

Date: December 17, 2014  
To: Academic Senate Committees  
From: Gina Anderson, Executive Director  
Subject: Report from the 13-14 Affirmative Action & Diversity Committee: *Report on UC Davis undergraduate science, technology, engineering and mathematics underrepresented students: Our leaky STEM pipeline.*

Chair Knoesen would appreciate your review and advice concerning the enclosed report. In addition to analyzing and evaluating the issues and recommendations, what, if any, action steps should the campus or Academic Senate initiate in response to the report?

Attachment

August 1, 2014

To: Academic Senate Chair, Bruno Nachtergaele  
Academic Senate Vice Chair, André Knoesen

From: Colleen E. Clancy, Chair,  
Committee on Affirmative Action and Diversity

**Subject: Report on UC Davis undergraduate science, technology, engineering and mathematics underrepresented students: Our leaky STEM pipeline.**

The enclosed report was reviewed by the Affirmative Action and Diversity Committee and is forwarded on behalf of Chair Clancy.

Cc: AEVC Rahim Reed, Vice Provost Stanton, Provost Hexter, STEM Deans, Steven Baissa, Marco Molinaro, Executive Director of Admissions, Walter Robinson

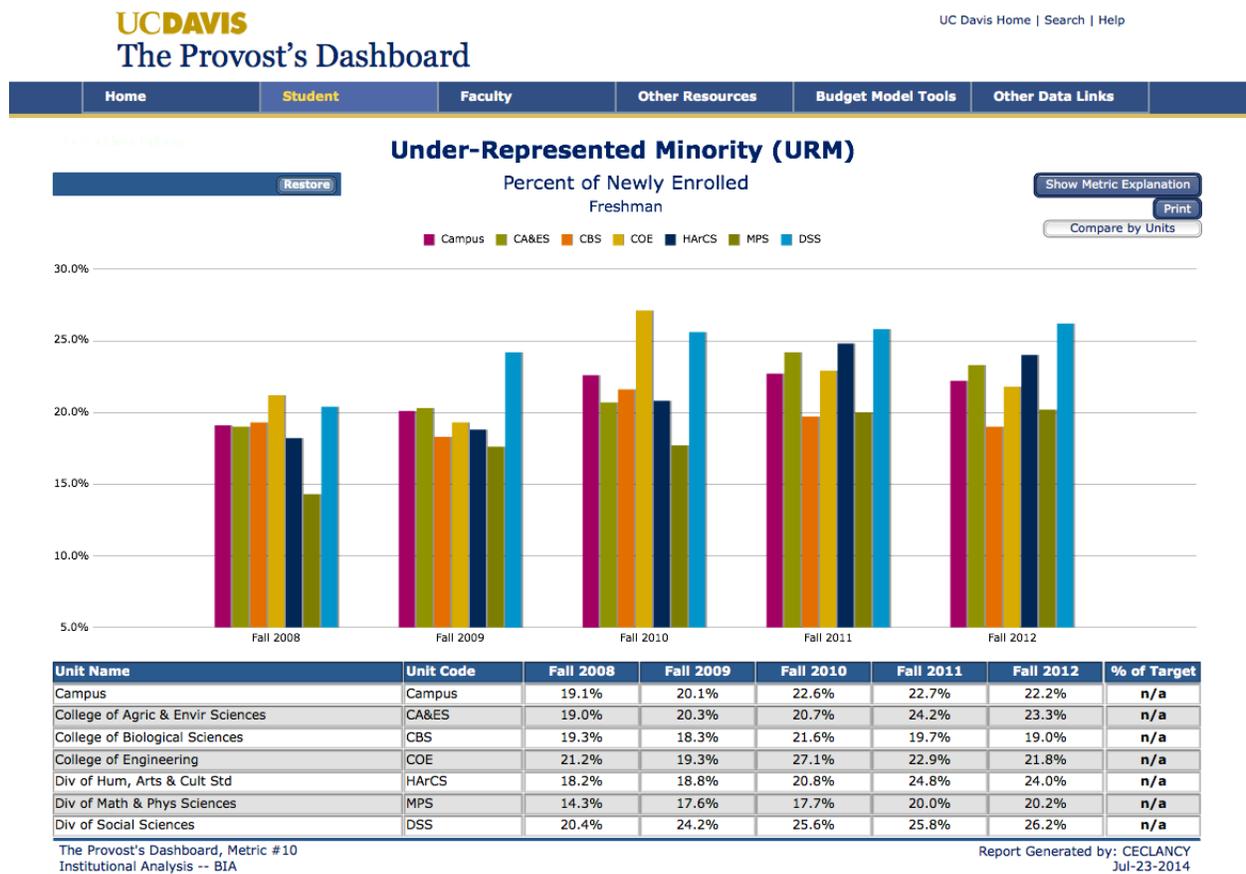
## **I. Introduction:**

A major challenge of the current technological era is to provide education and training in the quantitative fields including science, technology, engineering and mathematics (STEM) fields that are notoriously and historically lacking in racial and gender diversity. Multiple national initiatives have been spurred in recognition of the need to diversify the STEM-based workforce in order to reflect society's changing demographics, build upon the insights and resources of currently underrepresented populations and meet the