

National Science Board
Workshop

**BROADENING PARTICIPATION
IN SCIENCE AND
ENGINEERING RESEARCH
AND EDUCATION:
WORKSHOP PROCEEDINGS**

AUGUST 12, 2003



This document, *Broadening Participation in Science and Engineering Research and Education: Workshop Proceedings NSB-04-72*, is based on workshop transcripts and panelists' reviews. The contents of the presentations, including program descriptions, are solely the responsibility of the panelists' and do not represent National Science Board endorsement or policy.



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**AUGUST 12, 2003
NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD, ROOM 1235
ARLINGTON, VIRGINIA**

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OVERVIEW

BROADENING PARTICIPATION IN SCIENCE AND ENGINEERING RESEARCH AND EDUCATION

BACKGROUND

Education has always been vital to the success of individuals and the science and engineering enterprise. In the technology- and knowledge-based economy of the 21st century, science, engineering, and technology education is also an investment in the United States' collective future as a nation and as a society. For decades, the United States has excelled in building and sustaining institutions of higher education that attract science and engineering talent from all over the world. The Nation has done less well in encouraging and developing the mostly untapped potential of underrepresented minorities, women, and persons with disabilities. Developing this potential will lead to expanded opportunities for individuals as well as improving national competitiveness and prosperity.

To address these concerns, the National Science Board Committee on Education and Human Resources hosted a group of distinguished panelists to participate in a workshop entitled, "Broadening Participation in Science and Engineering Research and Education" on August 12, 2003. The workshop was very well attended by people concerned with diversity in U.S. academic institutions and the workforce. The workshop had two objectives: first, to celebrate the progress that American universities have made in bringing diversity to science and engineering; and second, to identify strategies for further increasing the diversity of the nation's science and engineering workforce.

PANEL SUMMARIES

The workshop consisted of four separate panels, each introduced by a moderator and featuring three or four speakers on a specific topic within the broadening participation theme. Presentations were followed by a general discussion session between panel members and the audience.

Dr. George Langford, Chair of the NSB Committee on Education and Human Resources, and **Dr. Rita Colwell**, Director of the National Science Foundation, provided opening remarks for the workshop focusing on the challenges that the National Science Foundation and the Nation face in science and engineering. Dr. Langford outlined some of the major questions to be considered during the workshop:

- What incentives must be provided to bring diversity to faculty at liberal arts colleges, research universities, and ultimately, the workforce itself?
- What are the barriers that Americans face in the science and engineering workforce?
- What policies can federal agencies such as the NSF put into place to change the culture and the hiring practices of university faculties?

Dr. Colwell emphasized the need to create effective policies and invest in developing the largely untapped resource of “home grown” talent in America — underrepresented minorities, women, and persons with disabilities. Dr. Colwell identified several NSF programs, including ADVANCE, and the Undergraduate Mentoring in Environmental Biology program, and recommended that these types of programs be emphasized through collaborative efforts to “go beyond policy and polemic.”

The Models of Success for Broadening Participation panel, moderated by **Dr. Joseph Bordogna**, Deputy Director of the National Science Foundation, focused on the need to develop successful models to recruit diverse talent into science and engineering research and education. Other countries are making significant investments in science and engineering capacity development and as a result, the United States must invest in strategies that keep America competitive in the global economy.

Dr. Shirley Ann Jackson, President of Rensselaer Polytechnic Institute, outlined several components of successful models for broadening participation at the undergraduate level and provided numerous program examples. Programs included the Meyerhoff Scholars Program, the Louis Stokes Alliance for Minority Participation, and the Gateway Coalition. Some of the key components of successful programs included: a vision and overall strategy; structuring to meet the individual needs of students; and periodic evaluations to assess program goals and achievements.

Dr. Shirley Tilghman, President of Princeton University, highlighted challenges in broadening participation at the faculty level, and the need to restructure the training path within science and

engineering to make it more attractive to under-represented groups, particularly women. Dr. Tilghman made several suggestions as to how this could be accomplished, including establishing programs that bridge the gap between the completion of graduate school and the first job. She also outlined one successful paradigm for recruiting and retaining faculty from underrepresented groups: Princeton's "target of opportunity" search process.

Dr. Norbert S. Hill Jr., Executive Director of the American Indian Graduate Center, focused on the factors that affect the productivity of students and faculty in academic environments. Dr. Hill identified the key idea of "change interrupted." That is, providing adequate mentoring, networking, financial support, and other support mechanisms throughout the education and teaching process to allow students and faculty to succeed.

