Workshop on Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry

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Executive Summary

The purpose of the Workshop "*Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry"* was to promote the development of a cadre of academic leaders who create, implement and promote programs and strategies for increasing the number of racial and ethnic minorities to equitable proportions on the faculties of departments throughout the academic chemistry community. An important objective of the workshop was to assist in creating an informed and committed community of chemistry leaders who will create, implement and promote programs and strategies to advance racial and ethnic equity in both the faculty and the student body with the goal of increasing the number of U.S. citizen underrepresented minorities (URM) participating in academic chemistry at all levels, with particular focus on the pipeline to chemistry faculty. This objective was met by (1) presentations of detailed data describing current levels of racial and ethnic minorities on the faculties of chemistry departments; (2) frank discussion of the obstacles to and benefits of racial/ethnic diversity in the chemistry professoriate; (3) summary of possible effective interventions and actions; and (4) promotion of the dissemination and adoption of initiatives designed to achieve racial/ethnic equity.

Federal programs over the past thirty years have been instrumental in delivering to our universities URM students intending to major in the physical sciences such as chemistry. However, the near absence of URM faculty means that there is also an absence of URM as role models for aspiring students. For example, citing 2003 as a representative year, some statistics reveal the severity of the pipeline shrinkage for U. S. citizen URM starting from chemistry B.S. degrees awarded to the appointment to chemistry faculty. Compared to the URM population of approximately 30% for that year, 67 % of the B.S. degrees in chemistry were awarded to white citizens and 17 % were awarded to URM citizens. Proceeding along the pipeline, 83% of the Ph.D. degrees in chemistry were awarded to white citizens, and 6.4 % were awarded to URM citizens. The number of white citizens occupying tenure faculty lines in chemistry departments at major research universities is estimated to be 86%, while the corresponding lines for URM was estimated to be only 3.7 % in 2003. In raw numbers, the number of white chemistry faculty is estimated to be 1459 and the number of URM faculty was estimated to be just 62 (see Table 5, Appendix I). Thus, starting with 16.6% for URM students awarded B.S. degrees in chemistry, the number decreases to 6.4% for URM students awarded Ph.D degrees in chemistry and then dwindles to only 3.6% URM faculty in major research universities, compared to a population of approximately 30% URM citizens. Similar statistics for URM representation in chemistry is found for the last two decades.

Clearly there is a serious lack of URM mentors and role models among tenure faculty in our chemistry departments. The impact of this deficiency is captured in the statement that "A university's lack of minority faculty sends a message to its students that minorities have no place in academia" thereby perpetuating a cycle of marginalization and discrimination [1]. The lack of mentors and role models in academia deprive URM students who pass through the undergraduate programs of an education that is enriched by the intellectual and cognitive diversity that is inherent in a faculty of diverse backgrounds and cultures. Furthermore, URM are projected to constitute almost 32% of the U.S. population by 2020, so that URM will outnumber White males [who are projected to constitute 30 % of the population (U. S. Census data)].

It is clearly time for this to change and proactive programs are needed immediately in order to insure that there will be an optimal inclusion of

the future "majority" of the U. S. domestic population throughout all levels of academia.

The workshop was organized with the intention of triggering such a change by working with key representatives of chemistry in academia, namely the chemistry department chairs, to generate such programs, strategies and plans of action. This workshop called together the chairs of several of the top 50 Ph.D. granting chemistry departments in the country to design and develop new and comprehensive strategies to solve the problem of chronic URM under representation in chemistry and to commit to the goal of increasing the number of URM faculty in their departments. These chairs are well positioned to promote changes because they exist in environments that produce the majority of our chemistry faculty. With these leaders in the chemistry field taking responsibility for designing, developing, and implementing workable solutions, the community will have its best chance to create an excellent and diverse academic workforce in which the excellence of the URM component is appropriately represented.

The organizing committee of the workshop considered its charge of achieving ethnic and racial equity in chemistry as a diversity imperative for our profession that can be viewed as being driven by at least three motivations:

1) In order to optimally address the energy challenge, environmental issues, globalization of our economy, national security and technological industries, the U. S. will "…require scientists and engineers who represent the spectrum of U.S. values, cultures and interests and will bring their experiences to the solution of the national, international and global crises facing our nation" [2]. Thus, the latter consideration is a strong motivation for the scientific community to ensure that an appropriate and adequate representation of U. S. citizens is available in the scientific workforce of the future. This is an important cultural issue and a value that is widely perceived as a major component that distinguishes the past successes of innovative U.S. scientists, who will generally possess the traits that results from the unique training achieved by domestic scientists; these traits and experiences are not to be generally expected of foreign trained scientists. Students need to be educated in this successful culture in order to best understand and embrace its values and rewards. Thus, domestically-trained scientists are clearly needed as leaders of innovation in chemistry since it is not to be expected that "outsourcing" the workforce will fulfill the need for producing chemists who will possess transferable U. S. values, skills, culture and innovational culture needed to address critical national challenges.

2) The predicted demographics of our nation for the next decades require diversity in science to provide a sufficient number of domestically educated innovative scientists. Significantly, by 2020, URM will outnumber white males, the current "majority" that is producing the overwhelming majority of Ph.D.s, postdocs and faculty in chemistry [2]. Clearly this means that the students in the URM population must be enlisted into the pool of domestically trained chemists if our nation is to maintain its historic position as a leading innovator in science and technology. It is therefore particularly important that the percentage and number of URM Ph.D., postdocs and faculty in chemistry at major research universities be increased during the next decades.

3) The diversity initiative is a moral imperative rooted in the fundamental principles upon which our nation and universities were founded. As such, it must be seen as a high priority for implementation by the nation's universities. If only a small elite continue to have access to positions of power and leadership in the nation and in science, the nation has little hope to fulfill its core value of equal opportunity for all of its citizens.

Throughout the workshop, in presentations, panel discussions, informal round table discussions and breakout sessions, numerous ideas and strategies were offered for more effective approaches to the problem. In some individual cases these positive approaches are already being implemented. In others, they are being planned or are being contemplated, while in many cases they are recommended actions. All these actions and interventions, whether being practiced or anticipated, can be categorized into the following broad areas:

- Recognition of the existence and effects of implicit bias
- Creation of an appropriate working climate
- Design of strategies for effective recruiting and retention

- Effective mentoring and empowerment
- Diversity as a planned event

The extensive material covered in the workshop may be summarized by a few important "take home" messages

- Implicit bias is a subtle factor pervading all our interactions that undermines the progress of URM candidates at all levels of the pipeline from B.S. to faculty.
- The statistics on URM in chemistry are unacceptable; yet have changed very little in over a decade. Clearly, the old strategies and tactics are inadequate or have failed to be implemented; new, more effective, strategies are needed. A conclusion from the workshop is that the historical lack of progress may not be an inherent deficiency of past strategies and tactics but may more likely result from a failure of institutional/organizational *commitment* to change the culture, processes and practices.
- Mentoring of URM students, postdocs and faculty has not been effective and needs the attention of research sponsors and department heads.
- A network for identifying excellent URM students, postdocs and faculty does not exist and needs to be established so chemistry departments will have a means of identifying excellent candidates in an organized, systematic and productive fashion.
- The academic climate for URM has been largely unsupportive, indifferent, or in some cases even hostile; a nurturing and supportive environment for URM needs to be established in chemistry departments to encourage Ph.D. students and postdocs to consider academic positions and promote the hiring and retention of URM faculty.
- The community of academic chemists needs to commit to diversity as a core value and academic imperative that is in the self interest of the chemistry community: "Diversity and excellence can coexist in an organization."
- Departments need to commit to some of the Action Items from the workshop, and to be aware that this is a "work in progress."

The following report highlights the issues and their potential resolution, as viewed by the speakers. The Appendices provide additional details of the workshop, including the list of attendees, the workshop agenda, the breakout session questions, and the workshop organizers.

Workshop attendees at a session break: Isiah Warner, William Guillory, Nicholas Turro, James Mitchell, Rigoberto Hernandez, Sharon Neal, and Tyrone Mitchell.

Introduction: an Overview of the Problem and the Need for its Resolution

Half a century ago, on October 4, 1957, the Soviet Union successfully launched Sputnik I, the world's first artificial satellite. In purely material terms, Sputnik I--the size of a beach ball (58 cm in diameter) and weighing only 83.6 kg--was puny and almost comical in comparison with today's satellites. Yet its significance is incalculable: it induced a new era of US focus on science research and technology innovation. Fifty years later we are living in an age of unparalleled achievements in science and engineering. The internet, virtual designs, hypersonic transport, wireless telephony, supercomputing, interplanetary photography, communications and space launches have become routine, and US scientists are successfully tackling problems of far greater intricacy and complexity than imagined by most half a century ago. The promises of nanotechnology; the exciting possibilities offered by the sequencing of the human genome; the prospects of tailoring pharmaceuticals to provide therapeutic regimens to treat individual patients based on their genetic make up…these are just a few of the areas in which the physical sciences, especially chemistry and physics, in an interdisciplinary collaboration with the biological sciences, will be continuing to alter our world.

Predictions of what new discoveries, inventions and applications will emerge are difficult to make. However, one thing is certain: the US must continue to be a world leader in the realization of these future innovations. To meet these future challenges and maintain our scientific and technological leadership, we will need an increasing number of highly qualified, motivated and empowered individuals in the scientific workforce of tomorrow. The US academic graduate enterprise, still one of the world's best, has the primary responsibility for educating and training an adequate supply of scientists and engineers to underpin the US global competitiveness.

The steering committee of the workshop endorsed the premise that the excellence of the domestically-trained scientific workforce emerging from academia during the next decades can be maximized by increasing the participation of underrepresented minorities at the Ph.D., postdoctoral and professorial level of academia. The following report describes discussions, arguments, data and action items that were put forth as possible paths to achieve excellence, specifically in chemistry, empowered by a diverse academic workforce.

US Global Competitiveness: Technology and Business Innovation

In response to a request from the National Science Foundation (NSF), the National Research Council recently conducted an in-depth benchmarking analysis to gauge the standing and competitiveness of the U.S. chemical engineering enterprise in the world, based on measures including numbers of published papers, citations, trends in degrees conferred, patent productivity, and awards. The results indicate that "…the U.S. publishes more papers than any other single nation, and that 73 of the 100 most cited papers in chemical engineering literature during the period 2000-2006 came from the United States." Further, the U.S. is expected to remain among the world's leaders in most sub areas of chemical engineering research. However, U.S. leadership in some classical and emerging sub areas will be strongly challenged. For example, Japan and other Asian countries are particularly competitive in materials-oriented research, and Europe is very competitive in bio-related research [3]. Also, other studies have indicated that while the U.S. still leads the world in potential citation impact of publications, the European countries are close behind and publish at twice the rate of the U.S., resulting in a higher overall impact. Moreover, the relative financial investment in science and technology (S&T) of Europe and Asian countries is significantly higher than that of the U.S. [4].

A far more serious threat to U.S. competitiveness in S&T arises from the trends in the relative numbers of domestic scientists and engineers being produced each year in the U.S. compared with the rest of the world. For example, since the 1980s Chinese college enrollment has quadrupled to 20 million, and China graduates 200,000 engineers per year, compared to 60,000 in the U.S. Further, according to the World Economic Forum (WEF) Global Competitiveness Report, the U.S. has slipped from number two to number six, in part because it has diverted the focus of its funding to areas other than education of its scientific workforce and science research. In addition, U.S. companies are outsourcing skilled jobs to China and India [5]. The preceding is merely the tip of

the iceberg and can be substantiated by numerous other statistics.

In the face of this critical challenge we seem ill prepared to meet the scientific demands of the future, and recent years have seen an erosion in the leadership of the U.S. in S&T. In fact, in some sense we appear to be moving in a disturbing direction: the traditional source of U.S. science and engineering is diminishing as "baby boomer" scientists and engineers are aging and leaving the workforce [2, 6], and as a nation we are falling behind in many fields of science, engineering, and manufacturing. Hence, the once vast economic and technology gap between the U.S. and the rest of the world is closing rapidly and may even reverse in the near future unless actions are taken that allow the nation to maintain its leadership position in scientific research.

