, MCC was able to increase the number of STEM majors transferring to UNO from 142 in 2003 to 217 in 2010. As of 2011, all 15 of the former MCC students who received a bridge scholarship had either graduated with or had persisted in their STEM degree.<sup>82</sup>

As part of the STEP grant, UNO and MCC also offered walk-in tutoring for STEM students through the Math-Science Learning Center. This center employed upper-level mathematics and science students who were available to tutor lower-level STEM students in need of additional academic support. In order to create faculty interest in the learning center, tutors were selected and trained by university professors. This concerted effort to engage both students and faculty members in working toward a higher rate of STEM completion has helped to ensure that the learning center established under the STEP grant is sustainable even after the grant period has ended.<sup>83</sup>

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<sup>80</sup> “UNO and MCC STEPping Together.” STEP Central. <http://stepcentral.net/projects/178#.VDb3jPldWck>

<sup>81</sup> Heidel, et. al

<sup>82</sup> Ibid.

<sup>83</sup> Ibid.

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