The Changing Demographics and Challenges of the Future panel, moderated by **Dr. Diana Natalicio**, President of the University of Texas at El Paso and Vice Chair of the National Science Board, highlighted the rapidly increasing number of non-white groups in the American population contrasted with a slow growth in the number of non-whites at all levels of science and engineering research and education.

Dr. Beverly Daniel Tatum, President of Spelman College, suggested strategies for overcoming subtle perceptual factors that affect how universities recruit non-white faculty. Dr. Tatum outlined the work of John Dovidio and Samuel Gaertner in the area of "aversive racism" and suggested several effective ways to overcome this barrier to increasing diversity and science and engineering. Recommendations included the need for institutional leaders, federal agencies, and other interest parties to clearly identify the diversity goals of institutions so that appropriate behaviors at all levels can follow. In other words, leaders need to help "keep our eyes on the prize."

Dr. Shirley Malcom, Head of the Education and Human Resources Directorate at AAAS, pointed out that the relatively few non-whites at higher positions within academia discourages non-whites from pursuing science and engineering careers as undergraduates. Dr. Malcom proposed several ways to create positive outcomes in this area, including: reducing the time to degree; and holding grantees accountable for establishing feasible mechanisms to improve diversity in the student and faculty makeup.

Dr. Richard Tapia, Professor at Rice University, highlighted the low numbers of non-whites in higher education and stressed the need to have recruiting and support systems that bring all of those who are qualified to excel into science and engineering fields. Dr. Tapia recommended that these systems concentrate on creating friendly, encouraging environments that are realistic in their expectations of students to prevent "burn out." By meeting students where they are, and showing them where they can go, the precious few can achieve leadership positions at higher institutions.

Discussion continued on how universities recruit for faculty positions and the need to make educators feel that they are an integral part of the overall science and engineering community.

The Diversity Gap between Students and Faculty panel, moderated by **Dr. Esin Gulari**, Division Director in the Engineering Directorate at NSF, concentrated on the lack of Hispanic, African-American, and Native American faculty at top liberal arts colleges and research universities.

Dr. Evelyn Hu-Dehart, Director of the Center for the Study of Race and Ethnicity in America at Brown University, suggested that Asians have found success in securing faculty positions because they earn degrees from top universities. This is in contrast to Hispanics, African Americans, and Native Americans, who may earn doctoral degrees from less prestigious institutions, but, due in part to poor recruiting efforts on the part of universities, are seldom identified or given a chance to compete for positions. Dr. Hu-Dehart stated that this is a cultural problem, and one that can be overcome by a three-step process: 1) Creating means to identify candidates from underrepresented groups; 2) Hiring qualified candidates from this pool; 3) Providing support mechanisms to help faculty from underrepresented groups succeed.

Dr. Emilio Bruna, Assistant Professor at the University of Florida, emphasized the need for policies that increase funding opportunities for underrepresented minorities to improve their exposure and get them into the pipeline. Dr. Bruna gave specific examples of ways to get individuals from underrepresented groups into the pipeline, including: expanding NSF's fellowship program for minority scholars; increasing funding opportunities for junior faculty from underrepresented backgrounds; making Research Experiences for Undergraduates grants available to faculty that do not have full NSF grants; holding grantees accountable for achieving the broader impacts of their grants.

Dr. Lilian Shiao-Yen Wu, Program Executive at IBM, used her experience in business at IBM to explain how changing diversity policies to a business imperative, instead of just a moral imperative, can bring diversity in the science and engineering workforce. She recommended and expanded on several potential strategies that can be used to increase diversity in the workforce. From inside the organization, leaders need to push to make diversity a part of what everyone does day-to-day, such as: holding conferences on multiculturalism to improve culture competency; mentoring; and creating executive task forces to solve problems and get senior executives personally engaged and become advocates. From outside the organization, professional societies, government, and the media need to push for more transparency on how well organizations are doing in diversity.

General discussion focused on the outdated systems of faculty recruiting that university departments often use, the rankings used by university departments to assess their progress, and the effect of homeland security policies on international students in American universities and the American workforce.

The Policy Options Development panel discussed methods for implementing effective policy practices. **Dr. Judith Ramaley**, Assistant Director of the Directorate for Education and Human Resources at NSF, challenged current policy assumptions and identified limitations that policies have in bringing diversity to the science and engineering workforce. She summarized areas of agreement on the challenges the U.S. science and engineering community faces and suggested three guidelines for policy-makers to follow as they develop approaches to increasing national

competency in science, technology, engineering, and mathematics: 1) Modeling policies on solid evidence; 2) Demanding evidence of the success of those supported by federal funding; 3) Challenging assumptions on the system works to better understand the context of the problem that is being confronted.