national need for highly skilled STEM professionals who will invent, innovate, and find solutions for society's challenges. In addition to the direct contributions of STEM professionals to society, STEM degrees also offer individuals the promise of socioeconomic mobility, as STEM graduates typically have higher salaries and better employment stability <sup>1</sup>. There is also expected job growth in the STEM sector that is anticipated to outpace non-STEM employment <sup>1</sup>.

In recognition of the critical importance of diversifying the STEM workforce and the benefits of STEM degrees to individuals, the UC Davis Academic Senate Committee on Affirmative Action and Diversity (AA&D) undertook an investigation into our existing campus programs geared toward serving underrepresented minorities (URMs) in the STEM disciplines. While we recognize that URMs are not the only underrepresented groups in STEM, many of the difficulties facing URMs in the STEM fields are also applicable to other underrepresented groups, including women.

## II. UC Davis Undergraduate URM persistence in STEM

The UC Davis undergraduate student population is a racially and ethnically diverse population, with an apparent positive trend toward increasing diversity, which is particularly strong in some divisions such as Social Sciences (**Figure 1**, generated via the Provost's Dashboard <sup>2</sup>). It is notable that URM newly enrolled freshman are well represented in STEM divisions (~20+ % in the Fall 2012 incoming cohort in the College of Engineering and in the Division of Math and Physical Sciences).



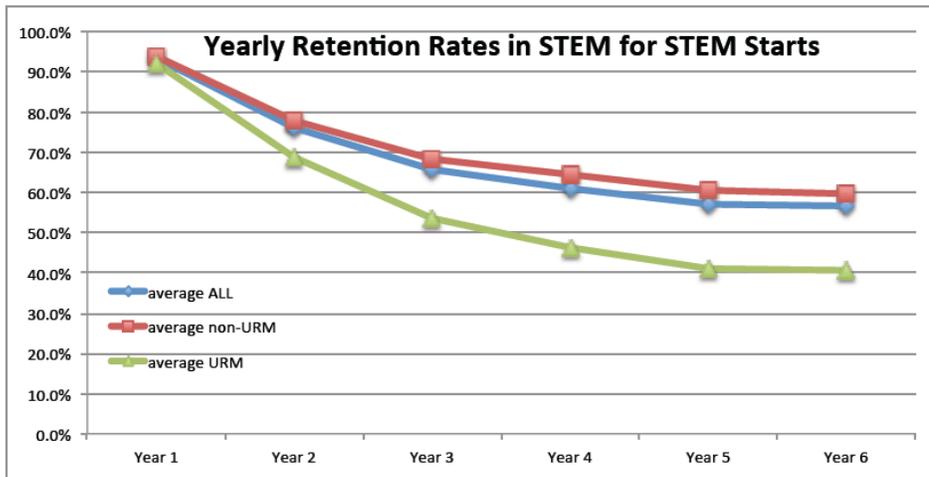
**Figure 1:** A snapshot from the Provost's Dashboard. All division and colleges have diverse populations when viewed as freshmen enrollment.

