

# SPECTRUM



*A report on underrepresented minorities in astronomy*

**INSIDE THIS ISSUE**

*Editor's Note:* On March 16, 2010, the Subcommittee on Research & Education of the House Committee on Science and Technology held a hearing on "Broadening Participation in STEM". The purpose was to examine the institutional and cultural barriers of increasing diversity in the sciences, the efforts to overcome these barriers, and the ways Federal agencies can provide support for successful outreach programs. In this issue of *Spectrum*, we excerpt two testimonies from this hearing: one related to Hispanic participation in STEM by Dr. Alicia Dowd (below) and another by Dr. David Yarlott on the role of Tribal Colleges & Universities in training Native Americans in the sciences (page 8).



*Witness panel at hearing on 'Broadening Participation in STEM'. From left: Dr. Shirley Malcom, Dr. Alicia Dowd, Dr. Keivan Stassun, Dr. David Yarlott, and Ms. Elaine Craft.*

Challenges of Increasing Hispanic Participation in STEM Fields <i>by Alicia C. Dowd</i>	<b>1</b>
CSMA/CSWA Hold Mentor Training Sessions at January AAS <i>by Dara Norman</i>	<b>1</b>
News You Can Use	<b>4</b>
Fun at the CSMA Dinner in DC <i>by Kartik Sheth</i>	<b>5</b>
Women of Color in Physics Departments: A Data Snapshot <i>by Rachel Ivie</i>	<b>6</b>
Broadening Participation in STEM: The Role of Tribal Colleges & Universities <i>by David Yarlott</i>	<b>8</b>
MIT's Minority Report: A Roadmap for How to Improve Diversity at the Faculty Level <i>by Laura Lopez</i>	<b>10</b>

## Challenges of Increasing Hispanic Participation in STEM Fields

**Statement by Alicia C. Dowd, University of Southern California**

**I**n this testimony, I first describe the context of higher education for Hispanic students, who attend community colleges and Hispanic Serving Institutions (HSIs) more than other students. I then discuss the value of NSF funding in two broad categories: (1) student services, academic support programs, and curricular reform; and (2) scholarships and fellowships. While recognizing the value of expanded student services and academic programming, I raise concerns that current approaches do not address the fundamental problem of the negative racial climate in STEM classrooms and programs. In conclusion, my recommendations emphasize the need for consortium based and interdisciplinary collaboration in curriculum reform, particularly in mathematics education. I also call for the adop-

*(Continued on page 2)*

## CSMA/CSWA Hold Mentor Training Sessions at January AAS

**by Dara Norman, National Optical Astronomy Observatory**

**F**ormal and informal mentoring are an important part of every scientist's career. This is true not just at the graduate student level, but throughout one's professional life, including job searches and the tenure process. However, few scientists have ever been formally trained in how to be an effective mentor. Trial and error is the most common way to have educated oneself on this topic;

*(Continued on page 3)*

## Increasing Hispanic Participation in STEM... (cont'd)

(Continued from page 1)

tion of more robust and comprehensive evaluation standards to evaluate the impact of NSF funding on diversity in STEM.

In making these recommendations, I draw on findings from a three-year NSF-funded study called 'Pathways to STEM Bachelor's and Graduate Degrees for Hispanic Students and the Role of Hispanic Serving Institutions', for which I serve as principal investigator. This study involved statistical analyses of college financing strategies and the impact of debt on graduate school enrollment; interviews with ninety faculty, administrators, and counselors at Hispanic Serving Institutions; and the development of instruments to assess institutional capacity for expanding Hispanic student participation in STEM.

### Hispanic Students in Higher Education and STEM

Two types of institutions play a much greater role in the education of Hispanic students in comparison to students of other racial-ethnic groups: community colleges and Hispanic Serving Institutions (HSIs), which are defined by the federal government as institutions with 25% or more Hispanic full-time equivalent student enrollment. More than half of all Hispanic college students enrolled in postsecondary education attend a community college. In 2006, the enrollment of Hispanic students in U.S. community colleges was 932,526, which compares with 903,079 Hispanic students enrolled in four-year institutions. Hispanic college students are enrolled in HSIs in such large numbers that approximately half of all Latina and Latino undergraduates enrolled in four-year universities can be found at just a fraction (10%) of four-year universities. As a result, a large proportion (40%) of the bachelor's degrees awarded to Hispanic students in all fields of study are awarded by HSIs.

In 2006-2007, 265 institutions of higher education were classified as Hispanic Serving Institutions (HSIs). Almost half of these were community colleges. The other half were divided between public and private not-for profit four-year universities (with a small number of private not-for profit two-year institutions). Hispanic students and Hispanic Serving Institutions are heavily concentrated in the Southwestern states, where over half of the HSIs are located (see Figure 1). However, several states outside the Southwest are also home to HSIs, in-

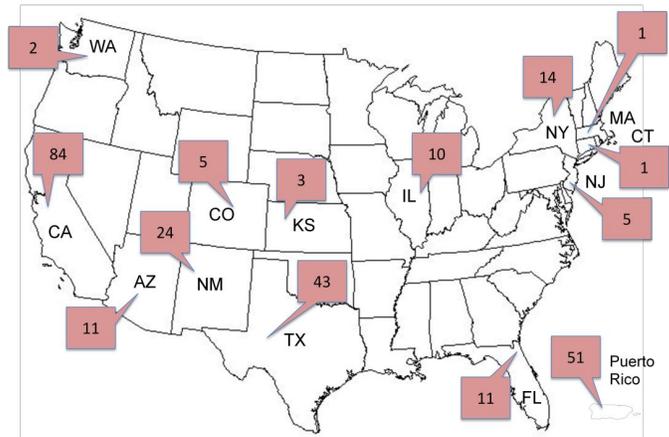


Figure 1: Number of Hispanic-Serving Institutions by state, 2006-2007.

cluding Florida, Illinois, and New York, and fifty-one HSIs are located in Puerto Rico. More institutions will be classified as HSIs in other states as the Hispanic population continues to grow. Although approximately 40% of the bachelor's degrees awarded to Hispanic students in all fields of study are awarded by HSIs, this proportion is lower in STEM fields. Only 20% of the bachelor's degrees awarded to Hispanic students in STEM fields are awarded by HSIs. Only a small percentage of Hispanic STEM baccalaureates (6.5%) earn the bachelor's degree at an HSI after having earned an associate's degree.

In her analysis of NSF's National Survey of Recent College Graduates (NSRCG) for our study of Latino Pathways to STEM Degrees [1], Professor Lindsey Malcom of the University of California Riverside found that Latino community college transfers who first earn associate's degrees have lower access to STEM bachelor's degrees at academically selective and private universities than their counterparts who do not earn an associate's degree prior to the bachelor's. These transfer students who held associate's degrees were more likely to graduate from Hispanic Serving Institutions (32.1% with an associate's degree compared to 16.8% without one) and from public four-year institutions (83% as opposed to 62.9%). However, they were less likely to graduate from academically selective institutions (42% with an associate's degree compared to 59% without one) or from a research university (25.3% as opposed to 43.5%).

The analysis also showed differences in the fields of study in which students earned their bachelor's degrees. HSIs had greater success than

(Continued on page 16)

## Mentor Training Sessions at AAS... (cont'd)

(Continued from page 1)

this requires practice, dedication and finesse in order to be truly effective as a mentor. Although there are professional groups that provide mentoring training, many astronomers likely feel they have few resources or time to identify and attend the workshops that would be the most useful for them. In order to fill this need in the astronomical

community to engage in practical training and information about mentoring, the CSMA and CSWA co-sponsored two mentoring sessions at the January 2010 AAS conference in Washington, DC. Each session was designed to provide unique and practical information for participants and attended as a unit, the sessions provided both useful information and the opportunity to practice and discuss the techniques and information presented.