Dr. Clifton Poodry, Division Director at NIH, suggested expanding the definition of “success” for programs to include a clause on improving diversity. This expansion, coupled with mentoring of individuals from underrepresented groups can lead to improvements in hiring at universities and liberal arts colleges. Dr. Poodry also hypothesized that providing financial incentives to institutions that send individuals from underrepresented groups on to graduate studies could be an effective method to improving diversity in science and engineering.

Dr. Willie Pearson Jr., Chair of the School of History, Technology and Society at Georgia Tech, presented an overview of important issues to consider when discussing ways to improve diversity in science and engineering research and education. Among other things, Dr. Pearson recommended that interested parties concentrate on collecting better data on the state of diversity in science and engineering so that assessments can be more effective at measuring progress, and policies can be better formed. Also, Dr. Pearson recommended that this issue be confronted by federal agencies, public and private sectors, and individuals themselves to fundamentally address this important issue.

Open discussion focused on how to make science and engineering careers look more attractive through media portrayals, and through attitudes within fields that help encourage students to pursue these paths.

Dr. Langford, in conclusion, encouraged a continuing dialogue about issues raised during the workshop at the attendees’ respective institutions, and welcomed any feedback from the panelists and audience on broadening participation in science and engineering research and education.

INTRODUCTION AND OPENING REMARKS

Dr. George Langford, Chair of the Education and Human Resources Committee of the National Science Board, opened the proceedings by outlining the major goals for the workshop. Dr. Langford placed the workshop into context by presenting statistics regarding the number of minority students in science and engineering. He then challenged audience members to consider questions on how to bring together a diverse population of both faculty and students to broaden participation in science and engineering research and education.



Hello and welcome. I am delighted to see all of you here today to participate in the broadening participation workshop. We have over 100 registered guests, not counting the numerous NSF staff that are in attendance today. Thus, we have an excellent group of individuals to talk about some very important issues facing the nation. The ideas and issues identified at this workshop will guide the development of a set of recommendations by the Education and Human Resources Committee¹ for presentation to and approval by the whole Board. This is not a workshop about National Science Foundation programs *per se* but about ideas to guide policy development that will lead to new program development.

This workshop has two major objectives. The first is to celebrate the progress that we have made in broadening participation in the science, math and engineering fields by women and persons of color. Our universities, in fact, have made significant progress and it is something that we can be very proud of. The second objective is to identify strategies to achieve faculty diversity at our colleges and universities. We would like to find ways to bring about structural changes at universities: changes that will lead to the hiring and retention of faculty of color in the sciences.

We would like to find ways bring about structural changes at universities: changes that will lead to the hiring and retention of faculty of color in the sciences.

Most institutions have up to 30-35 percent students of color at the undergraduate level. So not only have universities achieved significant progress in student diversity, our institutions have developed programs and have staffed offices to facilitate the success of students in the academic disciplines. For example, Jim Wright at Dartmouth College established an Office of Pluralism and Leadership² a couple of years ago and this office has full-time advisors for students, minority students, Asian students, Hispanic,

African American, Native American, gay, lesbian, bisexual and transgendered students. This is a far cry from the early days when students of color arrived on our campuses. The recent Supreme Court decision and the ruling in the Michigan Case, should keep us on course for the near term. Furthermore, because of the changing demographics in the country, we anticipate that the percent of students of color on our campuses will grow.

The numbers that I have seen estimate that the percentage of students of color will climb to about 40-45 percent within a decade or two. So this is all good news for us. We have made significant progress at the NSF and federal agencies have played a significant role in this achievement.

On the other hand, the numbers for faculty of color continue to lag behind those for students and this lag is not due to a lack of trying. It is quite clear to me that universities have found successful strategies for achieving student diversity but have failed to come up with a successful strategy for hiring and retaining faculty of color. The lack of faculty of color, I think, is linked to another unfortunate trend on our college campuses. Whereas about a third of white students major in the sciences, the percentage is closer to 15 percent for students from groups that have been traditionally underrepresented in the sciences. For Hispanic, for Native American, for African American students, the percentage expressing an interest in science upon entering the university is about the same as for whites. However, the number who actually choose to major in science is less by a factor of two.

Whereas about a third of white students major in the sciences, the percentage is closer to 15 percent for students from groups that have been traditionally underrepresented in the sciences.

This trend away from science and engineering is a significant concern as the relative numbers of minority students increase on campus. We have to get those numbers up.