The diminishing U.S. global competitiveness in science and technology has not been lost on U.S. Government policy makers, as evidenced by recent U.S. competitiveness legislation. For example, Congress has recently approved landmark legislation aimed at making the U.S. more competitive in the global marketplace through substantial increases in federal R&D funding of science and math education. The America Competes Act (H.R. 2272) authorizes a total of $33.6 billion over the next three fiscal years for science, technology, engineering, and math education programs across the federal government. It also authorizes multiple grant programs at various federal agencies to further educate current and future teachers in science and math. The bill also proposes a doubling during the next decade of the budgets of research programs at NSF, the National Institute of Standards & Technology (NIST), and the Department of Energy's (DOE) Office of Science [7]. The legislation is largely based on recommendations in the 2005 National Academy's report, "Rising Above the Gathering Storm: Energizing and Employing American for a Brighter Economic Future," which concluded that the U.S. is falling behind other countries in math and science education. The report found that about two-thirds of the students studying chemistry and physics in U.S. high schools receive instruction from a teacher lacking a degree or certification in the field [8].

Competitiveness and Full Utilization of U.S. Minority Workforce Resources

Why is the nation falling behind with respect to the production of a scientific workforce? Numerous factors can be cited, some of which are probably beyond our control (for example, the growing relative strength of S&T in Europe and Asia). But one contribution to our diminished competitiveness in the world, one in which our failure is both glaring and possibly self-inflicted, is the lack of diversity--that is the under representation of women and ethnic/racial minorities in the fields of science and engineering--especially among faculty and students seeking advanced studies (Ph.D. and post-doctorate). It is said that "A rising tide lifts all ships," but it seems that the effect is hardly uniform: the revolution brought about by Sputnik did little to advance the lot of underrepresented minorities (URM), since the generation of scientists and engineers inspired by the post-Sputnik boom were predominantly white men. The steering committee of the workshop took as self-evident that there is excellence in underrepresented minorities and that the failure to incorporate this excellence into the scientific workforce diminishes the nation in both a practical and a moral sense. Practically speaking, the nation cannot afford to ignore domestic scientific talent and excellence, and morally speaking the nation has an obligation to produce the conditions that allow all of its citizens to demonstrate their excellence in all fields.

Underrepresented Minorities in Chemistry: Current Status

Despite the long-term awareness, advancement in the participation of minorities within the graduate professional ranks of the chemical sciences has been sluggish, especially among faculty and students seeking advanced studies (Ph.D. and post-doctorate). The revealing statistics on the gender gap and the number of URM in chemistry are widely available. In the following pages and in Appendix I we will discuss some of these statistics in more detail, but we cite a few samples here to set the stage [2, 9, 10].

- The absolute number of URM Ph.D.s is relatively quite small; moreover, it is not commensurate with the U.S. population of URM.
- Worse, the percentage of URM Ph.D.s is not commensurate with the number of URM BAs.

- In the nation's 50 most prestigious chemistry departments only 18 out of 1,638 chemistry faculty are African-American.
- Only 15 of the top 50 universities have an African-American faculty member.
- Only 35 of the top 50 universities have a Hispanic faculty member [2].
- Population trends in the U.S. are exacerbating the problem: the traditional pool of Ph.D.s/faculty (namely, whites) is decreasing relative to that of URM.
- While the production of domestic post-doctoral candidates is decreasing the number of foreign post-doctoral candidates is increasing.

But what lends an even more alarming air to these already dismaying statistics is the diminishing numbers of successful transitions from the Ph.D./post-doctorate level to the professoriate. This diminished flow in an already constricted pipeline is very troubling, for it augurs poorly for the future prospects of increasing the numbers of URM in chemistry. Or, as noted by Freeman A. Hrabowski III (President of the University of Maryland, Baltimore County): "You have accomplished nothing until you have changed the professoriate."

The chemical sciences and technology community has been aware of the under-representation of minorities and has expended stellar efforts with significant successes at the undergraduate level. Project SEED and the ACS Scholars Programs are noteworthy examples. While several individual chemistry departments have enhanced URM graduate student participation and faculty ranks, the overall situation has not improved measurably for over a decade. Clearly, to remedy the situation, new strategies and tactics must be implemented systematically and institutionalized to increase the numbers of URM in academic chemistry departments at all levels.

Education and Training of URM Workforce: Chemical Department Leadership

How is it possible that in the United States, the "land of equal opportunity" with world-class academic institutions, we are failing to educate and train, and therefore make effective use of one of our greatest "natural resources": the domestic workforce in science? Among categories of U.S. institutions/organizations benefiting from public funding (taxpayer generated revenues), the university sector in the physical sciences, including chemistry, has made the least progress with respect to inclusion of URM. Ordinarily, it would be expected that the tax-exempt status of the university enterprise embodies a national imperative, obligation and responsibility to educate and train citizens that would be representative of the U.S. demography. Unless universities develop inclusive departments with a professorate representative of the ethnicity, race and gender of the domestic US population, this failure in the training, hiring and participation of URM will continue. The University S&T Enterprise not only has a public responsibility to solve its current exclusionary status with respect to participation of URM, but should also consider this achievement one of the top intellectual accomplishments ever to be attained in an academic society. Academic chemistry departments have the opportunity to provide the first existence proof for empowering scientific excellence through the inclusion of URM faculty.

Brainstorming Strategies for Long-Term Solutions: A Stakeholders' Workshop

The U.S. government agencies NSF, DOE, and the National Institutes of Health (NIH) have recognized the problem we are faced with and are taking steps to redress it. As discussed in Chapter 3, a number of Federal agency programs address the issue. In 2006 these agencies sponsored a workshop on "Building Strong Academic Chemistry Departments through Gender Equity" [11]. As noted by Nicholas Turro, co-organizer, along with Isiah Warner, "Before the [Gender Equity] workshop Chemistry Department Chairs felt that their ability to hire women faculty was largely beyond their control." However, after the workshop "Chairs were significantly more likely to perceive that factors under their control either limited the hiring of women or served as barriers to progress in hiring women." As a result, "…the workshop provided recognition that departmental attitudes were not conducive to hiring women, some faculty were opposed to hiring women, mentoring was minimal, subtle bias existed, teaching loads precluded effective action, etc." [9]. Of course this apparent change in attitude is just the beginning, and it will take time, dedication, and persistence to really effect a change.

The same U.S. government agencies which supported the Gender Equity workshop approached academic leaders of the chemistry community with the intention of holding a similar workshop on the subject of URM in chemistry departments of U.S. universities. The workshop, entitled "Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry" was held from September 24-26 in Arlington, Virginia. This "stakeholders' workshop" was attended by 125 people, including 43 Chairs or their representatives from the chemistry departments of some of the top 50 Ph.D. granting institutions, U.S. government officials and others.

The goal of the workshop was to assist in creating informed and committed chemistry leaders who will create, implement and promote programs and strategies to advance racial and ethnic equity in both the faculty and the student body with the goal of increasing the number of U.S. citizen URM participating in academic chemistry at all levels. The workshop aimed to advance this vision by:

1. Presenting detailed demographic data describing current levels of racial and ethnic minorities on the faculties of chemistry departments in the light of trends over the past 50 years,
2. Conducting a frank and open discussion of the obstacles to and benefits of racial/ethnic diversity in the chemistry professoriate,
3. Providing a summary of social science studies that indicate the effectiveness of specific interventions,
4. Promoting the dissemination and adoption of programs of action and initiatives designed to accomplish racial/ethnic equity including:

(a) More effective hiring practices,
(b) More effective mentoring,
(c) Strategies for building accountability into diversity plans,
(d) Dissemination of tools and guidelines for periodic monitoring and assessment,
(e) Encouraging future periodic summative conferences for reevaluation, renewal/redirection and expansion of participants.
(f) Establishing an enhanced networking system to enable department heads to identify in an organized and systematic fashion excellent URM students, postdocs, and faculty.

In his introductory remarks, **Luis Echegoyen** (NSF) stated very clearly his hope for the outcome of the workshop. He noted that although we are certainly interested in the career development of a scientist from the very early school years, the primary target of this effort is to increase the numbers of URM who successfully make the transition from the Ph.D. and post-doctoral level to the professoriate. The role modelling effects will take care of the rest. Department Chairs were chosen to participate in this workshop since they have the ability to really effect change and make things happen on a larger scale. If we act collectively, come up with a series of recommendations and action items to be taken back home, and act on them seriously, we can make a difference. In contrast, if when we return home it is business as usual then we will have accomplished nothing.

Luis Echegoyen of the National Science Foundation addressing the workshop.

Echegoyen's comments were supported by Eric Rohlfing (DOE) and Michael Rogers (NIGMS/NIH). Rogers also noted that NIGMS has a long history of supporting diversity programs, but in the last few years there is a sense of urgency concerning the need for increasing the number of URM on the faculty of research-intensive universities. Rogers stated that a subcommittee of the National Advisory General Medical Sciences Council recently recommended refocusing the Institute's programs for underrepresented minorities on the goal of increasing the number of URM students with Ph.D.s with an emphasis to increase the number of URM faculty in colleges and universities and

further integrating this goal into all of the Institute's offerings.

Throughout the workshop, in presentations, panel discussions and breakout sessions, numerous ideas and strategies were offered for more effective approaches to the problem. In some individual cases these positive approaches are already being implemented, in others they are being planned or are being contemplated, while in many cases they are recommended actions. All these actions, whether being practiced or anticipated, can be categorized into the following broad areas:

- Recognition of the existence and effects of **implicit bias**
- Creation of an appropriate working **climate**
- Strategies for effective **recruiting** and **retention**
- **Mentoring** and **empowerment**
- **Diversity**

The following report highlights several issues along with potential resolutions, as viewed by the speakers. The Appendices provide additional details of the workshop, including tables of relevant statistics on URM, the list of attendees, the workshop agenda, the breakout session questions and the workshop organizers.

CHAPTER 1: A Glimpse into the extent of the problem—an overview of the data on URM

Nicholas Turro, Columbia University, and Thomas Cech from Howard Hughes Medical Institute, gave keynote speeches in which they provided an overview of the disturbing statistics on the number of URM in academia in general, and in the professoriate in particular. The basic message they conveyed was somber, namely, that we are confronted by a multi-faceted problem: while the U.S. need for domestically-trained scientists is increasing, the supply of Ph.D.s trained in the U.S. is decreasing, the number of URM pursuing Ph.D.s is relatively small and the pipeline constriction makes the problem worse at the output end. Moreover, population trends suggest that the problem will become critical within the next few decades. Some details of the preceding will now be discussed.