The two 90 minute special sessions, entitled, "Mentoring Astronomers: Students to Faculty I & II", took place during the morning and afternoon sessions on Wednesday, January 6, 2010. The sessions were well attended, with about 40 people in the morning session and 30 for the afternoon session. Audience members included astronomical researchers and faculty, as well as students, who act as mentors to more junior colleagues. The number of invited speakers was kept intentionally small in order to allow ample time for discussion during the sessions. In addition to their expertise on issues of mentoring, the selected speakers were trained Ph.D. astronomers and therefore have an insiders perspective of the field. The session organizers felt that it was important that the speakers to be able to connect with attendees in a knowledgeable way about the culture of the astronomy field when discussing the mentoring of future and junior colleagues.

The morning session was devoted to an exchange of information and best practices on mentoring. The speakers were selected for their current work with and knowledge of mentoring activities and programs over a wide range of topics. Invited speakers included Dr. Nigel Sharp (NSF), who gave an overview of NSF's Postdoctoral Researcher Mentoring Plan that is now a requirement for all NSF proposal submissions that request funds to support postdocs. Dr. Sharp emphasized that while the options are wide open as to how a mentor program will be executed, proposals lacking a mentoring plan will be returned without review.

The second speaker in the morning session was Dr. Kathleen Flint (National Postdoctoral Association) who discussed tips and tools for mentors generally. She advocated the development of a mentoring plan, where both the mentor and protege identify their roles, responsibilities, and goals in the mentoring process. Flint also stressed the value of regular self-assessment for the mentor and protege to gauge progress and areas that need im-

(Continued on page 14)

### SPECTRUM

Editor:

Laura A. Lopez  
University of California, Santa Cruz  
[lopez@astro.ucsc.edu](mailto:lopez@astro.ucsc.edu)

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<http://csma.aas.org>

## News You Can Use

*If you would like to contribute stories to 'News You Can Use', send articles and ideas to the Editor: [lopez@astro.ucsc.edu](mailto:lopez@astro.ucsc.edu)*

### UPCOMING ASTRONOMY CONFERENCE IN BURKINA FASO

The IAU Symposium #277, titled "Tracing the Ancestry of Galaxies on the Land of Our Ancestors" will take place December 13-17, 2010, in the capital city of Burkina Faso, Ouagadougou. The scientific focus of the meeting will be galaxy formation and evolution, from both the observational and theoretical perspective. The deadline to apply for an IAU grant to support travel to the meeting is June 15, and the abstract submission deadline is July 15.

The conference aims to further the astrophysics discussions and collaborations in Africa and in Burkina Faso in particular. The astrophysics program at Université de Ouagadougou began in 2007 under the leadership of Professor Claude Carignan of the University of Montreal. It now has both an undergraduate and graduate program, and the 1-m MARLY telescope has been relocated from La Silla, Chile, to Burkina Faso and will be refurbished for student research. Thus, the IAU Symposium will mark the beginning of astrophysics in Burkina Faso.

### MINORITY SPEAKERS LIST

The CSMA reminds readers of the minority speakers list on the CSMA website:

<http://csma.aas.org/speakers.html>

The list includes AAS members who have volunteered and identified themselves as underrepresented minorities. These individuals are available to give astronomy talks (at a public or professional level) at your institution, and the website gives the speakers' areas of expertise and topics they are ready to present.

If you would like to be added to the minority speakers list, send an e-mail to Laura Lopez, [lopez@astro.ucsc.edu](mailto:lopez@astro.ucsc.edu), and she will add you.

### NSBP/NSHP HOLD CONDENSED ANNUAL MEETING IN DC

The annual meeting of the National Society of Black Physicists/National Society of Hispanic Physicists was condensed to a single day this year due to funding issues. As a result, the extensive student component of the conference had to be removed and the meeting consolidated from the original three days down to one day. The condensed meeting included two technical/science sessions, an NSBP business meeting, and a joint plenary session with the American Association of Physics Teachers and the American Physical Society on physics education.

The president of NSBP, Peter Delfyett, indicated that NSBP and NSHP leadership are now exploring additional revenue sources for future meetings, including long-time supporters like Brookhaven National Lab and the Office of Naval Research in addition to NSF funding. The NSBP and NSHP are working toward resolving the funding concerns and hope to have a large annual conference in 2011.

### OBAMA ADMINISTRATION ISSUES STRONG SUPPORT FOR AFFIRMATIVE ACTION

On April 1, 2010, the Obama administration filed an amicus brief with a federal appeals court to defend the use of affirmative action in admissions at the University of Texas at Austin. The brief supports affirmative action on the grounds of the educational benefits of diversity, and it states that colleges and universities need flexibility to determine how factors, such as race, go into admissions decisions.

The amicus brief was filed in a case of two white plaintiffs who claim they were rejected by UT-Austin because of unfair favoritism toward minority applicants. The case challenges the 2003 Supreme Court decision in *Grutter v. Bollinger*, which upheld the consideration of race under certain conditions in public higher education.

## Fun at the CSMA Dinner in DC

by Kartik Sheth, NRAO/North American ALMA Science Center

The most amazing thing happened at this AAS for me. All of a sudden I was seeing a lot of diverse faces. A lot of young astronomers of color. I have been to nearly every AAS in the last decade and this was the first time I felt that I was witnessing a real sea change. I hope that this trend continues and we finally see some real change in the overall numbers of under-represented minorities in our field at all levels.

Our CSMA informal dinner organized by eVite and word of mouth had over 55 people show up at the Lebanese Taverna! It was a wonderful evening. Besides the excellent food and conversa-

tions amongst us, we discussed the mission and ongoing activities of the CSMA, introduced the CSMA members, and advertised some of the activities of interest to the group, such as the CSMA-sponsored mentoring workshop, the movie, "Hubble's Diverse Universe," etc. The mentoring workshop organized by Dara Norman was a huge hit. I was really buoyed by all of this -- as a member of the CSMA and as the AAS Liaison to the national AIP committee on minorities, I feel that lots of little changes we have all been making are starting to pay off! I look forward to the next CSMA get-together and to meeting more of you.



All photos by Knut Olsen, NOAO

## Women of Color in Physics Departments: A Data Snapshot

By Rachel Ivie, Statistical Research Center, American Institute of Physics

Most readers know that there are very few women of color in physics, and it is important to know exactly how few there are. However, the numbers alone do not adequately portray the day-to-day inequality that women of color experience in physics. In my years of studying women in physics, I have seen many people make the mistake of assuming that if the representation of women in physics increases to some “acceptable” level, then the problem of inequality will be solved. This is far from the truth. While it is essential to document and remedy the small numbers of women of color in physics, it is also necessary to collect data on other areas of inequality so that they can be addressed. To my knowledge, a few researchers have begun to collect these data (Maria Ong, TERC, and Sharon Fries-Britt, University of Maryland, for example), but the results are either not yet available or have not been widely disseminated among the physics community. This article will document the tiny numbers of women of color in physics and will also point to areas of potential inequality about which we have no data. These include hiring, salaries, promotions, working conditions, and the general experiences of women of color in physics.