To achieve a diverse workforce in the sciences, we need a diverse faculty at our liberal arts colleges and at our research universities. Students have to be cajoled and pushed, encouraged and followed, shown role models and successful career paths to enter the sciences.

To achieve a diverse workforce in the sciences, we need a diverse faculty at our liberal arts colleges and at our research universities. Students have to be cajoled and pushed, encouraged and followed, shown role models and successful career paths to enter the sciences. Unfortunately, what students too often find is disinterest and sometimes suspicion that they are not quite up to the task. One minority faculty is not going to do it. I was hired at Dartmouth in 1991 and I remain the only faculty of color in the science division including chemistry, biology, physics, computer science, geosciences. There is one colleague in the math department.

How do we provide incentives to our faculty to diversify? What

are the structural barriers? Why have universities succeeded at the undergraduate level but failed at the graduate student level, I should mention as well as at the faculty level? What policies can federal agencies such as the NSF put into place to change the culture and the hiring practices of university faculties? We have with us today a stellar group of panelists sitting around the table with me. I am absolutely thrilled at the group who have agreed to participate, to share their ideas at this very important workshop and I want to thank each of the panelists for agreeing to do so. We can all anticipate a lively and substantive discussion of these issues.

I have a lot of people that I want to thank for help with organizing and implementing this workshop. I want to thank Dr. Warren Washington, chair of the National Science Board, for his support and encouragement for this effort. Warren has a key personal interest in the topic of this workshop and his support is greatly appreciated. I want to thank the members of the Education Human Resources Committee for their help in planning the workshop. This wonderful list of panels that we have here came through recommendations from the Committee.

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I also want to thank the other members of the Board for their support and guidance during the planning phase of the workshop and thanks also for being here today. I want to thank the NSF management and staff; Drs. Colwell and Bordogna were on board with us from the very start of this effort. Rita has placed education and the workforce high on her priority list and she has advocated for the inclusion of women and minorities in science from the day she assumed the directorship of the National Science Foundation. Thank you very much, Dr. Colwell.

Dr. Bordogna was so enthusiastic that we drafted him to be one of the panel moderators. Joe speaks about these issues from personal experience and there is no stronger voice for broadening participation than his. I thank you, Joe. The real work of putting on a workshop like this one falls on the shoulders of the NSB's office personnel and we at the NSB are very fortunate to have a very competent and dedicated staff. The person who took on the lion's share of the work was Dr. Robert Webber. You all got lots of emails and communications with Bob. I have put on a few workshops in my day and I have never had a more competent and efficient person to work with in organizing a workshop. I thank you very much, Bob. There were other people in the NSB office³ as well and I am pleased to recognize their contribution to this effort.

I now have the pleasure of introducing the Director of the National Science Foundation, Dr. Rita Colwell.

¹ National Science Board. Active Committees. Education and Human Resources Committee, <http://www.nsf.gov/nsb/committees/ehrcmte.htm>

² Dartmouth College. Office of Pluralism and Leadership, <http://www.dartmouth.edu/~stulife/StuLifeDiversity.htm>

³ National Science Board Staff, <http://www.nsf.gov/staff/subdiv.cfm?key=27>

Dr. Rita Colwell, Director of the National Science Foundation, discussed some of the challenges and successes of the NSF. Dr. Colwell pointed out that while the United States has trained scientists and engineers from around the world in its first-rate academic institutions, there remains an untapped resource of “home grown” talent, including underrepresented minorities, women, and persons with disabilities. Having discussed the importance of science and engineering for shaping innovation and the progress of ideas, Dr. Colwell concluded by stating that if each of us realizes the importance of broadening participation in the science and engineering workforce, then, “we will be on our way to creating a new generation of scientists and engineers with the capability to lead us into the future, whatever it may hold.”



Thank you and good morning to all of you. My assignment today is twofold. First, I am delighted to welcome you on behalf of the National Science Foundation. We are honored to host this distinguished group that has gathered here today to address an issue of vital importance to the nation.

My second task is to express to you the continuing and strong commitment of NSF to our collective endeavor: ensuring that *all* the nation’s talent can reach its full potential in science, engineering, mathematics and technology.

The word “*all*” is key. For decades, the U.S. has excelled in building and sustaining institutions of higher education that attract science and engineering talent from around the world.

As a nation, we have done less well in encouraging and developing homegrown talent - our mostly untapped potential of underrepresented minorities, women, and persons with disabilities - America’s “ace in the hole” or “competitive edge” for the 21st century. For too many years, our progress has been too slow, and has come at too high a cost - a cost in lost talent and fresh ideas that we are only now beginning to calculate.