Although UC Davis is experiencing some success in recruiting a racially and ethnically diverse undergraduate pool in the STEM divisions, these successes do not lead to persistence of URMs in STEM nor do they result in URMs obtaining STEM degrees. The iAMSTEM Hub on campus now

allows detailed probing and analytics for discrete student cohorts. Assistant Vice Provost for Undergraduate Education and iAMSTEM Hub Director Marco Molinaro provided us access to the data contained within the iAMSTEM Hub to construct a time course of the undergraduate STEM pipeline. **Figure 2** shows clearly that for the incoming declared STEM starts 2006 freshman cohort, **~60% of URM students that started in STEM as freshmen did not persist in STEM after 6 years** (graduation by 2012). There is also a substantial gap between URM persistence and non-URM persistence in STEM over 6 years.

Further parsing of the data available via the iAMSTEM Hub (**Figure 3**) reveals that of the ~60% of URM students who started in STEM and did not persist in STEM, 46% graduated with non-STEM degrees after 6 years ( $173/374 * 100 = 46\%$ ), while 54% of URM students who started in STEM and did not persist in STEM did not graduate within 6 years from UC Davis.

## STEM Retention



Retention through year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
average ALL	93.4%	76.0%	65.8%	61.1%	57.2%	56.5%
average non-URM	93.7%	77.7%	68.4%	64.2%	60.4%	59.5%
average URM	91.9%	68.6%	53.6%	46.2%	41.1%	40.5%

**Figure 2:** In the 2006 freshman cohort, ~60% of URM students that started in STEM as freshmen did not persist in STEM after 6 years (graduation by 2012). There is also a substantial gap between URM persistence and non-URM persistence in STEM over 6 years.

# STEM Retention



ADMIT\_LEVEL Freshman  
 ADMIT\_TERM (All)  
 FIRST\_TERM 200610  
 STARTED\_INTERNATIONAL 0

Row Labels	Values		Sum of	
	Count of PIDM	GRAD		
<b>started non-STEM</b>	<b>2292</b>	<b>1905</b>	<b>83.1%</b>	
non URM	1819	1554	85.4%	
0 STEM degrees	1613	1350	74.2%	
1 STEM degree	205	203	11.2%	13% of graduates switched non STEM to STEM
2 STEM degrees	1	1	0.1%	
URM	379	270	71.2%	
0 STEM degrees	361	252	66.5%	
1 STEM degree	18	18	4.7%	7% of graduates switched non STEM to STEM
(blank ethnicity)	94	81		
0 STEM degrees	85	72		
1 STEM degree	9	9		
<b>Started STEM</b>	<b>3088</b>	<b>2474</b>	<b>80.1%</b>	
non URM	2452	2009	81.9%	
0 STEM degrees	997	569	23.2%	
1 STEM degree	1410	1396	56.9%	28% of graduates switched from STEM to non STEM
2 STEM degrees	45	44	1.8%	
URM	527	374	71.0%	
0 STEM degrees	325	173	32.8%	
1 STEM degree	194	193	36.6%	46% of graduates switched from STEM to non STEM
2 STEM degrees	8	8	1.5%	
(blank ethnicity)	109	91		
0 STEM degrees	43	25		
1 STEM degree	63	63		
2 STEM degrees	3	3		
<b>Grand Total</b>	<b>5380</b>	<b>4379</b>	<b>81.4%</b>	

**Figure 3:** Data from the iAMSTEM Hub shows that of the ~60% of URM students who started in STEM and did not persist in STEM, 46% graduated with non-STEM degrees after 6 years (173/374 \* 100 = 46%), while 54% of URM students who started in STEM and did not persist in STEM did not graduate within 6 years from UC Davis.