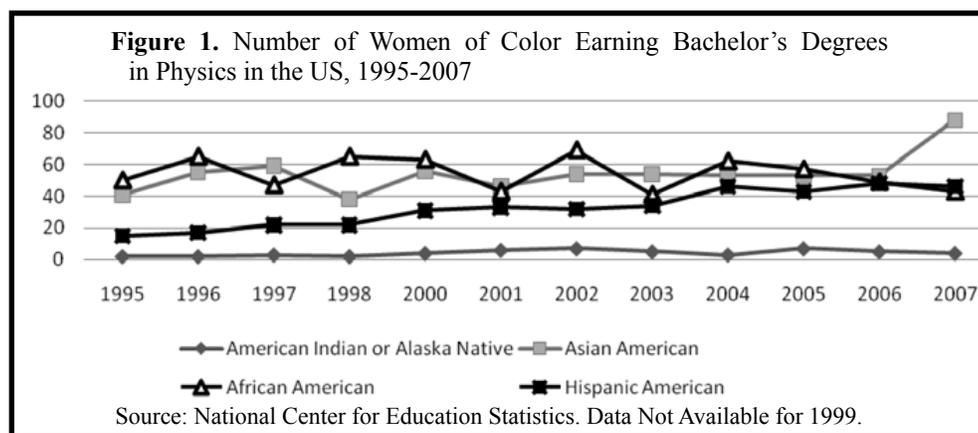
**Representation.** Figure 1 (bachelor’s degrees), Table 1 (PhDs), and Table 2 (faculty members) show just how small the numbers of women of color in physics are. At the beginning of the academic pipeline, there is only a trickle of women of color into physics, and the numbers don’t improve farther along. For comparison, approximately 5000 people, mostly white male US citizens, earn bachelor’s degrees in physics annually. In 2007, only 181 women of color (including Asian American

women) earned bachelor’s degrees in physics. In the 33 years shown on Table 1, more than 35,000 people have earned physics PhDs in the US, but only 111 under-represented minority women have done so. In all 800 physics and astronomy departments in the US (Table 2), there are approximately 9100 full-time equivalent faculty positions, but there are only 29 black women and 38 Latinas on physics faculties.

**URM Women.** The category “under-represented minority” (URM) applies to minority groups that are represented in science at rates lower than their representation in the US population. Therefore, African Americans, Hispanic Americans, and American Indians are considered URMs in science and in physics. Table 1 reveals just how low the numbers of URM women are. These data represent the numbers of physics PhDs earned by women in a 33-year period. African American women average a little more than one physics PhD per year. Hispanic women average fewer than 2. And the smallest number of all is American Indian women: there have been only four physics PhDs earned by American Indian or Alaskan Native women since 1974.

**Asian American Women.** The statistics on the representation of Asian American women in physics help illustrate why additional data on the experiences of women of color are needed. Compared to

(Continued on page 7)



(Continued from page 6)

their proportion in the US population (about 5%), Asian Americans are not under-represented in science generally or in physics specifically. Asian American women are more than adequately represented in physics, but they may be just as likely to face discrimination in the workplace as other women of color.

**Representation Doesn't Tell the Whole Story.**

Women of color in physics are "double minorities:" minorities because of race and sex. For all minorities, representation does not tell the whole story, although it certainly plays a large part. As double minorities, women of color may be subject to inequities in hiring, salary, promotions, etc. Their experiences are likely to be different from men's and from white women's experiences. But data on these topics generally have not been collected. Data are missing about the experiences of women of color in physics, along with quantitative data on hiring, salary, and promotions. However, women of color are likely to experience inequity in most, if not all, of these areas. Furthermore, we don't know if the problems are happening in the higher education system, in the workplace, in both, or if the reasons for low representation happen much earlier in the pipeline.

**Conclusions.** Sometimes scientists think that their work environments and classrooms are not affected by issues of race or sex. By studying the actual experiences of women of color in physics, we can determine whether or not this is true. These data also have important implications for efforts to recruit and retain women of color in physics. Because of the lack of data on where the problems lie, such efforts may be ineffective if they are directed to situations that do not need correction. Programs to increase the representation women of color in science should be based on data documenting the exact nature of the problems, rather than on assumptions about these problems. These data can only be gathered by studying women physicists of

**Table 1.** Number of Women Who Have Earned PhDs in Physics in the US, 1974-2006

	NUMBER	%
US Citizens and Permanent Residents		
African American	46	1.2
American Indian or Alaska Native	4	0.1
Asian American	492	12.8
Hispanic	61	1.6
White	1784	46.3
Temporary Residents	1466	38.0
Total	3853	100

Source: National Science Foundation

**Table 2.** Number of Women Faculty in US Physics & Astronomy Departments, 2008

	PHD	MASTERS	BA	TOTAL	% OF ALL WOMEN
African American	14	3	12	29	3
Asian American	106	14	56	176	16
Hispanic	19	7	12	38	3
White	465	64	340	869	78
Total				1112	100

Source: AIP Academic Workforce Survey

color at a more detailed level, perhaps using in-depth interviews and collecting data on facts other than representation.

Correcting the low representation of URM women in physics will go a long way toward ending the inequities they experience. However, this will not remedy all problematic areas. It will not address discrimination that all women of color may experience in their daily lives as physicists. Inequities such as these, if they exist, should be documented so that corrective steps can be taken by institutions. At that point, we will truly have made progress toward an equitable situation for women of color in physics.

Thanks to Arnell Ephraim of the Statistical Research Center, American Institute of Physics, and Kenneth Nunn for their assistance with this article.

*Dr. Rachel Ivie is the Assistant Director with the Statistical Research Center at the American Institute of Physics.*

*Reprinted with permission from the American Physical Society's Committee on the Status of Women in Physics newsletter, Gazette.*

## **Broadening Participation in STEM: The Role of Tribal Colleges & Universities**

***Statement by David Yarlott, Little Big Horn College***

**I** will speak briefly on three topics: The Tribal College Movement in general; the role of Tribal Colleges in broadening participation of American Indian students in STEM fields; the challenges and barriers facing our institutions as we carry out this work; and finally, the role of the National Science Foundation's TCU program in helping our institutions to develop STEM degree programs.

### **Background: The Tribal College Movement**

American Indian tribally chartered colleges and universities are young, geographically isolated, poor, and almost unknown to mainstream America. Our institutions are also extraordinarily effective catalysts for revitalization and change -- so much so that we have been called "higher education's best kept secret."

Located in some of the most rural and impoverished regions of this country, Tribal Colleges are planting resilient seeds of hope for the future; nurturing and sustaining languages, cultures, and traditions; and helping to build stronger tribal economies and governments. Yet, the oldest Tribal College is younger than many of the people in this room. My institution, Little Big Horn College, celebrated its 30th anniversary this year. Our oldest institution, Diné College on the Navajo Nation, turned 40 last year.

The Tribal College philosophy is simple: to succeed, American Indian higher education must be locally and culturally based, holistic, and supportive. The education system must address the whole person: mind, body, spirit, and family. Today, the nation's 36 tribal colleges are located throughout Indian Country (see map on the right): all seven tribes in Montana and all five in North Dakota have colleges. Tribal Colleges are also located in the Southwest, the Great Lakes, and the upper Northwest. We are expanding in all regions, including Alaska and Oklahoma, and through distance education programs, our colleges are reaching all of Indian Country.

In only a few short decades, Colleges have grown from very humble beginnings to thriving academic centers. Little Big Horn College, for example, began in the early 1980s in two trailers and a garage that was serving as a barn. In the early