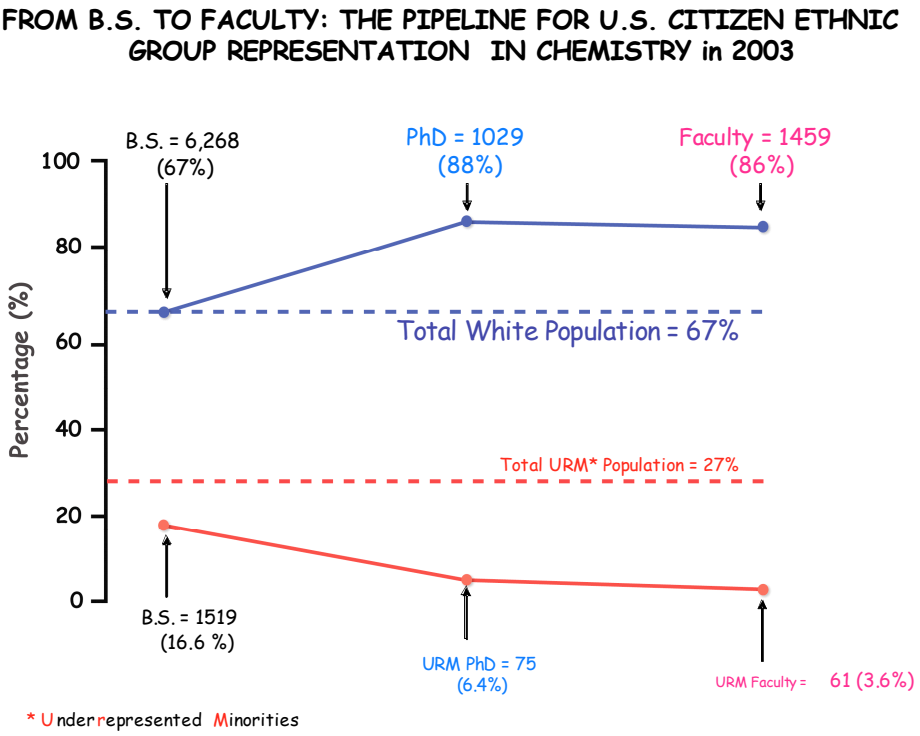
Turro noted that based on projections of the number of job openings in science over the next few years we will need an increase of 18% in the number of scientists to meet the demand. Yet, the white population, which is the traditional source of the faculty, is decreasing as a percentage of the total population. For example, in the next decade the population of 18 to 24 year old whites will increase by only 5%. Meanwhile, the relative percentage of URM is projected to increase dramatically. In particular, as a percentage of the total population, the URM population in the year 2000 was 24% but is projected to be 40% in 2050. However, relative to their population few URM Ph.D.s are being produced. Even worse, an even smaller percentage of the URM Ph.D.s are being recruited by the top universities. Of 124 black Ph.D.s only 4 will be recruited to the top 32 universities and of 224 Hispanics, only 10 will be recruited to the top 32 universities [9].

Nicholas Turro, Co-Chair of the workshop, addressing the workshop.

To emphasize the seriousness of this problem it is worthwhile considering more closely the following schematic shown by Turro to examine the "flow" from the already low numbers of URM to the faculty level. What is clear is that it is not simply a problem of too few URM getting undergraduate degrees in science generally (and in chemistry in particular). Of the number of URMs completing the requirements for an undergraduate degree in science, an even smaller percentage are going on to earn a Ph.D. and still fewer of URM Ph.D.s are choosing to enter the professoriate.

Hence, the pipeline constriction is such that an already inadequate flow becomes barely a trickle

by the time it reaches the faculty level, leading Turro to justifiably ask, "From where will the needed domestically trained scientists come?"



Thomas Cech, president of the Howard Hughes Medical Institute (HHMI), reinforced these observations with his own statistics. He noted that the representation of URM in chemistry faculties is very low. In fact, in a histogram of the statistics the bars representing African-American or Hispanic faculty are barely visible. Moreover, the progress in remedying this situation has been very slow. For example, from 1983 to 2003 the growth in the number of URM graduate students has been very small, as shown in Table 3 in Appendix I. Hence, there are still very few URM in the pipeline at the Ph.D. or postdoctoral level.

Regrettably, as noted, the challenge will only be more difficult in the future because of the changing demographics. Consider the following figure showing the predicted trends in the U.S. population over the period from 2000 to 2050.

The rise in the relative size of U.S. "minorities" in the population is striking. For example, the Hispanic population is predicted to double in size in several decades. Thus, at some point in a few decades, the "minority" will refer to the white population. Once again this raises the cogent question: if whites continue to be the major source of the pool of Ph.D. candidates and the professoriate, and this source is decreasing, from where will the needed scientists be coming?

Clearly, the preceding figures should be a wake up call to the scientific community who need to recognize the obvious: we are faced with a very a serious challenge. With good will, dedication and persistence, we can view the statistics as a wonderful opportunity to alter the future and ensure that these projections are not inevitable.

In summary:

- Ph.D. production is flat in all groups, but Ph.D.s from U.S. citizens and permanent residents have dropped considerably in the last decade.
- The number of URM faculty is tiny compared to white faculty.
- Relative to the percentage of their population, few URM Ph.D.s and postdocs are being produced.
- Even worse, an even smaller percentage of the URM Ph.D.s and postdocs are recruited by the top universities.
- In the coming decades the dominant pool of potential scientists and engineers will shift from the white community to URM.

The bottom line is our nation needs to take advantage of the excellence inherent in the growing percentage of URM in order to maintain a sufficient supply of domestic Ph.D.s.

Coincidentally, just a few days after the end of the workshop, Donna Nelson published the results of the first national and most comprehensive demographic analysis to date of tenured and tenure track faculty in the top 100 departments of science and engineering disciplines. The report shows that minorities and women are significantly underrepresented, which is consistent with the general observations above [2].

CHAPTER 2: What are the contributing factors?

The statistics on URM, albeit of great importance, are of course only a part of the story. They alert us to the magnitude and extent of the problem, but they do not address its root causes. What explains the dismal statistics and the chronic lack of progress? Why have previous efforts to solve this problem not been any more effective? More importantly, how do we resolve this problem so that the excellence in the URM population is tapped in an effective and sustainable manner? The presentations and discussions of the workshop offered some answers to these questions. In this chapter we address the "Whys" and in the next chapter, we consider ways to craft solutions to the problem.

Anne J. MacLachlan participating in the "Contributing Factors" panel, along with John Dovidio, Daniel Solorzano, Frank Dobbin and Sharon Neal.

A. A counterintuitive example

Understanding the contributing factors is challenging. Often the unfortunate history of racial interactions and the highly charged political debate that attends them obscure the core issues at hand. Uri Treisman, a mathematician whose innovative strategies to improve the experience of URM students in calculus at UC Berkeley have generated remarkable results [12], noted that before studying the habits and progress of URM students, he and the other instructional staff (faculty and teaching assistants) thought that the reason for the students poor performance could be summed up in four hypotheses: 1) URM students were not as highly motivated to excel in calculus as students from other groups, i.e., Asians; 2) URM students were inadequately prepared for the intensity, speed and cumulative nature of the discipline; 3) URM students lacked the kind of family support or guidance that facilitates rigorous study, i.e., their families did not push them enough; and 4) the problem is really one of family socioeconomics and URM students are disproportionately from low income families.

After surveying and observing groups of highly and poorly achieving students, their assessment was quite different. They learned that many of the URM students were so motivated to excel that they had endured social isolation in order to focus on earning the necessary credentials to attend Berkeley. They were surprised to find that the Black students who were best prepared fared

the most poorly. These students' calculus grades correlated negatively with their high school Math SAT scores. Interviews with parents revealed that many of the Black students' parents were committed to sending their children to college even before the children were born. Finally, they found that income correlated negatively with student performance. Clearly, their hypotheses regarding the nature of the problem were flawed.

What did Treisman and his colleagues find when they observed the students closely? "… 18 of the 20 [Black] students never studied with their classmates. … [Chinese students] studied calculus for about 14 hours per week. They would put in 8 to 10 hours working alone. In the evenings, they would get together. They had constructed something like a truly academic fraternity …" Based on these observations, Treisman and his coworkers developed an effective program to support students' studies, but it was a substantial departure from the study-skills and remedial courses that were in place to address URM students' poor performance. They designed an intensive, anti-remedial workshop course, which sought to help students "create for themselves a community based on shared intellectual interests and common professional aims." The implication of this account is that the UC Berkeley Mathematics community had downplayed the significance of personal interaction in their efforts to educate URM students. They had relegated their URM students to an isolated existence at the margins of the course and then attributed their poor performance to personal and/or societal failings. One analysis of why the anti-remedial workshop implemented by Treisman was effective is that it combined efforts to address student performance with efforts to impact the climate in which students were working.

B. Flawed hypotheses (myths) obscure the facts in the chemical enterprise

Many in the chemical enterprise also subscribe to flawed hypotheses, i.e., myths, about why the participation of URM in chemistry (and science at large) is so low. At the Stakeholders' workshop, Turro discussed some of the prevalent myths concerning URM scientists that tend to undermine efforts toward faculty diversity. The following summarizes a few of these myths [13].

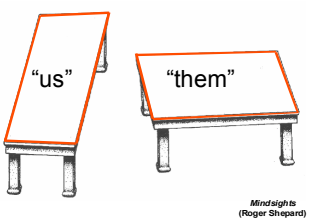
- It is well known that because there are so very few URM candidates for faculty positions, we cannot find any candidates to interview.
- It is well known that there are so very few URM candidates for faculty positions in the pipeline that those in the pipeline are in high demand. They are being sought by numerous institutions which compete against each other.
- It is well known that only the wealthy institutions have the resources to compete for the small number of URM candidates for faculty positions. The bottom line is that we cannot compete.
- It is well known that most URM candidates for faculty positions prefer more lucrative positions in government, industry, law, medicine or business.
- It is well known that the current faculty recruiting and hiring system works very well and identifies all of the excellent candidates, so why change it?

What is the reality of URM chemists in academia? Recent data collected by Valerie Kuck and presented by Turro at the Stakeholders' workshop show that URM Ph.D. graduates who earned their degree at a U.S. institution between 1994 and 2003 secured faculty positions at research active universities at less than half the rate of their majority counterparts. These data also show that URM Ph.D.s secured positions at the top 32 research universities at less than a third the rate of their majority counterparts. Moreover, URM Ph.D.s take positions at institutions at the lower end of the resource scale at rates that are very similar to, but higher than, their majority counterparts. Therefore, while these myths are demonstrably false, their pervasiveness in the mind of the chemistry body politic provides a partial explanation for the inadequacy of existing efforts to address the problem of under representation more effectively.

C. Distortion of objective perceptions

Brian Nosek described another phenomenon that contributes to the difficulty of developing and implementing effective strategies and tactics

to address racial under representation in science: automatic cognitive processes that limit our capacity for objective perception. In an engaging presentation full of examples, Nosek illustrated how unreliable the senses are in making judgments when our experience or expectations circumscribe the elements in the field of view. Objects that are the same look different; (see Mindsights example in the figure), expectations make the obvious invisible. In a demonstration called **Counting Passes** Nosek first informed the audience that he was about to show a video clip of two teams of young people passing a basketball between them. The audience was instructed to count the number of times the ball was passed. One side of the room was to count the number of catches made by the white-shirted team while the other side was to count the number of catches made by the black-shirted team. The video clip was then shown and the audience was asked for the number of catches of each team. The audience was also asked if they noticed any unusual occurrences in the video and very few said they did. The same video clip was replayed with new instructions from Nosek to simply to look for anything previously missed. To the astonishment of most they now noticed a young woman holding an open umbrella above her head walking through the basketball court. A different version of this experiment has been reported in the literature in which, in place of a woman carrying an umbrella, a person dressed in a gorilla suit walks into the midst of the basketball players, waves conspicuously into the camera and then walks out of the scene. In the latter experiment over half the audience did not notice the gorilla! The explanation for this phenomenon is that the brain manages its resources to focus on the counting task and filters the conscious perception of the non-essential things in the environment (woman with umbrella or gorilla), even though much of the brain's visual system is apparently informed of the presence of the "extraneous" image. This "perceptual blindness" is a striking example of the brain's ability to be highly selective in its choice of sensory information to be consciously perceived and is an intellectual and cognitive relative of implicit bias [14].



Mindsights: These two seemingly different sized tables are actually equal in size (measure them!)

Brian Nosek captured the attention of the audience with his presentation on "Mind Bugs: The Ordinary Origins of Bias."

The following example, provided in a later presentation by **William Guillory** of the Center for Creativity and Inquiry, demonstrates dramatically how expectations can color perception:

A father and his son were in a terrible car accident.

The man was killed and the son was taken to a hospital emergency room in need of immediate surgery.

A surgeon walked into the emergency room, saw the boy and said, "I can't operate on this young man – he's my son!"

How can this be?

This is a puzzle to anyone with implicit gender bias. Without gender bias, a woman surgeon is a logical answer to the puzzle. The "puzzle" of the father and son in a fatal traffic accident shows very dramatically how profoundly engrained in our psyche implicit bias can be (in this case gender bias). Very few in the workshop guessed how this could be even though the audience consisted of a more than average mix of racial/ethnic/gender diversity and, moreover, were certainly much more sympathetic and enlightened than a typical sample from the general population (or at least we would like to think so!).