But I believe that is changing. Although broadening participation in the science and engineering is by no means a new objective, the circumstances of our times have given it new salience that strengthens year by year. A heightened sense of urgency now accompanies the task of identifying new learning and institutional

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strategies that will open the portals of science and engineering to the full diversity that is the face of America.

Education has always been vital to the success of individuals. In our knowledge-based economy, it is also an investment in our *collective* future as a nation and a society. Science, engineering and technology play an increasingly vital role in enabling and shaping progress. These realities, taken together with new demographic realities, have raised the stakes for diversity dramatically.

Our nation's future depends more and more on the quality of our new ideas, the vitality of our intellectual discourse, and the innovative use of new knowledge generated through our research and education enterprise. This is the bedrock that underpins our prospects for economic prosperity and improved well being.

The strength of our democracy has rested from the start on the principle that we are a land of opportunity enabled by an extraordinarily diverse workforce.

The strength of our democracy has rested from the start on the principle that we are a land of opportunity enabled by an extraordinarily diverse workforce. But in our technologically sophisticated society, fast-paced change often puts the most expansive opportunities out-of-reach to many.

These truths of our times and our broader national values demand that we embrace the *imperative* of preparing people to take advantage of these opportunities. If we allow anyone to be left behind, we create a formula for our nation to be left behind. We are talking about opportunities not only for individuals. We are also talking about ways to create expanded opportunities for the U.S. to compete and prosper.

Thus, our overarching objective is one vital to our nation's prosperity. It is *our* collective necessity to encourage, educate, and enlist citizens into jobs and professions that drive the new knowledge economy, contribute to social well being, and safeguard the basic values of our society. That is no small task!

We are confronted by another harsh reality. Students are walking away from careers in science and engineering.

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Fewer of today's students are choosing science and engineering career paths. And fewer than half of those who embark on these paths, actually graduate. Among those who graduate, we hear anecdotal evidence that more are considering abandoning science and engineering to seek alternative careers. This gives a whole new meaning to voting with your feet!

We know that students face many potential hurdles to careers in science and engineering - financial, social, and cultural. But we know all too little about how these actually affect individual student choices.

Do students believe they can't break through historically prevalent glass ceilings? Are they deterred by uncertain job prospects in academic research institutions or industry? Are they choosing more lucrative learning and career paths, or ones they believe offer more scope for creative contributions?

We don't know the answers to these questions, although research is beginning to address them. The answers are likely to be highly complex and involve a mixture of these and a host of other factors.

We *do* know that minorities, women and people with disabilities face particular challenges that require greater insight to unravel and to address.

Our ability to meet these formidable challenges depends in part on our capability to renew the institutions we have designed for this purpose. NSF is one of these institutions, and so is the nation's superb higher education network - our universities, colleges, and community colleges. Industry and the non-profit sector have important roles to play as well.

To put some meat on the bones of my remarks, I will describe some of NSF's efforts to address these issues.

At NSF we are committed to identifying and supporting innovative programs to broaden the participation of underrepresented minorities, women, and persons with disabilities in the science and engineering workforce.

Our mandate to ensure the health and vitality of the U.S. science and engineering enterprise explicitly includes this responsibility. In fact, as a matter of policy, NSF returns – without review – any proposal for funding that does not address the broader impacts of the proposed work on society, including how well the activity broadens the participation of underrepresented groups.

NSF's approach is to incorporate diversity initiatives throughout NSF's scientific and educational programs. That means identifying NSF's most successful programs to encourage minority participation and bringing them together with other highly successful NSF programs.

At NSF we are committed to identifying and supporting innovative programs to broaden the participation of underrepresented minorities, women, and persons with disabilities in the science and engineering workforce.

NSF is focusing on two particular issues – improving science, technology, engineering, and mathematics education capacity at all Minority Serving Institutions, and improving the education of all minority students and encouraging them to pursue science and engineering careers in academia, government, and industry. In our new budgets we are intensifying and sharpening these aims.

Here is one example. The Louis Stokes Alliances for Minority Participation Program⁴ (or LSAMP, as we say) has developed a number of approaches to improving minority enrollment and retention in science and engineering.

It is worth quoting some figures here, because they show what can be done with a sustained effort. Institutions receiving funds through this program have produced 174,000 minority bachelor degrees in science and engineering since 1991.

In 2001 alone, the LSAMP institutions produced 21,704 minority S&E graduates - 70% of all minority S&E baccalaureate graduates that year.

A new challenge is to develop improved strategies to recruit and retain an increasing number of these students in graduate science and engineering programs.