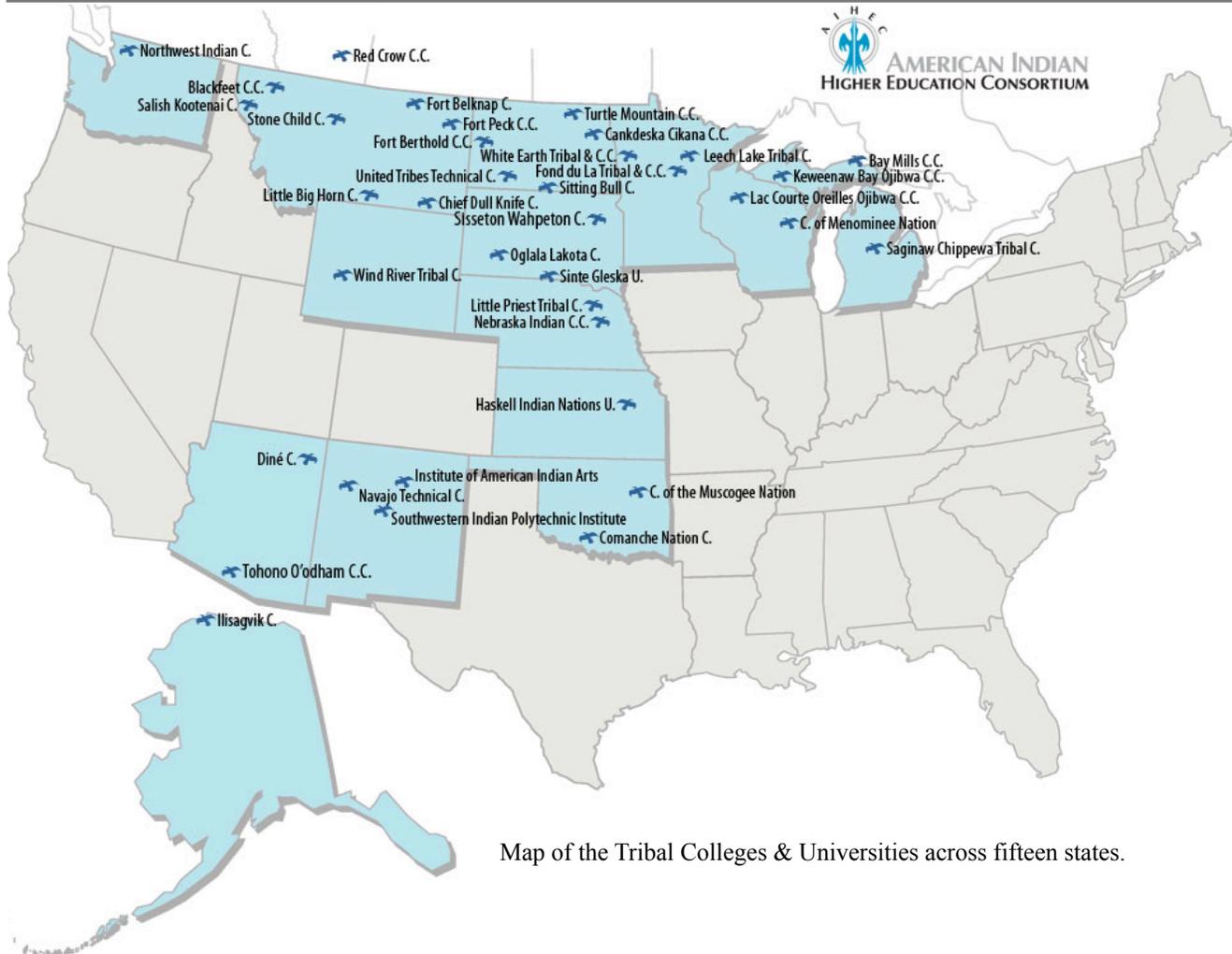
years, the college had about 30 students. Today, the college averages more than 400 students each semester and focuses on 10 degree programs in areas critical to our tribe's economic and community development.

Little Big Horn College, like all Tribal Colleges, is first and foremost an academic institution, but because of the number of challenges facing Indian Country -- high unemployment, poorly developed economies, significant health issues, and lack of stable community infrastructures -- Tribal Colleges are called upon to do much more than provide higher education services. Tribal Colleges, such as Little Big Horn College, often run entrepreneurial and business development centers. Many TCUs are the primary GED and Adult Basic Education provider on their reservations, and all TCUs provide a variety of evening, weekend training and para-professional programs for tribal employees, Bureau of Indian Affairs (BIA) and Indian Health Service (IHS) staff, K-12 schools, and tribal courts and justice system staff. TCUs operate day care centers, health promotion and nutrition programs, community gardens, and often, the community library and tribal museum or archives. Tribal Colleges have strong partnerships and linkages with the local K-12 education system, offering Saturday and summer "bridge" programs for high school students, running summer camps for youth, and providing after-hours gymnasiums and computer labs for young people.

Several TCUs are involved in climate change research and education projects, funded by NSF and the National Aeronautics and Space Administration. This semester, 15 TCUs launched a distributed, online Introduction to Climate Change course, developed collaboratively from a Native perspective through funding awarded to AIHEC by NSF.

Perhaps most important, Tribal Colleges are actively and aggressively working to preserve and sustain their own tribal languages and cultures. All TCUs offer Native language courses, and in fact, passing a language course is a condition of graduation from a TCU. In some cases, the tribal language would have been completely lost if not for the Tribal College. Turtle Mountain Community College in Belcourt, North Dakota, was established primarily for this purpose, and over the years, its success in preserving and revitalizing the Turtle

*(Continued on page 9)*



Map of the Tribal Colleges & Universities across fifteen states.

(Continued from page 8)

Mountain Chippew language has been unparal-leled.

Many TCUs offer unique associate and bachelor degree programs, as well as in-service training, in elementary education. At the TCUs, teacher education programs follow cultural protocols and stress the use of Native language in every-day instruction. Well over 90 percent of teachers who graduate from a TCU teacher education program begin teaching on the reservation shortly after graduation, providing positive role models to Indian children.

Tribal Colleges have advanced American Indian higher education significantly since we first began four decades ago, but many challenges remain. Tribal Colleges are poor institutions. In fact, Tribal Colleges are the most poorly funded institutions of higher education in the country:

1. First: Tribal Colleges are not state institutions, and consequently, we receive little or no state funding. In fact, very few states provide support for the non-Indian students attending TCUs, which account for about 20 percent of all Tribal College students. However, if these

students attended a state institution, the state would be required to provide the institution with operational support for them. This is something we are trying to rectify through education and public policy change at the state and local level.

2. Second: the tribal governments that have chartered Tribal Colleges are not among the handful of wealthy gaming tribes located near major urban areas. Rather, they are some of the poorest governments in the nation. In fact, three of the ten poorest counties in America are home to Tribal Colleges.
3. Finally, the federal government, despite its trust responsibility and treaty obligations, has never fully-funded our primary institutional operations source, the Tribally Controlled Colleges & Universities Act. Today, the Act is appropriated at about \$5,784 per full time Indian Student, which is less than half the level that most states fund their institutions.

To continue to thrive and expand as community-based educational institutions, Tribal Colleges must

(Continued on page 14)

# MIT's Minority Report: A Roadmap for How to Improve Diversity at the Faculty Level

By Laura Lopez, University of California Santa Cruz

In 1999, the Massachusetts Institute of Technology made headlines for its groundbreaking report documenting discrimination against its female faculty. Compared to male professors of similar rank, the women's salaries were less, their offices and labs were smaller, and they had many fewer leadership positions. Rather than shy away from these data, MIT's administrators admitted the truth of the systematic bias against the female faculty, and the Institute began to take steps to ameliorate the problem.

Nearly a decade later, MIT has just completed and released a similar report on its underrepresented minority faculty. The "Report on the Initiative on Faculty Race and Diversity" is the product of extensive research by nine MIT professors on how race has influenced the recruitment, retention, and professional lives of the Black, Hispanic, and Native American faculty at MIT. The study finds some key differences between the experiences of minority and majority faculty, and the results aid in understanding how practices and policies can be improved to foster a culture of inclusion.

MIT is the first institution to perform this kind of rigorous and systematic analysis of the experiences of URM faculty across its campus. Thus, the report's findings and recommendations offer valuable insight for how other institutions can address diversity on their campuses. Toward this end, this article summarizes the pertinent analysis, results, and conclusions of the MIT report that can be utilized to promote and improve diversity elsewhere.

The research undertaken for the MIT race initiative consisted of several components. The first was a quality of life survey of the entire faculty in January 2008 which included questions regarding race and gender issues. The responses were used to compare the URM faculty perceptions to those of non-minority faculty on issues like satisfaction and teaching load. Secondly, the initiative performed a quantitative cohort analysis of all MIT faculty from 1991-2009 to compare promotion timing, tenure rates, hiring, departures, and salaries. Third, the researchers interviewed all URM faculty and several non-URM faculty as a control group to gain

qualitative information on climate and personal experiences. Lastly, the initiative held a series of open-forum discussions with junior and senior minority faculty to gauge the general issues/concerns across these groups.