D. Implicit bias linked to subjective evaluation

Brian Nosek also used examples to illustrate the link between the brain's reliance on pre-existing information to bias in interactions between racial groups. He described a resume study in which resumes, identical in every way except the name of the applicant, were sent along with job applications to various organizations. The names were deliberately chosen to be suggestive of different racial/ethnic groups. Resumes more likely to represent Caucasians received a much higher success rate than the others, even though the contents of the resumes were otherwise identical. Another example illustrated the impact of viewer assumptions on the task of interpreting alternative sketches of a young white or black man reaching for his back pocket. This is similar to a study in which subjects, who were shown photographs of men with similar athletic abilities, rated the athletic ability of the African-American men higher than that of white men. These examples show how culturally derived generalizations influence what the evaluator perceives to be objective assessments of individuals.

This connection between unconscious cognitive processes and biased decisions was described in more detail by **John Dovidio** of Yale University. He opened his presentation with encouraging statistics showing the dramatic decline in the years between 1933 and 2000 in the endorsement of egregiously negative stereotypes of blacks by whites. He explained that the blatant, virulent prejudice that characterized many racial interactions before the civil rights era is no longer widely practiced. What happens commonly now is that when someone categorized as an out-group member (a "them" rather than an "us") is encountered in ambiguous, time-sensitive interactions, conscious, deliberate egalitarian attitudes and behavior are undermined by unconscious beliefs and spontaneous behavior. When the out-group member's credentials clearly qualify or disqualify them for the situation at hand discrimination against the Black candidate is not observed. In contrast, when the credentials are less obvious and the "correct" decision more ambiguous, White participants recommended the Black applicant/candidate significantly less often than the White applicant/candidate though they had exactly the same credentials [15]. When circumstances provide room for interpretation, as when the credentials are not clear, Whites tend to give White applicants/candidates a "benefit of the doubt" or embrace criteria that validate decisions against the Black applicant/candidate. This is a critical element in the low participation of underrepresented groups in science. Studies show that approximately 80% of White Americans exhibit this kind of implicit bias. Since very little of the work carried out by individual scientists is unequivocally excellent or flawed and assessment is ambiguous and conducted under time pressures, the work of out-group members is subject to more scrutiny and less readily embraced as valuable.

E. Implicit bias linked to unproductive work environments and unwelcoming climates

Another important consequence of this kind of unwitting aversion to out-group members discussed by Dovidio is the fact that the damage done to interpersonal interactions between members of alienated groups is out of proportion to its intensity as perceived by members of the majority group. He showed the results of a study of the perception of the quality of interracial interactions by Black and White students paired on timed problem-solving teams. The perceptions of the interactions were related to the White students' explicit and implicit racial attitudes by classifying the White students' racial attitudes. The students were classified into three groups: traditionally prejudiced (openly biased behavior); aversive racists (egalitarian views with unconsciously biased behavior); and minimally prejudiced (egalitarian views with little evidence of unconscious bias). The White students' impressions of their behavior reflected their conscious attitudes, so many viewed themselves as friendly and trustworthy in their

interactions with the Black student. On the other hand, the Black students' impressions reflected the White students' unconscious attitudes. The Black students perceived the conflict in the aversive racists and mistrusted them more than they mistrusted their partners who were openly biased! It is also interesting that the teams staffed by aversive racists required even more time to complete their assigned tasks than those staffed by traditional racists.

In Dovidio *et al*., 2002 [16], the authors write "In contrast to these isolated and relatively rare interracial encounters for Whites, Blacks may experience disparate treatment and outcomes more consistently and across a range of situations … Whites and Blacks are likely to develop different, and potentially conflicting, views about the roles that racial prejudice plays in their lives."

The preceding observation was reinforced by the presentation of **Daniel Solorzano** of the University of California, Los Angeles who pointed out that students and faculty of Color experience and respond to the university climate very differently from the perceptions of their majority counterparts. His research shows that many of the interactions URM have with majority group members are not harmless but constitute "racial microaggressions" because they serve to remind the out-group member that s/he is not fully embraced by the in-group member. He defined racial microaggressions as a "form of systemic everyday racism used to keep those at the racial margins in their place." These include:

- **Subtle verbal and non-verbal insults/assaults** directed toward URM, often done automatically or unconsciously.
- **Layered insults/assaults,** based on one's race, gender, class, sexuality, language, immigration status, phenotype, accent, or surname.
- **Cumulative insults/assaults** that take their toll on URM.

Solorzano described several examples of racial microaggressions including:

- "When I talk about ***those Blacks***, I really wasn't talking about you."
- "You're not like the rest of ***them*****.** You're different."
- "I don't think of you as a ***Mexican*****.**"
- "You speak such ***good*** English."
- "How do Black people **feel** about…?"

The message regarding the difference in the perceptions of the academic environment by underrepresented scientists was reiterated and elaborated on by **Anne J. MacLachlan** of the University of California, Berkeley. MacLachlan began her presentation with a rhetorical statement "If there are so few chemistry doctoral students of color, and we want to increase the number of faculty of color, then we will welcome these students and treat them supportively and fairly." She forthrightly attributed the lack of welcome in most science, technology, engineering, and mathematics (STEM) departments to stereotypical perceptions of underrepresented students by faculty. MacLachlan based this view on years of interviews with STEM faculty and students from which she abstracted public comments and observations of senior STEM faculty who believe that African-American students are likely incapable of succeeding in "our" graduate program and Mexican-Americans in general are viewed as slackers, troublemakers, and unsuitable for graduate school. She pointed out that the lack of open discussion of racial issues in most academic settings perpetuates an environment in which these views are not effectively addressed, even when they are held by a minority of faculty. MacLachlan reinforced the negative consequences of an unwelcoming climate on faculty and students. These include not receiving critical information about successful completion of their doctoral project or the road to tenure as well as being subjected to harsher evaluation standards. She quoted an African-American graduate student "Your ethnicity is from society, it affects virtually all your experiences. It is part of American society; it is part of the consciousness of Americans. It influences the nature of your experience in graduate school, how you are perceived. It is impossible for me to separate this from graduate education."

This research suggests that a significant factor contributing to the low rates of participation of URM is the unexpectedly damaging effect of implicit bias and unwitting aversion on the interactions of underrepresented groups with the rest of the chemistry community. Conscious, deliberate efforts and programs to recruit and

retain minorities in chemistry departments are being undermined by a small number of conscious behaviors by detractors and a large number of unconscious behaviors of well-intentioned faculty and students who do not perceive the conflicting messages in their demeanor.

A lively discussion among workshop participants.

F. Attitudes, mindsets and other disincentives

In her presentation on diversity and learning, **Sylvia Hurtado** of the University of California, Los Angeles provided some insight into the common mindset that impedes progress in advancing the status of URM. Examples of this mindset include the following

- **The zero sum game**. Diversity and excellence are competing concepts; one has to forgo one in order to attain the other.
- **Survival of the fittest**. Our courses have to differentiate between those who have the talent for science and those who do not.
- **Diversity is not my responsibility**. I teach science, what does diversity have to do with my work?

Hurtado pointed out that these mindsets are not the only way to think about diversity. She described a line of research illustrating the value of diversity to learning that dates to Piaget. In short, it is well documented that encountering the new and unfamiliar causes us to abandon routines and think actively. The disequilibrium that occurs when one encounters perspectives that depart from one's own embedded worldview encourages learning and social development. Moreover, Hurtado pointed out that: "Economists estimate achieving equality in URM degree holders will generate at least $80 billion in new tax revenues, and attract employers seeking high skilled workers [17].

She suggests replacing the "survival of the fittest" mentality, which projects the view of "science [as a] sieve" which must sort out the strong from the weak students, with a view to develop rather than harvest the talent in all students. She described some results from a large scale study of undergraduates in science (5,049 students at 160 institutions) that sought to understand the factors that influenced students' choices to participate in health related scientific research. The data show that the interest and aspirations of URM in science is high relative to those of White and Asian students. It is not surprising that surveys show that interpersonal interactions, such as receiving advice from upper-division students and interacting with faculty more often, increased the students' odds of participation in research. In fact, analyses of the survey results of a sub-sample of Black students revealed that social self-concept, participation in a learning community, and positive interactions across racial and ethnic lines were key.

During the discussion following Hurtado's presentation it became clear that "faculty attitude" is a very important factor limiting the effectiveness of programs designed to recruit underrepresented groups to science in general and chemistry in particular. A number of Chairs noted that such activities are not valued as determining factors for tenure and promotion. On the contrary, faculty who engage in them may even be considered "not to be interested in chemistry." Similarly, "a great teacher" is not valued for tenure and promotion, these services may be appreciated but are not rewarded.

Hector Abruña of Cornell University suggested that in addition to bias there are other factors that contribute to the low numbers of URM in academia. In response to a question he posed, "Why are the top 50 ranked universities in chemistry unable to hire female and URM doctorates they have produced?" he answered

with another rhetorical question, "Why should they (URM) take or even be interested in such jobs?" He described several factors that can make positions in other sectors of the chemical enterprise more attractive than those in academia. Many young underrepresented scientists perceive a stark contrast in the effort expended in recruiting by and benefits available in industry that undermines the wisdom of choosing a career in academia. This is a problem that impacts the recruitment to academia of students of all backgrounds, but here as in other areas of education, underrepresented students may be the canaries in the mine, i.e., more adversely affected by structural issues that affect all students negatively. This reminds us that one of the factors contributing to lowered interest in academic careers in chemistry by all students may be related to academic chemists not using every opportunity to convey the deep satisfaction many find in scientific and pedagogical achievements.

In short, it is clear that flawed hypotheses and biased observations have undermined our efforts to craft solutions which address the under representation of minority chemists in academia. While there is still a great need for more research into this phenomenon, the work described by the workshop participants shows that more refined observations on which to base judgments have been made. These observations reveal the fact that implicit, unintentional bias has an impact on the evaluation of applicants, the productivity of working relationships and the climate of the academic environment that can be surprising because these biases often operate beyond conscious thought. This suggests that effective solutions to the problem of under representation will give chemists tools to support their efforts to train, mentor and evaluate members of underrepresented groups that provide them with the means to check their assessments and balance their automatic responses. The deeper issue of changing the unwitting aversion many chemists of all races feel in encounters with members of other groups is a challenge we must each embrace as individuals. Let us hope that we will find encouragement and support for this within our departments, institutions and communities.

CHAPTER 3: Positive actions

As noted in the Introduction to this report, the purpose of the workshop was not just to discuss the causes and examples of the under representation of URM in academia, but also to suggest courses of action to remedy the situation. Hence, throughout the workshop, in presentations, panel discussions and breakout sessions, numerous ideas and strategies were offered for more effective positive approaches to the problem that could be addressed by the Chairs of chemistry departments and that could also be adopted broadly by the chemistry community. In some individual cases these positive approaches are already being implemented, in others they are being planned or are being contemplated, while in many cases they are recommended actions. All these actions, whether being practiced or anticipated, can be categorized into the following broad areas:

- Recognition of the existence and effects of **implicit bias**
- An appropriate working **climate**
- Strategies for effective **recruiting** and **retention**
- **Mentoring** and **empowerment**
- **Diversity** as a planned event through courses of actions accessible to the Chairs of chemistry departments

This chapter will summarize the key suggestions for positive actions from the perspectives of various speakers.

A. Challenges and opportunities for interventions (Nicholas Turro)

Turro provided a series of very specific challenges and opportunities for interventions by Federal agencies, university administrations, university departments, and even individuals. A number of these suggestions were echoed by several others during the workshop, but Turro's list is quite inclusive, so it will be presented here

- Challenges and opportunities for Federal agency diversity interventions
  - Agencies provide carrots and sticks for encouraging URM to proceed from BA to Ph.D. to Postdoc to Faculty,
  - Agencies require an active diversity plan for proposals from departments,

- Agencies provide supplemental funding to support diversity plans of departments,
- Agencies provide PIs to encourage diversity in review criteria, proposals, reporting requirements,
- Agencies provide supplements to grants to individual PIs for diversity graduate students and postdocs

- Interventions by University administrations: diversity plans
- University provides departments with resources for targeting opportunities to hire diversity faculty candidates,
- University provides assistance to departments on effective recruitment of diversity faculty candidates,
- University provides assistance to departments on effective retention of diversity faculty that are hired,
- Universities provide support for the concept that everything that is good for the faculty in general can come from diversity initiatives,
- Universities strongly couple the ideas of excellence and diversity as desirable objectives that enhance each other.