The idea is to weave together what are now separate but complementary efforts and to integrate these activities across and among institutions. The innovation the community brings in response to this challenge is key to moving beyond our current performance to fresher, more inclusive, more productive, educational systems.

We need the efforts of everyone to achieve greater diversity in science and engineering.

Another example is ADVANCE,⁵ NSF's newest program to bring more women into science and engineering. ADVANCE is not limited to women; we need the efforts of *everyone* to achieve greater diversity in science and engineering. The program intends to spark system-wide changes that will foster a more positive climate for women to pursue academic careers.

NSF's *Workforce for the 21st Century* priority area aims to broaden participation in science and engineering through this integrative approach. In many institutions, including minority-serving ones, the focus will be on drawing elements from existing NSF programs and challenging collaborators at these institutions to

design programs that develop an innovative and seamless route of advancement for the students they serve.

Retaining promising students in science and engineering fields is a difficult challenge. We need a better understanding of the factors that influence career choices, and of the quality and productivity of the traditional and non-traditional paths that students use to prepare for or advance science and engineering careers.

We know that women and minorities face experiences - from pre-K through postgraduate - that make successful careers particularly challenging. NSF will support research to determine what experiences or strategies are most effective in realizing this objective.

NSF has a long tradition of support for innovation in science, engineering, mathematics and technology education. We will continue to build on what we have learned in the past to develop even more effective efforts in the future.

NSF has done *less* well in integrating diversity concerns across the entire spectrum of NSF programs - directorate by directorate. That is one of our *new* challenges at NSF, and one we gladly embrace.

NSF's Undergraduate Mentoring in Environmental Biology⁶ program is an example. The announcement for this year's competition, posted only a few weeks ago, emphasizes projects that increase minority participation. The field of environmental biology is one in which the need to increase minority participation is particularly acute. The larger payoff is apparent: we need diverse perspectives and experiences to guide the research and education that will help inform our environmental policies in the decades ahead.

I don't have to remind this audience that the very best ideas always come from the science and engineering research and education community. This workshop is a good example of collaborative efforts that bring together people with the passion, experience, and knowledge to set strategic directions.

NSF's competitive grants process and merit review are fundamental to eliciting and supporting the most promising new directions in research and education in the community. Our challenge is to point investigators toward significant ends, while allowing them maximum elbowroom for innovation. That is your job, and it's essential.

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The need to develop all the nation's science and engineering talent demands a commitment that goes beyond policy and polemic. It will require a comprehensive and collaborative effort.

As scientists and engineers, we understand the processes and values of discovery and innovation in our very bones. We know how to formulate questions, devise answers, and put them to the test. We are adept at looking for the surprising as well as the universal. These are the skills we now need to apply to our search for effective learning paths and institutional strategies that will bring minorities, women, and persons with disabilities into the science and engineering fold.

The need to develop *all* the nation's science and engineering talent demands a commitment that goes beyond policy and polemic. It will require a comprehensive and collaborative effort. That means hard work and getting things done.

If each of us recognizes the imperative to broaden diversity in science and engineering, and accepts responsibility for acting upon it, we will be well on our way toward a future in which we match excellence in research with equity in education. We will be on our way to creating a new generation of scientists and engineers with the capability to lead us into the future, whatever it may hold.

I want to assure you that NSF is committed to undertaking this challenge. We can only do so with your help. I look forward to learning more about your ideas for new directions and strategies. The challenge is formidable, but working together, we can meet it.

⁴ National Science Foundation. The Louis Stokes Alliances for Minority Participation, <http://www.ehr.nsf.gov/ehr/hrd/amp.asp>

⁵ National Science Foundation. ADVANCE, <http://www.nsf.gov/home/crssprgm/advance/>

⁶ National Science Foundation, Undergraduate Mentoring in Environmental Biology, <http://www.nsf.gov/bio/progdes/umeb.htm>

MODELS OF SUCCESS FOR BROADENING PARTICIPATION

***Dr. Joseph Bordogna**, Deputy Director of the National Science Foundation, opened up the panel on models of success for broadening participation.*



Our panelists are charged with discussing successful models: efforts that work for expanding diversity of both faculty and students in science and engineering. Much has been discovered during the past several decades on what works and what does not. Our focus now is to accelerate the use of models that work.

I would like to quote a U.S. President whose tenure in office just preceded the Civil Rights Act. There is a critical word in this quote: the word “each.” This word signifies a focus on every single one of us. This President was John F. Kennedy, who said, “Let us think of education as a means of developing our greatest abilities because in each of us, there is a private hope and dream which, fulfilled, can be translated into benefit for everyone and greater strength to the nation.”