This poor performance led us to explore existing undergraduate STEM student retention and support programs on campus, with a particular focus on their service to URM students. Via consultation with the Executive Director of Admissions, Walter Robinson and Assistant Vice Provost for Undergraduate Education and iAMSTEM Hub Director Marco Molinaro we asked, “which programs are available to serve URM STEM students?” We then invited the coordinators of the programs to present to the AA&D committee during the 2013-14 academic year to allow us to assess whether the programs are: 1) Designed with the particular interests and needs of URM students in mind? 2) Well-supported and accessible to students in need? 3) Effective in terms of persistence and graduation? The following section describes our campus programs.

### **III. Existing Campus Programs for URM STEM matriculated students.**

#### **1) *Minority Undergraduate Research Participation in the Mathematical and Physical Sciences (MURPPS)***

The MURPPS program, led by Professor Richard Scalettar (Physics), has a primary goal to “involve undergraduates in the advanced research taking place in physical science, computer science, and mathematics departments at UCD”. The program is executed by assigning early stage students to faculty mentors who engage them in laboratory based research projects. The MURPPS program began as a robust initiative and has experienced a steady decline in program activities and support. At this juncture, the MURPPS program is facing extinction due to lack of external and internal support.

The MURPPS program was started in 1991 with two 3-year substantial National Science Foundation Grants (~\$700,000) with the purpose to engage undergraduate URMs in research with the goal to build a pipeline to diversify graduate school enrollments. The first six years of the MURPPS program including multiple components including engagement with high school students and STEP, tutoring, advising, curricular development and courses, seminars and research stipends for both students and research advisors. The first MURPPS program period (1991-97) also benefited from support by two full time staff members.

In 1998, the MURPPS program was subject to a serious financial hit when NSF funding was withdrawn as NSF priorities shifted: “We’re [NSF] not in the business of funding outreach indefinitely. Program should be institutionalized”. From 1998 – 2011 the MURPPS program was dramatically reduced in scope with termination of interactions with high school students, research advisor stipends and a striking reduction in staff support to 0.5 full time staff. The program was supported by UC Davis (~50K/year - MPS Dean: 50% student affairs coordinator (\$16,060 + \$2,500 OEE); and \$4,000 for a student assistant. Provost’s Office: \$20,000 for stipends (\$600/qtr); and Release time for one faculty to teach MPS seminar. Office of Student Affairs: \$10,000 for tutoring at Learning Skills Center) and individual student support via CAMP and NSF-REU.

Since 2011, additional campus financial support has been withdrawn from MURPPS, resulting in termination of the course release for MURPPS seminar faculty member, elimination of support for tutoring and reduction in staff support to 0.25 full time staff. Program support has now dwindled

to ~20K/year; even this level of funding is increasingly difficult to secure, and it has been suggested that MURPPS be converted to a “club” or seek outside gifts to continue support.

## **2) The Linda Frances Alexander Scholars Program (LFA)**

The Linda Frances Alexander Scholars Program (LFA), led by *Graduate Student* Maiesha Kiburi (Education) and Student Academic Success Center (SASC) Assistant Director Arnette Bates, was developed as a collaboration between the African Continuum and Black Student Union with the goal to develop a Scholars Program based on best practices derived from current research in student development. UC Davis has a very small African American student population (<3%) and these students have low graduation rates – especially males, with ~28% four-year graduation rates.

LFA aimed to develop an “integrated network” of holistic student support via coordination of new and existing campus resources that would develop 3 key domains: 1) Academic Excellence, 2) Social Support, and 3) Personal Growth and Cultural Enrichment (**Figure 4**).

The LFA program is unique on campus in its theory-based approach that incorporates components based on the following: 1) Hierarchy of need (Maslow), 2) Theory of Student Departure (Tinto), 3) Emerging Adulthood (Arnett), 4) Stereotype Threat (Steele), 5) Imposter Syndrome (Clance and Imes), 6) Third Space (Gutierrez), and 7) Responsive Mentorship (Hinsdale).

It is around these theoretical works that a coalescence of best practices is occurring across the country to improve URM engagement, persistence and success. The best practices include: 1) Mentoring, 2) Modeling, 3) Advocacy, 4) Cultural Inclusion, 5) Service and Leadership, 6) Strengths-based, 7) Scaffolding, 8) Holistic advising, and 9) Multiple, tiered exposures to information.