- Interventions by Departments: searching, hiring and retaining junior faculty
- Provide the faculty with data and evidence that enhanced diversity can, in fact, come hand-in-hand with enhanced excellence,
- Develop an environment in which merit and excellence, the universally accepted standards for hiring the majority faculty, remains the primary criteria for diversity hiring,
- Enhance the knowledge of the insidious impact of implicit bias on the recruiting, hiring and retention of faculty, i.e., train review, search, hiring and tenure committees to practice processes that will rid them of cognitive errors that result from implicit bias,
- Create and build networks that identify excellent diversity candidates and that are analogous to current networks that identify excellent majority candidates,
- Recruit respected faculty members who will be advocates for diversity,
- Enhance awareness of issues that lead to obstacles to success that may be specific to URM,
- Read JoAnn Moody's book "Faculty Diversity: Problems and Solutions" [18]

- Interventions by individuals: mentoring
- There is an absolutely critical need for effective mentoring of junior faculty,
- Effective mentors persistently bolster the confidence of their mentees,
- Mentors provide continuous support focused on career advancement of the mentee,
- Mentors insist on regularly-scheduled meetings with mentee with an emphasis on continuous quality improvement of the mentee,
- Mentors teach mentees how to self promote,
- Mentors teach mentees the unspoken rules of career advancement,
- Mentors demystify the tenure system by explaining how it works,
- Mentors do not allow the social isolation of mentees in the professional environment.

Turro noted that mentoring is rising in visibility and importance, as evidenced by the new law ("America Competes" Act) that will mandate mentoring in periodic reports required of PIs. The following box applies to the application of the law to NSF.

Federal Intervention: America COMPETES Act:

SEC. 7008. POSTDOCTORAL RESEARCH FELLOWS.

(a) Mentoring- The Director shall require that all grant applications that include funding to support postdoctoral researchers include a description of the mentoring activities that will be provided for such individuals, and shall ensure that this part of the application is evaluated under the Foundation's broader impacts merit review criterion. Mentoring activities may include career counseling, training in preparing grant applications, guidance on ways to improve teaching skills, and training in research ethics.

(b) Reports- The Director shall require that annual reports and the final report for research grants that include funding to support postdoctoral researchers include a description of the mentoring activities provided to such researchers.

As a possible "5 year plan" Turro suggested the following goal: each chemistry department should design a plan to add one or more URM faculty by 2012. This would amount to one URM for each department in the workshop. If achieved, the URM representation in Chemistry would be doubled!

Panel members James Mitchell, Mark Wightman, Daniel Romo, Steve Mayo and Erik Sorensen discuss "positive actions" to address the URM problem.

B. Examples of diversity interventions outside academia

Thomas Cech provided some information on successful diversity programs at HHMI, a non-profit medical research organization. He noted that the HHMI approach is to focus on the early career stage of URM, particularly undergraduates, since they feel they can make a real difference at that point. He gave examples of the programs supported by HHMI, including Georgetown's Institute for College Preparation and the "SOARING" program at Xavier University of Louisiana. Paraphrasing Freeman A. Hrabowski III, Cech stated that the number of minority students going through the programs is not important unless the number that eventually wind up in the professoriate is increased, that is the achievement that will be influential to the next generation. In response to the latter point, HHMI started the Exceptional Research Opportunities Program (EXROP), which draws students from underrepresented or disadvantaged groups and provides them with a highly mentored summer research experience in an HHMI lab. The program involves mentoring with peers, HHMI staff, and role models. This is followed up by annual meetings at the Chevy Chase, MD, headquarters of HHMI in order to sustain the students' vibrant interest in science.

HHMI also has three programs aimed at (a) research universities, (b) colleges, and (c) professors. They also have a one million dollar program to support distinguished research faculty, distinguished not for their research but rather for their ability and passion in personalizing and energizing undergraduates. Isiah Warner and Rebecca Richards-Kortum are two examples of such distinguished research faculty. Mentoring is strongly emphasized in HHMI programs.

The EXROP program has successfully graduated 28 students, with 120 more in the pipeline. Of these, 50% are in Ph.D.., Masters/Ph.D.. or M.D. /Ph.D.. programs, 25% are in medical school, and 20% are working in research-related jobs. The racial/ethnic composition of the EXROP students is as follows: 37% African-American, 28% Hispanic, 12% Caucasian, 8% Asian, 1% Native American, 13% Other/Multi-ethnic.

As lessons to draw from the HHMI experience, Cech offered the following.

- Mentoring: Mentor undergraduates, graduates, and post-graduates. Mentoring must not stop at the post-graduate level if you want to change the professoriate. One must go beyond this, in fact, until students get their first academic position.
- Mentor faculty, too, since they have little experience in recruiting and retaining URM students.
- Set graduate school as a goal.
- Set high standards and demand excellence.

Frank Dobbin from Harvard University discussed the results of a research study on the effects of corporate diversity training programs. "For the past 40 years companies have tried to increase diversity, spending millions of dollars a year on any number of programs without actually stopping to determine whether or not their efforts have been worth it," Dobbin said. This study was the first to examine the efficacy of diversity programs based on the actual change in minority representation in management positions. Dobbin and his colleagues examined reports submitted to the Equal Employment Opportunity Commission by private sector establishments and surveyed a sample of these establishments on the history of diversity programs within the company. The programs were categorized into three groups: organizational responsibility programs such as task forces or staff positions; managerial bias programs such as diversity training; and programs that create networking or mentoring opportunities for women and minorities. The researchers then evaluated these programs based on the change in proportional representation of black and white women and men in managerial positions.

The results indicated that the programs operate with different degrees of efficacy based on the demographic groups, but organizational responsibility programs proved the most effective. Diversity training programs failed to eliminate bias and increase the number of minorities in management. In fact, diversity training aimed at reducing managerial bias may actually increase it as such programs were followed by a 6 percent decline in the proportion of black women in management while white women benefited modestly with a 6 percent increase. Programs aimed at reducing social isolation showed limited success. Social networking improved representation of white women, but lowered that of black men. Mentoring programs showed a strong positive effect for black women.

James Mitchell, retired Vice President of Research at Lucent Bell Laboratories, Murray Hill, NJ, and currently a professor at Howard University, described the diversity program at Bell Laboratories. His major point was that diversity and excellence can co-exist in an organization, but that one must plan and work to accomplish this. Or, as he put it, "Diverse representation within an excellent scientific organization is a planned event; equitable representation of minorities on a physical science/engineering staff is not obtained spontaneously, it must be induced and is feasible to attain." He noted that although Bell Laboratories was an elite organization, the research culture envisioned itself as being intellectually color blind. The point being that elitism is a credible status to be sought by science and technology institutions as long as the policies, processes, and procedures that are used to pursue it do not implicitly involve racism or lead to exclusion. An important and necessary condition for URM progress within institutions/organizations is the establishment by an executive leader with authority and credibility of the principle that that real progress in URM participation is a major personal goal and the management expectation for the organization. Bell Labs enhanced the knowledge and awareness of racial bias of the supervisory staff and research management by requiring participation in Urban Minorities Workshops. The Chemistry Division of the Bell Laboratories Research Area spearheaded the formulation and execution of the plans to become a URM inclusive organization while remaining scientifically elite. Other research divisions collaborated to make this venture one of the best success stories for inclusion of African-Americans within a corporate research organization. He noted that chemistry departments can lead the example of this transformation within university science and technology departments.

James Mitchell emphasized that "diversity and excellence can co-exist in an organization."

Catherine M. Millett, from Educational Testing Service, provided an overview of "Interventions that Encourage Underrepresented Minorities to Pursue Research Careers." After reviewing some of the statistics showing the relatively few Ph.D.s awarded to Black and Hispanic-American citizens, she discussed the "talent loss" of these URM due to "leaks" and "shifts" in the system. She noted the need to revitalize efforts to attract more domestic students to consider chemistry and other science and engineering fields. Among the opportunities to consider and pursue, she specified:

1. identifying new ways to grow the graduate school talent pool
2. providing access to graduate school
3. structuring graduate school opportunities for students to learn about research careers

C. Countering "mindsets" and implicit bias

A number of speakers emphasized the need to counter the inherent obstructions to the advancement of URM caused by discriminatory "mindsets" and unintentional and implicit bias. We provide here a sampling of these comments.

Daniel Solorzano noted that we can begin by having a proactive discussion of race, racism, and our professions in our colleges and in our departments. This discussion should lead to programmatic initiatives to enhance the campus racial climate and racial diversity at all levels of our institution.

Sylvia Hurtado stressed the need "...to develop, rather than simply harvest talent" and to get rid of the "survival of the fittest mentality" expressed by some faculty. Diversity is an asset because it empowers greater excellence in environments in which it has been previously excluded or ignored. Among the ideas that must be instilled in all concerned, especially the faculty, is that inequality is the threat to excellence, not diversity. Or, as repeatedly stated by James Mitchell, "Diversity and excellence can coexist in an organization." Hurtado also quantified the economic gains of being inclusive by noting that "Economists estimate achieving equality in URM degree holders will generate at least $80 billion in new tax revenues, and attract employers seeking high skilled workers" [19, 20].

John Dovidio noted that, among other things, we must be color conscious (pretending that we are color blind merely perpetuates the problem), we must provide strong and meaningful mentoring and we must also be accountable. In response to a question from the audience, "Do we advertise for the "best chemist" or for a female/minority chemist?", Dovidio noted that, "If diversity is a goal of the department, then "best" may not necessarily be the best academically qualified chemist, but rather someone who will be most effective in enhancing the department's goals. The best way to increase URM enrollment, etc., is to have URM as professors."

For **Anne MachLachlan** an effective way to begin to counter the ingrained bias and injustice in our system is to actuate the following *potential* contributions of this workshop

- Making racism a legitimate area of discussion.
- Identifying how white bias and sense of privilege affect URM chemists.
- Identifying how biases arise, and how they can be overcome.
- Taking information to home institutions and acting on it.

William Guillory emphasized the need to bring about a shift in our mind-set by acknowledging that we view the world through our unique version of reality, which is colored by biases and prejudices. He noted that it takes leadership to influence the thinking, commitment, and behaviors of others and ourselves. He specified

measurable activities of an inclusive academic culture. This includes actively recruiting and providing uniquely appropriate support of a multicultural administration, staff, faculty, and students. Such an academic culture ensures that women and URM play influential roles in the establishment of policy, strategic direction and administration of practices and procedures that ensure equity of opportunity. Further, it ensures practices and procedures which support the development and retention of all faculty, staff, and students—recognizing the unique needs of women and URM. Also, an academic culture should be established that continually and systematically monitors itself and updates new progressive practices and procedures for ensuring diversity and inclusion by measurement, and ensures equitable standards of both internal and external evaluation of students, staff, and faculty.

William Guillory emphasized the need to bring about a shift in our mind-set by acknowledging that we view the world through our unique version of reality, which is colored by biases and prejudices.

D. Climate, recruiting and retention: personal experiences relevant to URM

Most of the presentations and discussions surrounding Panel II were a change in approach from the other presentations, as they were meant to convey relevant personal experiences rather than research experience.

Mark Wightman from the University of North Carolina at Chapel Hill (UNC) discussed the programs implemented at UNC to enhance the recruitment, retention and career development of the faculty and doctoral students. It was clear from his description that UNC has a long-term comprehensive plan of positive actions with specific programs to ensure diversity to effect change for URM. He also noted that having African-American faculty members, who provide important role models for students, has helped maintain a reasonable level of URM students over the years.