Dr. Bordogna then introduced Dr. Shirley Ann Jackson.

***Dr. Shirley Ann Jackson**, President of Rensselaer Polytechnic Institute, highlighted the importance of capacity development in an era where national security is challenged and global markets are becoming increasingly competitive. By drawing from her experiences as a government official, president of a research university, and as a part of corporate America, Dr. Jackson stressed the formative role that diversity has played in the progress of America and the role that diversity must continue to play in science and engineering if America is to remain at the forefront of the global economy. She speaks of an “underrepresented majority” and nine principles of exemplary programs to build science and engineering talent.*



I want to speak with you this morning from a three-part perspective developed really from the three phases of my own career: from my service in government, from my being president of a research university, and from my involvement in corporate America as a worker, a researcher, and being on corporate boards. In all of these experiences, I have found a constant reinforcement of the fact that scientists and engineers are critical to continued American innovation, global leadership and competitiveness.

I believe that Dr. Colwell has essentially made the case for why we are here. We are here today because our challenge is how our nation will continue to lead in an era when national security is challenged and when global competitiveness is on the table. When that occurs, it certainly requires that we focus on whether we have adequate scientific and engineering resources at hand. This is a kind of challenge our nation has faced before, certainly in World War II, in the Cold War, and of course, in the space race.

It is important for us to understand that the risks of inaction are great and that is why this discussion is necessary. We know that so far the United States has remained competitive, having the world's deepest technology base, the most highly productive workforce, the strongest research and development capabilities and the most competitive domestic market despite the recent recession. However, we are not the only game in town because other countries understand the importance of investing in national capacity in science, engineering and technology, especially human resources, and that investment has begun to pay off for those countries. We know that Taiwan, Korea, Ireland, Israel and India have emerged in the pivotal information sector, that Scandinavian countries

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have developed strengths in telecommunications, that Japan and especially China are investing heavily in science and technology and that collectively, India, China, Japan, South Korea and Taiwan have more than doubled their production of bachelors degrees in the natural sciences since 1975 and quadrupled bachelors degrees in engineering.⁷ Additionally, the threat to our preeminence is exacerbated by a kind of brain drain that many people have begun to talk about and which has been exacerbated by security concerns.

New policies, because of very real security concerns, are causing delays for students who want to come into this country to pursue careers in science and engineering.

You probably know that there are nearly 600,000 international graduate and undergraduate students involved in U.S. higher education institutions. You probably know that one-third of university research assistants are international students. You probably know that nearly one-third of U.S. doctoral degrees in science and engineering are awarded to international students. You probably know that at the NSF, about one-third of U.S. Nobel prize winners were born overseas. Now why am I telling you this? I am telling you this for two reasons. First of all, inherent in these statistics is that it is diversity; diversity of origin and diversity of background that has given strength to our scientific and engineering enterprise. However, we all know that new policies, because of very real security concerns, are causing delays for students who want to come into this country to pursue careers in science and engineering.

A recent survey showed that 53 percent of U.S. universities had students who missed last fall's semester because of delays. Rensselaer had 29 young men from Malaysia who could not show up for the first semester because of visa issues. In fact, security reviews of foreign students highlighted by the Department of Homeland Security rose from 2,500 just two years ago to 14,000 last year. Such visa problems may cause some students to abandon American institutions and to study in other countries. Purdue University, which has more international students or foreign students in science and engineering than any other public university, is reporting a 10 percent decline, and they are not alone.

I happen to believe that international students and workers have always been, and will continue to be, a source of strength for our science and technology enterprise because they are exceptionally talented, because of the high-end graduate education we provide them, and because of their desire to succeed and contribute to American life.

I like to speak of what I call the underrepresented majority. We talk about underrepresented minorities or people of color and women but if you add it up today, these groups are the majority. As a result, we have to ask a realistic question of whether or not we can continue to succeed as a nation if we do not face these facts as a nation. I think as important as anything else that may come out of workshops like this one is a mindset that makes us understand that we are talking about an underrepresented majority.

We talk about underrepresented minorities or people of color and women but if you add it up today, these groups are the majority.