The key findings and some recommendations of these analyses can be broken down into issues related to recruitment, retention, and climate:

## Recruitment

- MIT primarily hires its URM faculty from its own alumni and only a couple other peer institutions: 36% of URM faculty have an MIT degree (undergrad or grad), and 60% received their PhDs from either MIT, Stanford, or Harvard. The numbers are similar but lower for its White (50%) and Asian (43%) faculty as well. The narrowness of sources of URM faculty suggests a lost opportunity to tap the talent from other institutions. *Solutions:* Create partnerships with top-URM PhD producers and implement broadened faculty hiring searches.
- URM faculty reported more active recruitment than non-URM faculty: 63% of URM faculty were recruited to apply, whereas only 21% of non-URM faculty were solicited before being hired. Therefore, proactive measures of recruitment are an important means to increase URM faculty hires.
- Comparison of hires by department showed great inconsistencies in the proportions of URM faculty added to their ranks. While some have substantial and positive hiring patterns, other departments have not hired a single URM professor in two decades! *Solutions:* Hold departments accountable for minority recruitment and hiring.

## Retention

- A statistically significant and disproportionate number of URM faculty leave MIT before their first promotion, to the level of associate professor without tenure (AWOT). Only 55% of URM faculty remained at MIT up to this point, compared to 74% of White and 79% of Asian faculty (see Table 1). Thus, a larger fraction of minority faculty are lost within their early stages, the first

(Continued on page 11)

**Table 5 from Report.** Percentage of promotions to associate professor without tenure (AWOT) for assistant professors hired from 1991-2004

	Promoted to AWOT	Left w/o Promotion	N
URM*	55%	45%	38
Black	61%	39%	23
Hispanic	50%	50%	14
White	75%	23%	436
Asian	79%	19%	80
Overall	74%	24%	554

\* Includes 1 Native American.

(Continued from page 10)

- three to five years, compared to non-URM faculty.
- The amount and the kind of mentorship received by URM faculty varied tremendously. The most positive mentor experiences were those where mentors were accountable to their department for taking an active role. *Solutions:* Create a university-wide mentorship program of all junior faculty; mentors should be accountable to their departments.
- The potential for subjectivity in tenure and promotion decisions was more of a concern for URM faculty. Additionally, URM faculty were uncertain about their departments' expectations of them in order to receive tenure. *Solution:* Junior faculty should receive ample and regular feedback from their departments starting in the first year.
- Tenured URM faculty were more dissatisfied than their White counterparts. From the interviews, reasons for this include lack of peer recognition and acknowledgement, ceilings/barriers at the high levels (lab directors, chairs, etc), frustration from past efforts to improve diversity, and the perception of others that MIT is an equitable place.

### Climate

- Non-URM male faculty view diversity as less critical to achieving excellence than URM and female faculty. Tension exists between faculty since some believe inclusion comes at the expense of excellence. *Solution:* Leadership at the top levels must advocate and maintain a climate of inclusion.

- Based on information collected in the interviews, discussion of race-related issues is avoided by both URM and non-URM professors, and they feel awkward openly addressing racial differences. Some URM faculty are afraid that focusing on diversity will "brand" them as less committed to other issues. *Solutions:* Use established/respected professors as spokespeople on the importance of diversity. Hold open forums/working groups on solutions to improve diversity.

These results shaped many recommendations by the initiative on how to improve the diversity of MIT faculty (including some which are given above). Common themes among these recommendations included accountability at department and school/division levels and Institute-wide advocacy that inclusion is necessary to achieve excellence.

Obviously, strategies to improve diversity are only effective if they are applied consistently. A strong commitment is necessary to overcome some of the hurdles identified by this report. However, the results offer a very specific guide of how and what should be done to be more inclusive. Now, it is simply a matter of targeting those areas and following through with change in policies, practices, and climate.

The full report on the initiative for faculty race and diversity is available online at this URL:  
<http://web.mit.edu/provost/raceinitiative/report.pdf>

*Laura Lopez is an MIT alum and is now a graduate student at the University of California Santa Cruz. She is a member of the CSMA, and she is the Editor of Spectrum.*

## The Role of Tribal Colleges & Universities... (cont'd)

*(Continued from page 9)*

stabilize, sustain, and increase our basic operational funding. Through tools such as AIHEC AIMS, we hope to better educate the public, lawmakers, and federal officials about the cost-effective success of our institutions.

### **Tribal College STEM Programs: The Significance of NSF-TCUP**

Although TCUs have made unprecedented strides in addressing the higher education needs of American Indians, much work and many challenges remain.

Of all groups in the U.S., American Indian students have the highest high school drop-out rates in the country. A 2010 report published by the Civil Rights Project/Proyecto Derechos Civiles at UCLA's Graduate School of Education and Information Studies revealed that less than 50 percent of all American Indian high school students actually graduate. If these students eventually pursue higher education, it is most often through the Tribal Colleges, which like other community colleges are open-admission institutions. In addition to offering a significant level of GED preparation and testing, Tribal Colleges face challenges with remediation and developmental education. On average, more than 75 percent of all TCU students must take at least one developmental course, most often pre-college mathematics. Of these students, our data indicates that many do not successfully complete the course in one year. Without question, a tremendous amount of TCU resources are spent addressing the failings of the K-12 education systems.

For this reason, TCUs have developed strong partnerships with their K-12 feeder schools are actively working, often through their NSF-TCU programs, to engage young students – early on and consistently – in community and culturally relevant science and math programs.

Because of the challenges TCUs face in engaging under-prepared students in STEM, improvement and innovation in science education programs have been areas of great interest to most Tribal Colleges. However, prior to NSF-TCUP, most Tribal Colleges were unable to secure the resources needed to build high quality STEM programs because we were not able to compete successfully in existing STEM programs sponsored by NSF and the U.S. Department of Education – most likely because we lacked the required PhD.-level principal investigators, or we could not demon-

strate the “impact numbers” because of our size and remote locations.

Beginning in Fiscal Year 2001, NSF-TCUP changed this by making available essential capacity building assistance and resources to Tribal Colleges. In fact, in less than 10 years, NSF-TCUP has become the primary federal program for building STEM capacity at the nation's TCUs. NSF-TCUP has served as a catalyst for capacity building and change, and the program can be credited with many success stories (see full testimony for these details).

In implementing NSF-TCU programs, Tribal College administrators have attempted to take a broad view and systemic approach to their STEM needs, maximizing the return on NSF's investment through leveraging support from foundations and other Federal programs. TCUs now have greater capacity to address the STEM education and research needs of the tribal communities they serve in holistic and culturally relevant ways, which have been shown to increase retention and completion. More American Indians are entering STEM education and more are entering STEM professions, as demonstrated by enrollment and completion increases of 200 to 300 percent or more in some cases. STEM faculty are becoming more effective and engaged STEM instructors and researchers. Students are becoming more engaged, and with guidance from their faculty, they are becoming involved in cutting-edge and community-relevant research in significantly greater numbers. Classrooms and laboratories are better equipped. American Indians are more aware of the importance of STEM to their long-term survival, particularly in areas such as climate change. Partnerships between TCUs and major research institutions are emerging in areas of education and research.

The need for increased funding for the NSF-TCU program is well documented. In fact, between 2001 and 2008, NSF-TCUP funding was essentially static. Further, since 2004, the percentage of proposals funded has declined each year, reaching an all-time low in 2009. In 2009, less than 30 percent of all proposals were funded, out of a pool that includes only 33 eligible TCUs. Clearly, the need for STEM-related funding at TCUs is not being fully addressed by available funding.