The LFA program is also unique in that the 40 student participants (25 freshmen, 15 transfer students) are randomly selected from the applicant pool. The program is supported by seed funds from the Chancellors Office (~100K). Early data suggest strong early successes of the LFA program with both high retention and persistence rates and high graduation rates on transfer students as shown in **Figure 5**.

# Integrated Structure



**Figure 4:** The integrated holistic approach of LFA. LFA coordinates new and existing campus resources to promote student development in 3 key domains: 1) Academic Excellence, 2) Social Support, and 3) Personal Growth and Cultural Enrichment.

## Preliminary Data



### Retention Rates:

2011 Cohort: 93%

2012 Cohort: 92%

### Persistence Rates:

	2011-2012	2012-2013
2011 Cohort:	93%	91%
2012 Cohort:	92%	90%

\* 9/13 2011 transfers graduated in 2013, all prepared for graduate or professional school, 4 are currently enrolled

\* Remaining 4 2011 transfers will graduate by end of winter quarter 2014

**Figure 5:** Early data suggest strong early successes of the LFA program with both high retention and persistence rates and high graduation rates for transfer students. Students are randomly selected for entry into this program.

### **3) *Biological Undergraduate Scholars Program (BUSP)***

The BUSP program, led by Dr. Connie Champagne, is geared toward URM and/or disadvantaged students. The program aims toward developing a sense of community and belonging while promoting and supporting outstanding academic achievement for successful entry into graduate school. The BUSP program spans the first two years of the undergraduate studies with a strong emphasis on fundamental rigorous coursework in mathematics, biology and chemistry. The summer between freshman and sophomore years includes a research skills course and biology boot camp.

Academic rigor is a hallmark of this program, which is supported via a strong programmatic commitment to advising through both faculty and staff advising and peer network support. During the sophomore year, BUSP students embark on paid research internships that allow their participation in cutting edge research. These experiences are also critical to promote the development of relationships with faculty mentors, a critical component to long-term success in science.

Successful BUSP students have additional opportunities to enter the BUSP-Honors program or the Minority Access to Research Careers (MARC) programs. Both of these programs allow continued research immersion experiences that may include financial support for tuition, fees, travel, and stipends.

BUSP students are more likely to graduate than UC Davis students in general and considerably more likely to graduate than non-BUSP URM students. Moreover, despite a rigorous curriculum and heavy course-load, BUSP students have better GPAs than non-BUSP students (**Figure 6**).

Despite the clear benefits to BUSP students, BUSP is also under pressure due to dramatic cuts in financial support. The long-term support for BUSP via the NIH sponsored Initiative for Maximizing Student Development (IMSD) grant was recently renewed, but the support for BUSP and BUSP-Honors was slashed drastically (to 53% of prior funding, and elimination of direct support for freshmen and sophomores), an additional casualty of NIH budget cuts and refusal to fund long-term “entitlement” programs. NIH expects institutionalization of NIH funded training programs that aim to increase racial, ethnic and socio-economic diversity. The Howard Hughes Medical Institute support (HHMI) has ended, and the MARC Undergraduate Student Training in Academic Research

Award T34 grant was not renewed. These drastic funding cuts have left the future of the BUSP program uncertain.

**Graduation Numbers/Percentages of UC Davis Non-UR, UR, & BUSP Students Entering as Life Sciences Majors\***

Entry Year	Graduated in Any Major [% (N)]			Graduated in Life Science-Related Major [% (N)]			Graduated in Life Science-Related Major with Cumulative GPA $\geq 3.0$ [% (N)]		
	Non-URM	URM	BUSP	Non-URM	URM	BUSP	Non-URM	URM	BUSP
2002-06	84% (5788)	79% (652)	86% (147)	54% (3741)	48% (397)	70% (121)	27% (1840)	20% (161)	44% (75)
2007**	72% (1233)	65% (161)	67% (29)	51% (877)	42% (105)	51% (22)	28% (490)	16% (40)	23% (10)
2008**	32% (547)	32% (75)	79% (30)	21% (362)	16% (38)	66% (25)	7% (125)	5% (12)	34% (13)
2002-08	73% (7568)	68% (888)	81% (206)	48% (4980)	41% (540)	66% (168)	24% (2455)	16% (213)	39% (98)