Daniel Romo from Texas A&M University discussed the importance of exposure, identification and connections in his own path to the professoriate. He emphasized the significant role played by mentoring in steering him in the right direction for his graduate studies. As an Assistant Professor he returned to his high school in San Antonio and gave lectures, which, he noted, "opened the eyes" of people like him and provided a role model. He firmly believes that diversity needs to be implemented at the departmental level.

Steve Mayo of Caltech, a current member of the National Academy of Sciences, gave a brief history of his academic career to point out the difficulties that can accompany African-Americans pursuing an academic career. In spite of his outstanding credentials, he seems to have been a victim of gross injustice, which he was reluctant to concede might be racism. As the first tenured African-American at Caltech he was fully aware that he was "unusual" on this campus since Caltech had no history of diversity. However, he always thought that scientists were objective and that if he did great science that was all that would count. But he discovered that "…there's more to objectivity than meets the eye, literally." Being frequently told that he was "the only black professor on campus," he was very concerned about getting good students to join his lab. In fact, his first 6 students were racial minorities or foreigners. He stressed the importance of being on the Graduate Admissions Committee in allowing the faculty to see/pick incoming students

In the reply to a question from the audience, Mayo noted that there has been some confusion as to how to handle the question of inadequate graduate student URM: there is a need to focus on the "best" students, but do we look for excellent graduate students among URM who are just like the others, or do we bring in potentially

excellent URM students and focus on education to bring them up to the desired level? The confusion as how to do that at Caltech led to undesirable outcomes, namely few URM graduates.

Eric Sorensen of Princeton University stressed the value of having the faculty visit schools to tell students about the excitement of chemistry as well as the opportunities of a career in chemistry. He also noted the importance of reserving full time equivalents to enhance the incorporation of URM faculty.

During the discussion period, some of the points made by the preceding speakers were reinforced and amplified. Anne MacLachlan noted in connection with the talk by Steve Mayo, that part of the problem we face is the reluctance by some to admit to the existence of racism and its possible impact on a person's career. In particular, she observed that denying the existence of racism while maintaining that scientists are objective,
despite substantial evidence to the contrary, are two powerful contributors to the current poor situation of URM scientists in higher education."

William Jackson, of the University of California, Irvine, pointing to the examples of Romo and Mayo, stressed the importance of mentoring, especially advising students on whom they should work with to enhance the chances of success.

Jim Mitchell, Howard University, emphasized the need for successful majority professors to "…examine the template that made them successful and modify and use it for their high-potential URM graduate students and postdocs." This will lead to a recognizable and impressive pool of individuals to whom we can look to change the landscape of chemistry departments in the country. He noted that the corporate world has been successful over the last four decades in advancing the roles of female and URM, but academic institutions have an advantage in this regard since in the corporate world an economic downturn in any given year can cause downsizing, reorganization, and sell-offs that in a few years can reverse the gains that had been made. The latter is not the case in universities, where the tenure process can ensure successful longevity of URM faculty gains.

Victor McCrary of Johns Hopkins University and Kathy Covert, NSF, exchange greeting.

E. Mentoring and empowerment

The presentations and subsequent discussions of Panel III were focused on examples of positive actions involving mentoring and empowerment in the academic environment.

Hector Abruña noted that Cornell University has had a commitment to diversity from its very beginning. He suggested that it is necessary to have clearly stipulated goals in terms of research productivity and research funding expectations. He stated further that one must decouple, at least to some extent, student support from grants, the importance and value of a quality undergraduate education must be emphasized (not just given lip service), good teaching must be truly rewarded, the importance of well trained graduate students must be emphasized, institutions who actively (not passively) recruit, hire and retain women and URM must be supported with funding, (for example by providing a portion of the start-up funds). But**,** programs with funds "earmarked" for women and URM should be avoided, because whether one is successful or not in obtaining the funds, the reaction from others is usually negative. Finally, he suggested that NSF, DOE and NIH can play an important role in promoting and facilitating diversity at all levels in our university-based education system by leveraging action through the research support it provides. As a concluding remark he expressed the hope that the participants of the workshop will develop the political will to institute changes. Otherwise, not much will change and we will be

here, yet again, wondering why there are so few URM in faculty positions.

Christine Ortiz from MIT explained the rather extensive program at MIT to mentor and empower URM Junior Faculty. Beginning with a general orientation and teaching orientation, MIT conducts a separate "New Faculty Teaching Orientation" workshop designed to help faculty think strategically about teaching, learn more about active learning and interactive teaching, and talk with other faculty about teaching at MIT. Diversity is emphasized in the workshop. Also, departmental programs exist to enhance collegiality, creating a supportive environment and reduction of bias. Also a "Faculty of Color Dinners" sponsored by the Chancellor held once a month permits open discussion of relevant issues and enhances community building and mentoring. In addition, the senior URM faculty lunches with junior URM faculty. Other programs include an institute-level initiative on race and diversity to study how race affects the recruitment, retention, professional opportunities and collegial experiences of URM faculty members at MIT. Further, the Office of Associate Provost for Faculty Equity is concerned with providing a strengthened, central MIT focus for matters related to faculty diversity and equity and representing faculty diversity and gender issues across the Institute, including the recruitment, retention, promotion and career development of minority and women faculty. As metrics for success, Ortiz cited:

- positive change within the community in terms of commitment to minority faculty advancement
- continuous improvement in processes and practices that support minority faculty advancement
- more minority full professors
- more minority faculty leaders in research, teaching and professional service

Steven Watkins from the Louisiana State University (LSU) discussed some of the historical background of LSU. He noted that the State of Louisiana has a sizable African-American population, particularly in Baton Rouge, yet LSU was segregated for over 100 years. In spite of its history, or perhaps because of it, LSU has very effective programs for recruiting and retaining minority students. The factors that have led to success in chemistry at LSU include mentoring and support, the proximity of HBCUs, critical mass, administrative and faculty buy-in, self-sustained recruiting, and employability. Among the programs implemented at LSU are: the Louisiana Alliance for Minority Participation (LAMP), the Graduate Alliance for Education in Louisiana, the Ronald E. McNair Research Scholars Program, and the MBRS IMSD Program. LSU's chemistry department produces more African-American Ph.D.s in chemistry than any other graduate school in the country, and Isiah Warner's research group is currently one of the largest in the department.

Joseph Francisco from Purdue University provided a report from the student's perspective on what Purdue and the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) are doing to mentor and empower their URM students. He reviewed some statistics on the numbers of URM obtaining degrees, comparing the numbers at Purdue with the national trends. During the period 2000-2004 Purdue ranked second in the number of minority chemistry Ph.D.s (20), just behind LSU (25) and ahead of Howard University (16). He noted that the Purdue NOBCChE Student Chapter is quite important as it provides a community for the student that is friendly, supportive and welcoming, and has an explicit common purpose of *learning and working* together. He provided many examples of the accomplishments of students working together. His closing remarks emphasized the role of mentoring, by noting that, "I believe that we as educators hold in our hand the opportunity to form or deform the student as a professional chemist, their sense of self and their relation to the world."

F. Incentives and accountability: Federal agency viewpoints

The Federal perspective was represented by Jeremy Berg, Director of the National Institute of General Medical Sciences of the National Institutes of Health (NIGMS/NIH), Luis Echegoyen, Director of the Division of Chemistry within the Mathematics and Physical Sciences Directorate at the National Science Foundation (MPS/NSF), and Eric Rohlfing, Director of the Chemical Sciences, Geosciences, and Biosciences Division within the Office of

Basic Energy Sciences, Office of Science, Department of Energy (BES/SC/DOE).

Jeremy Berg noted the positive efforts of the Minority Opportunities in Research (MORE) program in developing a representative diverse workforce, but emphasized that workforce development is a key mission of all of NIGMS. He also emphasized his view that mentoring, as it currently exists, is "haphazard," and that we need to find out how we can instill mentoring as a community-wide value rather than something that takes place on an *ad hoc* basis.

In connection with mentoring, several in the audience emphasized the fact that, contrary to what many seem to believe, mentoring is not an "in-born" talent, but instead one that needs to be taught. Because of the preceding misconception, there are few programs in the universities to teach strategies for mentoring and there is often faculty resentment that they have to be taught. Nevertheless, the faculty tends to be more efficient and spend less time on this once they learn how to mentor.

Eric Rohlfing conceded that DOE does not have many programs directed to the development of URM students, postdocs, and faculty at universities. However, DOE's Office of Science does provide seed funding for extensive programs in DOE laboratories and many of the programs partner with NSF and other agencies to reach out to the community, to community colleges, to provide summer experiences, etc., and some of these programs are targeted at URM. This and similar workshops have raised his consciousness to work, along with NSF, to eliminate bias in the peer-review process, and to try for diverse representation on peer-review panels. He noted that embedded in the contracts of the DOE labs are diversity plans, and the labs are held accountable for their progress on these plans. Similar arrangements do not exist with the universities. Energy concerns will be an increasing challenge in the future, both the science and national policy aspects, and we will need qualified scientists and engineers to handle these issues. The preceding will be a compelling motivation for the next generation of scientists, and we will include URM to help us address global energy challenges.

Luis Echegoyen indicated the ways NSF is attempting to broaden URM participation in chemistry. Among these are greater community involvement, including relevant workshops, and embedding "broadening participation" into business. An example is the Directorate for Engineering BRIGE program (Broadening Participation Research Initiation Grants in Engineering), a research initiation grant funding opportunity, the goal of which is broadening participation of all engineers, including members from groups underrepresented in the engineering disciplines.

Luis Echegoyen and Khaleelah Po Rome of NSF.

G. Elements of a successful diversity plan

Larry Dalton, University of Washington, noted that the elements of a successful diversity plan include:

- motivation and coordination
- climate and culture
- mentoring/empowerment
- recruitment/retention
- starting assessment/accountability/independent evaluation

He also commented on the role of Department Diversity Plans complementing University Diversity Plans and promoting buy-in of faculty, students, and staff. Department Diversity Plans also facilitate coordination of the activities of these groups with those of the university administrations.

Tim Swager, MIT, emphasized selling a diversity plan to the faculty by showing them that they have an enlightened self-interest in diversity. Specifically, it brings immediate

money and political power to their department in addition to being the right thing to do for the long-term betterment of the Department. In institutions with historically low promotion rates (<50%) it is important to have extra incentives, including additional positions, because faculty will be afraid that they will not be able to deny tenure in a close case when it is a URM faculty. Positions are often like golden eggs that departments treasure, so this is a large incentive. Getting faculty to realize that the environment is a problem is critical; denying that there is a problem is a non-starter and admitting a problem exists is critical. Swager believes that admitting his own implicit bias is a good way to break the ice. Faculty need to realize that they are not bad people for having bias, but they need to actively combat it.

Thom Orlando indicated that the complete "buy-in" from the faculty and administration is necessary for any positive change. Once this is accomplished, major advances in addressing URM issues can and will ensue. In general, an "action" plan is the most important element. With the appropriate feedback and input from the faculty and administration, action plans beget short and long-range diversity plans. The successful implementation also has a great deal with the social and professional environment within a unit. This is something that makes a huge difference with regard to the overall quality of programs, etc. but generally this does not show-up in assessments and ratings.

Members of the Successful Diversity Plan Panel, Larry Dalton, Thomas Orlando, Patrick Limbach and Timothy Swager exchange views with the audience.

H. Synthesis of the breakout session recommendations

Three breakout sessions were distributed throughout the duration of workshop, each of which focused on one main question. Each session was divided into six groups, A through F, which discussed particular aspects of the main question. Further details of the breakout sessions, including those assigned to each group, are provided in the Appendices. The main topic of discussion for each session focused on the following questions:

Breakout Session I
What new strategies can chemistry departments adopt to lower the barriers URM face as graduate students, post docs, and faculty?

Breakout Session II
How can chemistry departments best support the development of a diverse and well-trained scientific workforce which includes URM faculty?

Breakout Session III
How can chemistry departments and federal funding agencies most effectively support URM at all levels?