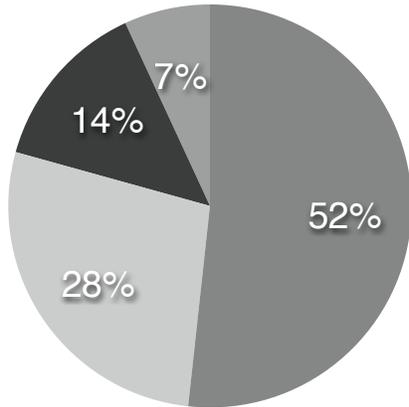
### **Systematic Challenges to Broadening Participation**

Outside of the NSF-TCU program, significant barriers to participation still exist and NSF's “broaden-

*(Continued on page 13)*

**Fall 2005 Enrollment**

- American-Indian Males
- American-Indian Females
- Non-Indian Females
- Non-Indian Males



Source: American Indian Higher Education Consortium

(Continued from page 12)

ing participation” effort has not been entirely successful. In fact, in some cases, it has had the effect of doing harm to Tribal Colleges and adversely impacting American Indian STEM education, as mainstream institutions seek to improve their chances to be competitive in grant competitions.

States and mainstream institutions have taken advantage of TCUs and our students, adding us to their grant proposals and including our students in their statistical reports, without ever speaking to us or even notifying us. We rarely receive any funding, technical assistance, or outreach when these proposals are successfully reviewed and awarded, and traditionally, we had no way of knowing how NSF or the awardee dealt with the lack of TCU inclusion after the award was made.

Over the past several years, as NSF’s “broader impacts” requirement has grown in importance, the number of proposals from mainstream institutions seeking to include Tribal Colleges -- without our knowledge or only after the proposal is completely developed -- has increased dramatically. In fact, the situation became so frustrating that in early 2008, the AIHEC Board of Directors, on which the presidents of all accredited TCUs sit, approved a motion urging federal agencies to adopt a policy that any proposal for federal funds, which directly or indirectly names Tribal College(s) or AIHEC in the proposal must include documentation confirming that the TCU is fully informed of and supports the college’s role in the proposed project. The goal of this motion is to en-

**Enrollment by Discipline: 2004-2005**

American Indian Studies	483
Business	1469
Computer Science	584
Education	1428
Liberal Arts	3862
Mathematics	27
Nursing/Health	989
Science	710
Social Science	1253
Vocational Programs	1496
Undeclared	1959
Masters Programs	106
Not Reported	2620
<b>TCU Total</b>	<b>16986</b>

sure that fewer proposals are funded that include TCUs without our knowledge or agreement and therefore fail to address the TCU priorities in a manner that is likely to prove successful, or whose project budget fails to include the resources necessary for the TCU to accomplish stated goals.

**Recommendations**

**Recommendation 1:** *Maintain and increase targeted funding for TCU STEM infrastructure, education, and research programs.*

Given NSF’s proposal in the Fiscal Year 2011 budget to eliminate TCUP and instead offer one program for several different types of minority-serving institutions, our first recommendation is to maintain this vitally needed program, and to the extent possible, provide increased funds to ensure equitable participation by all TCUs. We believe it is important to note that NSF’s decision was made without publicly providing any research or analysis in support of the proposal and without discussion or, in the case of tribal institutions of higher education, without consultation.

We urge the federal government, led by the NSF, to show an authentic commitment to broadening participation in STEM by honoring this nation’s commitment to build the infrastructure of all segments of the U.S. academic and research community. In our view, this is the only way to guarantee that ALL Americans, including the First Ameri-

(Continued on page 15)

## Mentor Training Sessions at AAS... (cont'd)

*(Continued from page 3)*

provement. The NPA has a checklist available on its website for self-assessment at this URL:

<http://nationalpostdoc.org/core-competencies>

The third speaker of the morning session was Dr. Hakeem Oluseyi (Florida Institute of Technology) who focused his discussion on advancing diversity in astronomy through mentoring. Dr. Oluseyi's presentation highlighted his personal experience both as a mentor to many underrepresented minority (URM) students and as a practicing URM researcher.

Each speaker's presentation is posted on the CSMA website at <http://csma.aas.org/events.html>. There is also a link from the CSWA webpage.

The afternoon session followed a different format and was devoted to a participatory mini-workshop on mentoring. Researchers at the University of Wisconsin-Madison have developed, field tested, and publicly released research mentor training materials for several STEM (science, technology, engineering and mathematics) disciplines, including astronomy. Dr. Eric Hooper (University of Wisconsin) led an interactive implementation of these mentor training materials. Participants were given some common mentoring challenges in the form of hypothetical situations, and they reflected upon and discussed how to handle them in small groups and then with the larger audience. The 3 scenarios presented were reminiscent of situations familiar to many who have advised students at a variety of levels (one is shown to the right as an example). The group discussions exposed a wide variety of possible ways to deal with each situation as well as perspectives on the causes of the underlying mentoring challenge. These few scenarios represented on a very small part of the full mentor training materials that are available online at [www.researchmentortraining.org](http://www.researchmentortraining.org).

Evaluations were handed out after the workshop session. Responses to the workshop were generally positive with several participants simply happy for the opportunity to think about and discuss mentoring strategies with colleagues. A few participants requested additional information about the Wisconsin online training course with the inten-

### **Hypothetical Mentor Training Scenario #1:**

You recently explained a complicated computational technique to your mentee. As you talked, he nodded the entire time as if he understood every word you said. Upon finishing, you asked him if he had any questions. He said no. Just to make sure, you asked him if everything was clear. He said yes. Several days later you asked the mentee how the work using this technique was going and he told you he hasn't started because he does not understand the technique.

*Some ideas to think about:*

- What can you do in the future to make sure your mentee understands what you are saying? How do you know if it's working?
- How do you avoid sounding condescending?
- How can you help your mentees learn to accurately assess their own understanding?
- What if he understood everything you said but made an implicit wrong assumption you hadn't anticipated?
- Why might students of similar potential have different levels of difficulty understanding?
- How do you balance independence with understanding?
- Have you said you understood but didn't? Why?

tion of applying sections to programs in their own institutions. Organizers were asked about the possibility of hosting a similar session at the summer 2010 meeting in Miami. The proposal was granted time and will be held on Tuesday May 25 during the afternoon session from 2:00pm-3:30pm. The

The CSMA and CSWA are hoping for an even larger participation rate at the summer meeting.

*Dr. Dara Norman is an Assistant Scientist at the National Optical Astronomy Observatory in Tucson, AZ. Dr. Norman is an appointed member of the AAS CSMA, and she acts as the AURA Diversity Advocate for the NOAO.*

## The Role of Tribal Colleges & Universities... (cont'd)

*(Continued from page 13)*

cans, can fully and actively participate in the effort to achieve our collective STEM education and research goals. Given the unique needs of TCUs, the government-to-government relationship between federally recognized Indian tribes and the federal government, the federal Trust Responsibility, and the programs' demonstrated success and need, we believe that it is imperative to maintain and expand funding for the NSF-TCUP.

If this is not done, TCUs will continue to be missing from the list of institutions participating broadly in NSF programs. "Broader participation" will apply to all but reservation-based American Indians and their tribally-chartered institutions of higher education. We know that this will be the case because today, most if not all, TCUs are unable to successfully compete in NSF programs beyond TCUP, primarily because of a lack of understanding and serious consideration by program officers and peer reviewers, as described above.

**Recommendation 2:** *Have appropriate length and focus of NSF-TCUP awards.*

Given the limited pool of TCU applicants (33 accredited TCUs) and the need to build – often from the ground up – and sustain STEM programs for a length of time deemed sufficient to achieve improvement at all levels, NSF should:

1. Make grants under the NSF-TCU program for a period of 10 years, or alternatively, five years, with ongoing support for an additional five years (without the need to re-enter a program competition), provided the programs meet appropriate NSF criteria for satisfactory progress; and
2. Refrain from expanding or prioritizing purposes within the NSF-TCU program in new areas (e.g. K-12 teacher education, which previously had been supported by NSF under the Urban and Rural Systemic Initiatives) until sufficient funding exists to meet the basic STEM needs of TCUs and reliable data demonstrates a significant improvement in basic STEM education participation and completion rates across TCUs.