\*Graduation numbers/percentages from 2002-08 are for first-time freshmen entering UC Davis in 2001-08 with majors in CBS & the College of Agricultural & Environmental Sciences, as of June 2013. \*\*For years 2007 & 2008, numbers are for students graduating in 4 and 5 years after entry, respectively; earlier years are students who graduated by 6 years after entry.

**Figure 6:** The BUSP program participants are more likely to graduate than UC Davis students in general and considerably more likely to graduate than non-BUSP URM students. BUSP students have better GPAs than non-BUSP students.

**IV. Impact of unstable funding on existing campus programs**

Programs aimed to support and encourage URM STEM students require integration of multiple components to serve student needs and improve outcomes. As such, these programs require thoughtful leadership and careful coordination. The required time and effort to implement and run student geared programs are significant and should not be underestimated. Unstable funding of programs undermines programmatic goals in several ways. Unstable funding makes retaining highly qualified staff difficult. Not only is a wealth of knowledge lost when experienced personnel are lost, but the relationships between staff members and the students they serve are severed. These relationships, which may take years to build, are often critical for student success. Critical measures of program success and outcomes cannot be tracked without stable staff appointments.

These metrics are critical components of any program that receives extramural funding and are also critical to feed back into program modifications for programmatic improvements.

The University commitment to URM STEM success is directly reflected in the resources that are allocated to support and success programs. Lack of funding indicates a failure of commitment to promising but vulnerable students<sup>3</sup>.

#### **IV. Recommendations to improve URM STEM outcomes**

In order to improve engagement and persistence of URMS in STEM, UC Davis must renew its commitment to serving our increasingly diverse undergraduate population. We recommend that campus stakeholders come together to develop new institutional policy, practices and designated funding aimed at serving URMs and other underrepresented groups to improve persistence and graduate rates in the STEM disciplines<sup>4 5</sup>. Our campus URM population largely comprises first generation and/or Latina/o students that may have specific needs and considerations<sup>6 4 7</sup>. Nora and colleagues have proposed a “Model of Student Engagement for Latina/Latino Students” that is intended to improve persistence and academic integration and success in the STEM fields of study<sup>8-10</sup>.

The existing resources on campus aimed toward improving persistence and graduation rates for URMs in STEM are few. Even these are experiencing drastic cuts in extramural and intramural funding and consequently staff and other needed supports. Existing programs improve success rates for participating students, but we engage far too few students in them, especially compared to the many students admitted as STEM declared undergraduates.

We recognize the many other modes of outreach that various campus entities are actively engaged in to diversify our STEM graduates, including community college and K-12 outreach. These efforts are clearly important. But these efforts are at best inadequate and at worst a set-up for failure if we do not concurrently strengthen our campus infrastructure for engaging, retaining, teaching and mentoring URM STEM undergraduate students.

We now ask that the Academic Senate and Academic Federation consider ***how we can invest in improved outcomes for our URM STEM undergraduates***. We recommend development of a task force that engages other Senate and Federation Committees including Undergraduate Council,

Academic Planning, Research, Affirmative Action and Diversity amongst others, as well as URM student networks, to develop a plan and an implementation strategy in conjunction with administrative bodies. We recommend a careful review of well-developed and successful programs including those developed Davis Laude at the University of Texas and David Yaeger and Greg Walton at Stanford University <sup>3 11</sup>. Other UC campuses <sup>12</sup> also have models that have even been implemented on other college campuses <sup>13</sup> that might serve as models for UC Davis. We need a recommitment to our talented undergraduates to ensure that UC Davis produces a diverse pool of top scholars and professionals.

## V. LITERATURE CITED

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