After each breakout session, a spokesperson for the group provided a summary of the recommendations and consensus achieved in each category. The following is a synthesis of the results:

General

- Make diversity a departmental core value.
- Have a consultant evaluate the current status of diversity in your department and develop a plan to increase diversity.
- Have a consultant audit the progress of the department on the goals in education, recruitment and environment.
- Develop a way to share successful strategies and discuss solutions to problems.
- Have an individual with status in the department spearhead advocacy for and lead the implementation of action items decided upon by the department.

Education

- Educate the department on "enlightened self interest;" discuss why a diverse department is a necessity.
- Educate the faculty, staff and graduate students on implicit bias, mentoring URM students, and developing an environment for retention of URM.
- Educate the members of every search committee on implicit bias and the need to have a commitment to diversity.
- Have a training session on implicit bias for everyone performing an evaluation in the department before each evaluation.
- Invite URM speakers.

Recruitment and Retention

- Have an open search to broaden the candidate pool.
- Pay attention to the composition of search committees and use the composition to increase the likelihood of success in hiring a URM candidate.
- Have an outside consultant on *ad hoc* committees with a charge to consider and inform on diversity issues.
- Recruit URM undergraduate students from schools which are already feeder schools for your graduate program.
- Grow your own faculty from among excellent URM graduate students. Encourage your URM graduate students to become faculty. Make sure you convey the benefits of an academic lifestyle.
- Use Alums in industry in the search for candidates and consider URM in industry as candidates.
- Have pre-recruiting seminars by URM postdocs and/or graduate students to begin a relationship with possible faculty candidates.
- Send faculty to NOBBChE, SACNAS, AISES, etc. meetings to meet and recruit graduate students and future faculty.
- Be sure to connect with graduate students in fellowship programs such as NIH, NSF, Ford, Miller, IBM, etc., when looking for faculty candidates. Develop a relationship early with those who look interesting for your program.
- Get the knowledge necessary to succeed in recruiting and retaining URM faculty and graduate students. Possible sources of information: Read JoAnn Moody's book on Faculty Diversity or her booklets on Cognitive Errors or Improving Retention and Reducing Stress.
- Require written evaluations by the recruitment committee for accountability
- Hire one URM FTE in 5 years or less.

Environment

- Educate the faculty on mentoring URM and make the mentoring accountable and valued.
- Keep URM faculty from being swamped with committee loads and mentoring responsibilities.
- Give junior faculty the support and advice to succeed in the tenure process
- Make URM students and faculty a part of department life
- Find out how to create an accommodating culture and institute the necessary changes.
- Organize monthly Faculty of Color dinners as a support mechanism with administration-initiated, cross-departmental efforts.

CHAPTER 4: Defining measures of success: action items resulting from the workshop

The top chemistry departments recognize that they have a unique responsibility to produce future faculty, including URM in proportion to the size of their talent pools, for departments across the nation and across the range of institutional types. The top departments must establish a climate that fosters the development of the talents of all graduate students, postdocs and faculty members, including URM. Chairs agree to consider diversity initiatives as a means of increasing excellence without borders; that embracing diversity through continuous review and monitoring of recruiting, retention and mentoring practices is an effective means for continuous improvement, and an investment in furthering excellence in the department.

The following recommended action items were generated by participants in the workshop. While the main focus is on departments, there are important roles for funding agencies and the ACS. The following lists are suggestions of actions that university chemistry departments, funding agencies and the ACS may take.

A. Recommended actions by departments and department chairs

It is the goal that departments will achieve greater diversity in faculty, postdocs and graduate students. The work of the chair and department faculty should result in:

- appointment of at least one additional URM faculty member in the next five year period.
- appointment of at least one additional URM postdoc each year over the next five years
- the recruitment and enrollment of at least one additional URM graduate student, and the graduation of at least one URM Ph.D. candidate each year over the next five years.

Strategies.

Under each major item 1 through 4 below, department chairs and departments are requested to select and work on up to three of the lettered subcategories to achieve the goal of greater diversity.

(1) Respected faculty member(s) should be appointed by the department chair to diversity management and/or a diversity task force to oversee improvements in department environment, policy and practice with respect to URM faculty recruitment and retention.

a. The manager/task force will report to the faculty regularly on departmental progress
b. The manager/task force will organize the faculty in the development of a robust diversity plan and share it with the broader community by putting it on the web
c. The manager/task force will have a consultant evaluate the current status of diversity in our department and develop a plan to increase diversity.
d. The manager/task force will have a consultant audit the progress of the department on its goals in diversity education, recruitment and environment.
e. The manager/task force will work with the faculty to make excellence with diversity a departmental core value.

(2) The department chair should work with department faculty to build consensus on creating an inclusive departmental climate that values the contributions of all, including URM faculty members, postdocs and graduate students.

a. The department will initiate a tradition of inviting at least one excellent URM academic or industrial scientist to present a research seminar in the department each term.
b. The department will develop a mentoring program for all junior faculty members that reflects the department's commitment to excellence through consistent self review. The new mentoring program will include an evaluation component that allows for junior faculty feedback
c. The department will develop a mentoring plan for all graduate students and postdocs. The department will provide information and training to faculty members on the issues that arise in mentoring URM and women students.
d. The department will ensure that mentoring is a valued activity and that those entrusted with it are held accountable.

(3) The department chair should work with department faculty to develop networks for the targeted recruiting of URM candidates for faculty positions, postdocs, and graduate students.

a. The department will conduct open searches for faculty positions to broaden the candidate pool.
b. The department will use alumni and other contacts in industry in the search for faculty candidates and consider URM in industry as candidates.
c. The department will host pre-recruiting seminars by URM postdocs and/or graduate students to begin a relationship with potential faculty candidates.
d. The department chair will encourage faculty colleagues to appoint talented URM as postdocs
e. The department will continue recruiting URM students for its graduate program(s) from schools that are already feeder schools and establish new bridges with other URM-serving colleges and universities.
f. The department will include its own URM graduate students and postdocs in these networks

(4) The department chair should facilitate, in collaboration with the university administration, implicit bias training for departmental graduate student admissions committees, faculty recruitment committees, and faculty retention tenure and promotion committees.

a. In addition to access to training, the chair will make information about implicit bias, such as JoAnn Moody's book *Faculty Diversity: Problems and Solutions*, available to members of the department faculty, especially those on evaluation committees.
b. The chair will host a speaker on implicit bias
c. The chair will pay attention to the composition of graduate admissions committees, faculty recruitment committees and faculty retention tenure and promotion committees to increase the likelihood of success in hiring and retaining URM candidates.

B. Suggested actions by funding agencies

(1) Funding Agencies should adopt a broader impacts requirement for all grant programs. In describing the broader impacts requirement, agencies will emphasize the importance of the research training of minority students and postdocs as well as their transition to and career development in academia, national labs or industry.
(2) Funding Agencies should require an institutional/departmental diversity plan from universities applying for institutional awards for research, training, or instrumentation.
(3) Funding Agencies should provide implicit bias training to their grant review panels, study sections, scientific review administrators, program administrators, and all others involved in the process of reviewing grants and making awards.
(4) Funding Agencies should facilitate contact between their undergraduate/masters-level grantees that train URM and their grantees at major Ph.D.-granting research universities.
(5) Funding Agencies should facilitate, through fellowships and other mechanisms, the entry of talented URM graduate students into postdoctoral appointments at major research universities that have a record of placing their alumni in faculty positions.
(6) Funding Agencies should institute training workshops for junior faculty in grant writing and grant reviewing.
(7) Funding agencies should continue to enhance their efforts to make excellence with diversity one of their core values.

C. Recommended actions by the ACS

(1) C&E News should publish annual data on URM graduate students, postdocs and faculty members in the top 100 chemistry departments.
(2) The ACS should continue to enhance its efforts to make excellence with

diversity a Society core value. This will be demonstrated in the Society's operations and its programs.

CHAPTER 5: Summary of key "take home" messages.

The extensive material covered in the workshop may be summarized by a few "take home" indispensable messages:

- Implicit bias is a subtle factor pervading all our interactions and undermining the progress of URM candidates at all levels of the pipeline.
- The statistics on URM are unacceptable yet have changed very little in over a decade. The old strategies and tactics are largely inadequate or have failed to be implemented and some new ones are needed. A conclusion from the workshop is that the historical lack of progress was not a failure of strategies and tactics but a failure of institutional/organizational *commitment* to change the culture, processes and practices.
- Mentoring of URM students, postdocs and faculty has not been effective and needs the attention of research sponsors and department heads.
- A network for identifying excellent URM students, postdocs and faculty does not exist and needs to be established so the departments will have a means of identifying excellent candidates in an organized and systematic fashion.
- The academic climate for URM has been largely unsupportive, indifferent or hostile. A nurturing and supportive environment for URM needs to be established in chemistry departments to encourage students and postdocs to consider academic positions and promote the hiring and retention of URM faculty.
- The community needs to commit to diversity as a core value and academic imperative that is in the self interest of the chemistry community. "Diversity and excellence can coexist in an organization."
- Departments need to commit to some of the Action Items from the workshop, and to be aware that this is a "work in progress."

CHAPTER 6: Conclusions

We have often heard the statement that one of the things that makes the United States a great country is that we are a "melting pot." This appellation may be accurate in many areas, but in others it may be more accurate to say that becoming a melting pot is an aspiration, a dream, but one that is not yet fully realized and will probably always be a work in progress. Indeed, it would appear that there are some conspicuous lumps in the melting pot! The role of URM in the world of academia, particularly at the professorial level, is a case in point in which our achievements have fallen far short of what would be the expected and acceptable goals based on national aspirations.

To bring about a long-term, sustainable and lasting change in the fundamental attitudes and ways of doing business, it is essential to "disrupt the equilibrium" in the status quo. There is no doubt that disrupting the equilibrium is not an easy task since, generally, people and organizations place a great deal of importance on stability and equilibrium, sometimes to their own detriment. Academia is no exception, indeed, it may be more guilty than most in this regard! Sputnik I is an example of a profound unexpected and sudden disruption in the equilibrium, some of the results of which have already been noted. For the present generation, "global competitiveness" is the new wakeup call which the U.S. must heed if we are to retain our place as the global leader. But we cannot wait for the state of U.S. global competitiveness or the need for energy self-sufficiency to reach a catastrophic stage before the appropriate counter measures are taken to augment the U.S. science and engineering workforce required to address these needs. This workshop has made it very clear that one of the fundamental requirements to meet this challenge is the removal of the barriers to URM—this lies at the core of our future competitiveness.

The presentations, discussions, and sometimes passionate pleas that transpired during the workshop provided clear indications that most of those in attendance understand, perhaps better

than before, that the problem of the inequity in the status of URM in academia is very real and pressing. Moreover, the reactions and comments of many suggest that there was a real sense of awakening to the hitherto poorly understood obstacles to diversity implementation provided by implicit bias. While the preceding enlightenment is to be welcomed, it will simply be "preaching to the choir" if it goes no further than this. Or, as noted by Luis Echegoyen, "…we need to put teeth into this and follow it up; otherwise this will be a wasted effort…"

Using the results of this workshop, including a serious of recommendations and action items, the Chairs and others have an excellent opportunity to be persuasive leaders in getting the message across that the status quo is no longer acceptable and that "business as usual" is not an option. Luis Echegoyen, Nicholas Turro, and others have emphasized that there was a very good reason for selecting department chairs as the primary audience at this workshop. As noted by Turro: "The Chairs are the fulcrum between the administration and the faculty…" and as such they can have the greatest impact. Among other things, it must be made clear to the departments that "diversity and excellence can co-exist in an organization," as Jim Mitchell stated repeatedly during the workshop, and that inclusion is in the interests of everyone. Also, critically, the departmental barriers surrounding the professoriate, and excluding URM, must be broken down, the present status quo is detrimental not only to our economic competitiveness in the world, but, frankly, also to our sense of justice and fairness as a nation. A major conclusion of the workshop might be that diversity indeed does empower excellence so that its inclusion in chemistry departments is in a department's self-interest.