**Recommendation 3:** *Ensure proposals for programs involving TCUs include adequate consultation and collaboration.*

We request assistance in enforcing and measuring compliance with a requirement that any collaborative proposal involving TCUs in which a non-TCU is the lead institution must include,

among the supporting documents, letters of support and commitment from the TCU signed by an authorized representative of the institution or the American Indian Higher Education Consortium.

**Recommendation 4:** *Establish a grant program to increase partnership between TCUs and K-12 schools.*

In the 1990s, through the National Science Foundation's Tribal College Rural Systemic Initiative (TCRSI), 20 TCUs partnered with their local school districts to achieve successful and sustainable improvement of STEM programs at the K-14 level. Founded on the assertion that all students can learn and should be given the opportunity to reach their full potential, Tribal Colleges led the effort to achieve "whole system change."

The close working relationship between the TCUs and K-12 schools was paying off, according to the National Science Foundation, which reported that successful systemic reform had resulted in:

- The program significantly enhanced student achievement and participation in STEM;
- Significant reductions in the achievement disparities among students based on socioeconomic status, race, ethnicity, gender, or learning styles;
- Implementation of a comprehensive, standards-based curriculum aligned with instruction and assessment, available to every student.
- Convergence of all resources (fiscal, intellectual, and material) into a focused program that upgrades and continually improves the math and science program for all students.
- Broad-based support from parents, policy makers, institutions of higher education, business and industry, foundations, and other segments of the community for the goals and collective value of the initiative.

Despite its demonstrated success, the program was terminated some years ago. This is the type of program that should be reinvigorated and strongly supported by the Congress and NSF.

This testimony has been abridged. The full statement by Dr. David Yarlott can be read online at: <http://science.house.gov/publications/Testimony.aspx?TID=15371>

*Dr. David Yarlott is the President of Little Big Horn College and is the Chair of the Board of Directors of the American Indian Higher Education Consortium (AIHEC).*

## Increasing Hispanic Participation in STEM... (cont'd)

*(Continued from page 2)*

non-HSIs in graduating Latinos in several STEM fields of critical importance in the workforce, particularly computer science and mathematics. However, transfer students who first earned associate's degrees were less likely to earn degrees in those fields of study at HSIs.

These figures illustrate that certain pathways to STEM bachelor's degrees are not as readily accessible for students who start out in community colleges. Notably, those institutions that provide the greatest access to graduate degrees (academically selective and research universities) are least accessible to Latina and Latinos who earn associate's degrees. As a result, the proportion of STEM doctoral degrees awarded to Hispanic students (estimated at less than 5%) severely lags the proportion of Hispanics in the U.S. population (around 15%). Our study indicates that access to STEM bachelor's and graduate professions can be expanded for Hispanic students by improving access to STEM bachelor's and graduate degrees through transfer from community colleges.

Expanded transfer access is necessary because although Hispanic participation in STEM fields has risen, it has not kept pace with Hispanic population growth. Growth in the number of bachelor's degrees awarded to Hispanic students has occurred primarily in non-science and engineering fields. From 1998 to 2007, there was a 64% increase in the number of non-science and engineering bachelor's degrees awarded to Hispanic students, as compared to an increase of only 50% in science and engineering degrees awarded to Hispanic students.

Furthermore, most of that 50% growth occurred primarily in the social sciences and psychology rather than in the biological sciences, engineering, computer sciences, and other fields categorized as STEM fields. The lower participation of Hispanic students in STEM is not due to lack of interest. A recent report by UCLA's Higher Education Research Institute demonstrates that Hispanic students enter college with the same aspirations to earn STEM degrees as students of other racial-ethnic backgrounds [2].

Although the number of STEM bachelor's degrees awarded to Hispanic students grew over the past decade, the rate of growth in the number of STEM degrees awarded at other levels (associate's, master's and doctoral) was quite flat. Approximately 6,000 associate's degrees were awarded to Hispanics in science and engineering fields in 2007, a relatively low number given the large

population of Hispanics enrolled in community colleges. These figures reflect the fact that many community college students from all racial-ethnic groups are placed in remedial mathematics classes at community colleges. There is considerable variation by state, but it is not uncommon for the rate of remedial placement to be as high as 50% at community colleges and in some colleges that figure can reach as high as 90%. Remedial instruction in mathematics is also common at the four-year level, but the rates of remedial placement are lower, nearer to 20% or 30%. Improving teaching and learning in mathematics instruction is therefore a high priority for increasing the numbers of STEM degrees awarded to Hispanic students.

### **National Science Foundation (NSF) Support for Diversity in STEM**

*Student Services, Academic Support, and Curriculum Reform*

NSF currently funds special programs at community colleges and four-year institutions that aim to increase the number of students earning STEM degrees by providing enhanced student services and academic advising. Typical strategies focus on recruitment, orientation, faculty and peer mentoring, and intrusive advising to inform students if they are running into trouble academically or to guide them in making good academic choices. These strategies are primarily designed to reduce the difficulties of navigating college by providing students with information and extra support. Other programs go farther by offering learning experiences designed to better engage students in scientific study, such as through intensive summer research programs, learning communities, and supplemental instruction. A subset of the student services and academic support programs place a particular emphasis on increasing the numbers of students from underrepresented racial-ethnic groups in STEM.

The value of these special programs is supported by research that indicates such approaches are "best practices" for keeping students in college. However, the most common program designs implemented by NSF grantees are not informed by studies of the racial climate of STEM classrooms and programs. Recent research documents that racial stigma and discrimination create significant barriers to the participation of underrepresented racial-ethnic groups in STEM. A sampling of recent studies and reports illustrates this point:

*(Continued on page 15)*

*(Continued from page 16)*

- A literature review issued in 2009 documenting the “Talent Crisis in Science and Engineering” points to “traditions and stereotypes” that create low expectations, bias, and race discrimination as a primary cause of the loss of talent in STEM fields [3].
- A book published in 2009 titled “Standing on the Outside Looking In: Underrepresented Students’ Experiences in Advanced Degree Programs” captures the experiences of African American, Latina, and Latino graduate students of color. It documents hostile learning environments and experiences of marginalization and exclusion based on race and ethnicity, class, gender, and language among students of color in STEM fields and Latinas in doctoral and professional programs in the health sciences [4].
- A report issued in 2010 on “Diversifying the STEM Pipeline: The Model Replication Institutions Program” raises concern about the lack of “buy in” among faculty and senior leadership at participating campuses towards the goal of increasing access and success in STEM education for minority and low-income students [5].
- A research article published in 2009 emphasizes that African American students participate in mathematics education with an acute awareness of the dynamics of race and racism in their lives. Successful students embrace a mathematics identity and an identity as African Americans, but this often comes only through a great deal of struggle and perseverance [6].

Programs that do not address the fundamental problem of the negative racial climate in STEM fields are, therefore, unlikely to have a substantial impact to increase diversity.

There is a second problem that limits the potential of such interventions. They are not primarily designed to transform STEM education at its heart: in the classroom and the core curriculum. They tend to be program based and therefore seldom bridge the boundaries of different disciplines and types of institutions. There is a risk that the improvements in mentoring, advising, supplemental instruction, and laboratory instruction that may be brought about by the special programs that have been funded will remain on the periphery and not have a broader impact on STEM education.

Through the case study of our work on Hispanic degree pathways, Professor Estela Mara Bensimon and researchers interviewed ninety faculty, administrators, and counselors at three universities and three community colleges, all of which were His-

panic Serving Institutions. Many of these individuals were employed by or affiliated with NSF-funded programs designed to improve diversity in STEM fields. These respondents often described and shared data with us showing programs intensively focused on a small number of Hispanic students relative to the entire Hispanic student body. As often as not, those we interviewed worked in isolation and were not part of robust networks of faculty and administrators engaged in changing the STEM curriculum. For some the isolated nature of the work led to a sense that the goal of improving Hispanic student participation and degree completion in STEM fields was not supported by the college leadership. These results led us to question whether interventions through special programs can be adequate to the task of substantially increasing the number of Hispanic students being awarded STEM degrees.