The list of action items presented in Chapter 4, as well as the fervor of several of the presentations by the chairs, suggest that many of the chairs, as well as others in attendance, have understood and concur with the message of the workshop. Indeed, it appears that their resolve has been galvanized by the workshop to implement substantive changes that will make a real difference in advancing URM in academia. In particular, among other actions, it has been resolved to:

- enhance URM faculty recruitment and retention by effective diversity management,
- create an inclusive departmental environment that values the contributions of all,
- develop networks for targeted recruiting of URM candidates for faculty positions, postdocs, and graduate students,
- provide implicit bias training,
- provide suggestions to funding agencies to enhance URM inclusion

The goal of the preceding actions is the achievement in the departments of greater diversity in faculty, postdocs and graduate students. The work of the chair and department faculty will result in:

- the appointment of at least one additional URM faculty member in the next five year period.
- the appointment of at least one additional URM postdoc each year over the next five years
- the recruitment and enrollment of at least one additional URM graduate student, and the graduation of at least one URM Ph.D. student each year over the next five years.

As noted by Turro, if the above "5 year plan" is achieved, the URM representation in Chemistry would be doubled!

Additional signs of hope were provided by the answers given to an evaluation questionnaire by approximately 30 people randomly chosen at the end of the workshop. Here we consider a few replies to just two of the five questions posed.

1. **What were the most valuable aspects of this workshop for you?**

- "Becoming aware of implicit bias and developing ideas for a plan to implement diversity in our hiring."
- "The data that clearly showed that there is a problem and what the basis of the problem is."
- "It opened my eyes to implicit bias that exists in all of us."
- "Brian Nosek's talk – which made me confront the idea of implicit bias in a meaningful way."
- "Raised awareness of subtle bias as an issue, and reinvigorated my commitment to make a difference."

2. **How specifically do you see yourself using information from the workshop to increase diversity in your department?**

- "I'm not a chair but as a faculty of a URM segment of academia I have been empowered to stand my ground and advocate for URM hiring."
- "We are already considering starting NOBCChE chapter. Now have evidence that it works."
- "My department is recruiting for two positions this year. I have several ideas about how to reach out to diversity candidates. We will also focus more heavily on developing our graduate students of color."
- "Make all grad students, but especially URM, aware of the benefits and joys that accrue with an academic career."
- "Fleshing out our diversity plan further – quantitative measures; strengthening formal mentoring."
- "I will work much harder in briefing search committees on implicit bias and I will keep a much closer eye on interpersonal dynamics during faculty meetings."
- "I believe that if we add one URM faculty per department we will have made a difference."

In short, a consensus seems to have emerged among many of the workshop participants to actively and vigorously push the advancement of URM in academia. Or, in the words of one of the participants: "**Perhaps I shall make some trouble after all!"**

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APPENDICES

APPENDIX I: Statistics on URM in academia--from interest in science to faculty in chemistry

Table 1. Freshmen Intending to Major in Physical Sciences* ref 1

in percentages	1983	2004	% of Population*
White	90.5	79.7	
Asian American	3.2	9.2	
Black	5.2	7.8	12.8
Hispanic	0.9	5.5	14.8
American Indian/ Alaskan Native	1.2	2	1.1

Ref 1Table 2-7, National Science Board, NSF, Science and Engineering Indicators 2006

*All races and ethnicities are U.S. citizens or permanent residents

*2006:US Census Bureau, Population Division, Annual Estimates of Population by Sex, Race and Hispanic or Latino Origin for the United States: April 1, 2000 to July 1 2006: and A National Analysis of Minorities in Science and Engineering Faculties at Research Universities by Dr. Donna Nelson,

Table 2. Earned B.S. Degrees 1995 to 2002 in Chemistry*

	1995	2002
Total	10,016	9,448
U.S. citizens and perm residents	9,620	9,105
White	7,112	6,268
Asian	986	978
Black	738	796
Hispanic	553	666
Am. Indian/Alaska Native	57	57

Table 2-27, National Science Board, NSF, Science and Engineering Indicators 2006

*All the races listed are U.S. citizens or permanent residents

Table 3. Graduate Enrollment in Chemistry*

	1983	2003
Total	17,802	20,049
U.S. citizens and perm residents	13,992	12,210
White	11,746	8,955
Asian	564	1,103
Black	439	663
Hispanic	403	750
Am Ind/Alaska Nat	32	51

Ref 1Table 2-15, National Science Board, NSF, Science and Engineering Indicators 2006

*All the races listed are U.S. citizens or permanent residents

Table 4. Earned Doctoral Degrees in Chemistry*

	1983	2003
Total	1,758	2,037
U.S. citizens and perm residents	1,357	1,169
White	1,252	1,029
Asian	39	65
Black	11	35
Hispanic	20	38
Am. Indian/Alaska Native	3	2

Table 2-31, National Science Board, NSF, Science and Engineering Indicators 2006

*All the races listed are U.S. citizens or permanent residents

Table 5. Tenure Track Faculty at the top 50 Chemistry Departments*

Total	1691
White	1459
Asian	170
Black	22
Hispanic	37
Am. Indian/Alaska Native	3

By chemical research expenditures FY 2004
Donna Nelson's Report, Table 1.
No breakdown by citizenship

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APPENDIX III: Workshop Agenda

Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry *September 24 – 26, 2007 Arlington, VA*

Monday, September 24th

6:00 PM – 7:15 PM	Reception (Light refreshments will be served)
7:15 PM – 7:30 PM	Welcome by Co-Chairs and Federal Agencies
7:30 PM - 8:00 PM	Workshop Charge and Data Overview (Nick Turro): "Pipelines, Data, Myths, Diffusion of Innovation, Interventions, Implicit Bias, and Paradigm Shifts"
8:00 PM - 9:00 PM	Implicit Bias Exercise (Brian Nosek, University of Virginia): "Mind Bugs: The Ordinary Origins of Bias"

Tuesday, September 25th

07:45 AM – 08:25 AM	Light refreshments
08:25 AM – 08:30 AM	Welcome and Workshop Format (Isiah M. Warner, Co-Chair)
08:30 AM – 09:00 AM	Keynote Speech (Thomas Cech, President of HHMI): "Diversity Synthesis: Expanding access to Chemistry."
09:00 AM – 10:00 AM	Diversity and its Role in Education (Sylvia Hurtado, UCLA): "Diversity and Learning: Making the Connection"
10:00 AM – 10:15 AM	Break
10:15 AM – 11:25 AM	Panel I (Moderator, Sharon Neal, Univeristy of Deleware): Understanding the Contributing Factors • John Dovidio: "Understanding the Contributing Factors: Aversive Racism and Social Categorization" • Anne MacLachlan: Berkeley: "Pipeline or Roadblocks? The Experience of Isolation for Chemists of Color" • Daniel Solorzano: University of California at Los Angeles: "Racial Microaggressions and Students and Faculty of Color" • Frank Dobbin: Harvard University: "Best Practices or Best Guesses: Which Corporate Diversity Programs Work?"
11:35 AM – 12:20 PM	Breakout Session I – *What new strategies can be used to overcome current barriers for URM as graduate students, post docs, and faculty?*
12:30 PM – 01:35 PM	Lunch and Reports from Breakout Session I
01:35 PM – 01:45 PM	Break
01:45 PM – 03:15 PM	Panel II (Moderator, Jim Mitchell, Howard University): Positive Actions (Climate, Recruiting, and Retention) • Daniel Romo: Texas A&M University

- Eric Sorensen: Princeton University
- Mark Wightman: University of North Carolina: "Enhanced Retention of Faculty and Doctoral Students"
- Steve Mayo: Caltech

03:15 PM – 03:30 PM — Break

03:30 PM – 04:50 PM — Panel III (Moderator, Rig Hernandez, Georgia Tech): Positive Actions (Mentoring and Empowerment)

- Hector Abruna: Cornell University: "On What Cornell is doing to mentor and Empower URM Faculty: A Department Chair's Perspective"
- Christine Oritz: MIT: "What MIT is Doing to Mentor & Empower their Underrepresented Minority Junior Faculty"
- Steven F. Watkins: Louisiana State University: "What is Louisiana State Doing Right?"
- Joseph S. Francisco: Purdue University: "On what Purdue & NOBCChE are doing to Mentor & Empower their URM students: A Report from the Student's Perspective"

05:00 PM – 05:45 PM — Breakout Session II – *How can chemistry departments best support the development of a diverse and well-trained scientific workforce which includes URM faculty?*

05:50 PM – 06:30 PM — Reports from Breakout Session II

06:30 PM – 07:45 PM — Dinner and Keynote Speech: Catherine Millet, Princeton University: "Interventions that Encourage URM to Pursue Research Careers"

07:45 PM – 08:00 PM — Break

08:00 PM — Town Hall Meeting (William Guillory, Center for Creativity and Inquiry) "Creating an Inclusive Culture for Academic Excellence"

Wednesday, September 26th

07:00 AM – 08:00 AM — Light refreshments

08:00 AM – 08:15 AM — Comments and Reflections on the Previous Day (Co-Chairs)

08:15 AM – 09:00 AM — James W. Mitchell, Howard University: "Diverse Representation Within An Excellent Scientific Organization Is A Planned Event"

09:00 AM –10:00 AM — Panel Discussion: Incentives and Accountability (representatives of Federal Agencies)

- Jeremy M. Berg (NIGMS/NIH): "Excellence Empowered by a Diverse Workforce: Achieving Racial and Ethnic Equity in Chemistry: A Perspective from NIGMS"
- Luis Echegoyen, (NSF): "Broadening Participation Activities in Chemistry"
- Eric Rohfling (DoE):

10:00 AM – 10:15 AM — Break

10:20 AM – 11:10 AM — Breakout Session III -- *How can chemistry departments and federal funding Agencies most effectively support URM at all levels?*

11:20 AM – 12:10 PM — Larry Dalton, University of Washington: "Elements of a Successful Diversity Plan"

- Thomas Orlando: Georgia Institute of Technology
- Patrick Limbach, University of Cincinnati
- Timothy Swager, Massachusetts Institute of Technology

12:20 PM – 01:30 PM	Lunch and Reports from Breakout Session III
01:30 PM – 02:15 PM	Defining Measures of Success (Entire Group, Co-Chaired by Billy Joe Evans and Rig Hernandez)
02:15 PM – 03:00 PM	Wrap-Up; Questions and Answers; Where do we go from here?
03:00 PM	Adjourn

Appendix IV: Breakout Session Questions

Breakout Session I – What new strategies can be used to overcome current barriers for URM as graduate students, post docs, and faculty?

- **Group A and B**: How can chemistry department administrations promote the advocacy of increasing the participation by URM chemists (graduate students, post docs, and faculty) and maintain their status as significant members of the department?
- **Groups C and D**: What strategies and tactics can chemistry departments use to incorporate accountability for diversity efforts into their evaluation and promotion policies?
- **Group E and F**: What new rationales, strategies, and tactics can chemistry departments identify to promote the professional development and accurate assessment of URM graduate students, post docs, and faculty in settings where affirmative action has been abolished?

Breakout Session II – How can chemistry departments best support the development of a diverse and well-trained scientific workforce that includes URM faculty?

- **Groups A and F**: How can chemistry departments recruit more effectively to include URM at the graduate, postdoctoral, and faculty level?
- **Groups B and C**: What specific steps can chemistry departments take to increase the participation of URM in their faculty ranks?
- **Groups D and E**: What specific steps can chemistry departments take to increase the number of URM graduate students and post docs who are motivated to and competitive for faculty positions at similar institutions?

Breakout Session III – How can chemistry departments and federal funding agencies most effectively support URM at all levels?

- **Groups A and D**: How can funding agencies best encourage the recruitment and retention of URM graduate students and post docs?
- **Groups E and B**: How can chemistry departments best encourage URM post docs to enter academia and groom them for faculty positions?
- **Groups C and F**: How can top chemistry departments best encourage the recruitment of top URM faculty?

Appendix V: Workshop Organizers

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