This committee has already heard testimony on February 4, 2010 from Dean Karen Klomparens of Michigan State University and Professor Robert Mathieu of the University of Wisconsin at Madison regarding the importance of creating active learning in STEM education and providing faculty with the know-how (through professional development) to bring about active learning. I endorse their testimony and note that in regard to diversity issues in STEM, active learning and “real world” problem-solving approaches hold promise to reduce the sense of alienation of underrepresented racial-ethnic groups too often experience in STEM fields. Studies show that students of color value the opportunity to serve communities and address social problems through their college coursework.

However, as important as active learning and real world problem solving is, even this solution is not sufficient in and of itself to substantially improve diversity in STEM fields. Active learning can be incorporated without attention to the root problem of the racial discrimination, stigma, and alienation experienced by underrepresented students in STEM fields. NSF has played an important role in supporting experimentation in the STEM curriculum. Future funding will be valuably invested by ensuring that curricular innovation and reform occurs in the core curriculum and with the majority of faculty members involved. Such initiatives will also need to directly engage and be designed to tackle the problems of racial discrimination experienced by too many students who then depart STEM.

*(Continued on page 18)*

## Increasing Hispanic Participation in STEM... (cont'd)

*(Continued from page 17)*

### *Scholarships and Fellowships*

Current NSF funding invests considerably in research and graduate fellowships for undergraduate and graduate students, including students from underrepresented racial-ethnic groups, in STEM fields. Many studies indicate that targeted financial aid is extremely important and that grants of this type improve students' persistence and degree completion in college. Scholarships and fellowships also reduce students' need to borrow for postsecondary education at the undergraduate and graduate level.

This is of particular importance when we consider diversity in STEM because debt can have a more negative impact on underrepresented students. An analysis of NSF's National Survey of Recent College Graduates (NSRCG), conducted as part of our study on Hispanic pathways found that cumulative undergraduate debt among STEM bachelor's degree holders had a more negative effect on graduate school enrollment right after college among Hispanic STEM baccalaureates than among students of other racial-ethnic backgrounds. The findings suggest a reluctance to incur more debt for graduate or professional study, which is a typical financing pattern except for those students who receive graduate fellowships. They illustrate the importance of scholarships and fellowships in improving Hispanic student participation in STEM fields and professions. They also provide support for policies that offer student loan forgiveness to students who work in socially valued professions.

### **Recommendations**

Through NSF funding, we have made valuable investments in the development of student services and academic support programs to help students navigate the complexities of college and the STEM curriculum. However, a broader strategy is required to reduce the negative campus climates experienced by Hispanic students and other racial-ethnic minorities. This is because stereotypes of underrepresented students—representing them as unable to succeed or disinterested in STEM—are pervasive in society, schools, and postsecondary education. The “treatment” of special programs in relation to the overall problem is insufficient because they tend to take place at the margins rather than the core of higher education.

### *Areas For Future NSF Support*

The area in greatest need of pedagogical innovation is remedial and basic skills mathematics instruction. Community college students in particular must experience success in mathematics to gain the competencies needed to earn degrees in biological, agricultural and environmental sciences, and in engineering, which are fields with limited transfer access for transfer students who earn their bachelor's degrees at HSIs.

To encourage diversity and active learning in STEM, we must invest in bold experiments in curriculum and pedagogical reform that are informed by the principles of culturally responsive pedagogy. Priority should be given to initiatives that include a focus on integrating mathematics education in real world problem solving. These experiments should involve people from multiple scientific, social science, and educational research disciplines. As well as being interdisciplinary, they should be “intersectoral,” bringing faculty, administrators and counselors from different types of institutions into close collaboration. Consortia involving community colleges, four-year comprehensive institutions, and research universities are needed to improve transfer access for Hispanic students from community colleges to STEM bachelor's and graduate degrees.

Few observers of American politics and society would disagree that racial issues are among the thorniest in the U.S. Yet, to broaden participation among racial-ethnic groups underrepresented in STEM requires attention to the underlying racial dynamics of STEM education. We cannot fix problems of diversity without acknowledging the problems of racial marginalization and stigma and stating the intent to fix them. Toward that end, a body of research knowledge has emerged that provides concrete and practical steps faculty can take to introduce culturally responsive pedagogies in classrooms and other instructional settings.

A powerful tool for shaping the objectives and methods adopted by recipients of NSF funds is the Program Solicitation (or request for proposals.) A valuable first step in broadening participation in STEM fields would be to convene a panel of experts in culturally responsive pedagogy alongside scientists and social scientists to develop the language for a program solicitation. Their charge would be to write a Program Solicitation that makes the study of the racial dynamics of instructional environments in STEM a central component of curriculum and pedagogical reform.

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The criteria for award decisions should also support the mission focus of proposals from HSIs that propose specifically to develop the Hispanic serving capacity of their institution (and similarly the mission focus of historically black colleges and universities and tribal colleges). This can be indicated by staffing, hiring, professional development, and evaluation criteria that involve a critical mass of Hispanic faculty and administrators in program implementation and a large proportion of Hispanic students on a campus (or located in institutional service areas) in program participation.

### Evaluation

Campuses will be able to achieve more widespread involvement in STEM reform by engaging STEM faculty at the department and college levels in self-assessment of their educational practices and beliefs regarding the causes of student success and lack of success. Reflective practices are needed to comprehend the complexities underlying student experiences of racial stigma and discrimination.

The methods of benchmarking can be used to create a more comprehensive evaluation system that measures program effectiveness and cost-effectiveness, student outcomes, faculty development, and changes in organizational policies. There are three valuable strategies, which are called performance, diagnostic, and process benchmarking [7]. Each has a different application and can be used together for a more robust measurement and implementation design:

- Performance benchmarking is used to establish baseline performance and to set and evaluate progress towards improvements in student transfer and degree completion.
- Diagnostic benchmarking involves assessing one's own campuses practices against established standards of effective practice, as documented in the research and professional literature.
- Process benchmarking involves closely investigating the changes in organizational policies, procedures, and practices that are needed to implement effective practices in a particular campus context with fidelity.

Campuses will benefit from resources to develop their evaluation capacity prior to implementing large-scale programmatic or curricular reform. One valuable way to acquire this capacity is by serving as a peer evaluator to a partnering institution in a peer group.

By using these three types of benchmarking procedures, campuses can evaluate instructional effectiveness in producing greater diversity in

STEM and increasing the number of Hispanic students who are awarded STEM degrees. In sum, these are strategies for organizational learning, professional development, and pedagogical innovation. For too long, our approach to improving diversity in STEM has been overly focused on the "demand" side of the problem, on "fixing" presumed student deficits through attempts to improve their aspirations, motivation, or willingness to succeed. In contrast, these recommendations focus on fixing the "supply" side of the problem by improving the quality of STEM education. Research conducted at the Center for Urban Education demonstrates that the most important starting point for broadening participation in STEM is to reframe the lack of diversity as problems of institutional practices and practitioner knowledge [8], which unwittingly create a negative racial climate harmful to students from racial-ethnic minority groups.

This testimony has been abridged. The full statement by Dr. Alicia Dowd can be read online at: <http://science.house.gov/publications/Testimony.aspx?TID=15369>

*Dr. Alicia C. Dowd is an Associate Professor and Co-Director of the Center for Urban Education at the University of Southern California.*

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**Committee on the Status of Minorities in  
Astronomy**

American Astronomical Society  
2000 Florida Avenue, NW  
Suite 400  
Washington, DC 20009-1231

Phone: 202-328-2010  
Fax: 202-234-2560  
Email: [csma@physics.wku.edu](mailto:csma@physics.wku.edu)



**We're online:  
[csma.aas.org](http://csma.aas.org)**

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