This issue will be a key component of my focus as president of AAAS. I serve with several other government, quasi-government, and private sector efforts to address the issues that we are talking about today. One of them is called “BEST,” Building Engineering and Science Talent,⁸ which was formed under the aegis of the Council on Competitiveness, driven by Congresswoman Eddie Bernice Johnson and former Congresswoman Constance Morella, with financial support from the National Science Foundation. I am also active on the Committee for Economic Development,⁹ which brings together corporate executives and major university presidents, and the Government-University-Industry Research Roundtable.¹⁰

In my remarks today, I want to draw heavily upon what BEST has been doing. I have been pleased in this effort to work with a number of people in this room. I had the privilege of serving as co-chair of the Blue Ribbon Panel on Higher Education and BEST will soon release a report to Congress outlining programs which, in its analysis, produce results based on a three-year national evaluation. This report will detail exemplary programs that can be replicated, transferred and scaled. Interestingly, all these programs share four key elements. One is specific evidence of effectiveness over at least a decade. The second is excellence and equity. A third is institutionalization and replication. The fourth is planning and execution that exceeded expectations. I will not detail every program and I will refer you instead to the BEST report,¹¹ which is slated to go to Congress this fall. But I can provide you with nine key principles and requirements for success that were distilled from the exemplary programs.

The first principle is the need to establish a vision and overall strategy and this requires institutional leadership: leadership which supports a broad commitment among administration and senior faculty to shared values, goals and programs that increase participation among the targeted population and among all students. A key example of the institutional leadership is at the

University of Maryland, Baltimore County, whose Meyerhoff Scholars Program¹² has gotten exemplary performance out of underrepresented minorities, particularly males. Having initially focused on financial support for African American males, the program has now expanded into a comprehensive research-oriented institutional program for all students while maintaining the focus on developing exemplary scholars among underrepresented groups.

Exemplary programs, by their nature establish, sustain and improve a feeder system across the educational spectrum.

A second key principle is that one cannot achieve a goal by just picking or stopping at one point in time: the pipeline has to be developed. This requires targeted recruitment and faculty from underrepresented groups. Exemplary programs, by their nature establish, sustain and improve a feeder system across the educational spectrum. This obviously demands exceptional and sustained institutional investment and commitment as well as active participation by those who graduated from such programs. An example of this, which has been around for a long time is the National Consortium for Graduate Degrees for Minorities in Science and Engineering.¹³ Because it operates as a talent scout, an information clearinghouse and a matchmaker connecting talented minority Bachelor of Science recipients in science and engineering with graduate programs, this program has been successful for over a decade.

A third key principle is that we have to break down old habits and, in the process, improve teaching. Achieving this principle requires engaged faculty: faculty who view positive student outcomes and all student outcomes as a critical measure of their performance and are rewarded accordingly. Although other things are still important, they do not replace an ongoing commitment to developing student talent. A national program, Preparing Future Faculty,¹⁴ exists under the aegis of the Council of Graduate Schools.¹⁵ It involves faculty preparation among 43 doctoral granting institutions and more than 250 partner institutions. The goal is to improve the quality of undergraduate teaching and education as well as raising the level of teaching in elementary and secondary schools. That is the kind of engagement of faculty we are talking about.

The fourth principle is that we have to meet the students where they are: we have to give them personal attention. Programs that are structured this way see the value of personal attention at every stage of higher education and are committed to meeting students' individual learning needs, which includes mentoring and tutoring. Two examples quoted by BEST are the Wise RP Program¹⁶ at the

University of Michigan and the Lore-El Program at the Stevens Institute of Technology.¹⁷ These are residential programs that build faculty-student interaction both in and out of the classroom into learning experiences that address the whole person's needs. This is an approach that many institutions are beginning to emulate.

The fifth principle is that it takes a village comprised of intergenerational support and peer support that enables students of diverse backgrounds, levels, and interests to interact with each other routinely and intensely. This key element enables undergraduates, graduate students, postdoctoral fellows and junior faculty to provide mutual support, guidance and advice for each other, creating an atmosphere of family responsibility. An example is the Louis Stokes Alliance for Minority Participation,⁴ particularly at Texas A&M University. They promoted Summer Bridge¹⁸ experiences assisting with the transition to college and undergraduate research using faculty in science and engineering to enhance the student transfer rate and improved academic advising. This program doubled the number of baccalaureate degrees awarded to underrepresented minority students. It proved that teamwork, cooperation and collaboration across the educational spectrum and linkages with community colleges, two-year colleges, is an important aspect of success.

The sixth principle is very important. Do not make students work at McDonald's and expect them to succeed. In other words, one has to have comprehensive financial assistance, meaning financial packages which combine merit and need-based support and which include scholarships, loans and grants. The institutional programs which BEST found to be exemplary worked to provide financial aid packages that enable students to avoid part-time work which was unrelated to course study which then begins to make academics the total focus of the students' life.

The seventh principle is that if you want researchers, then you have to let the students do research early. Exemplary programs cited by BEST extend research experience beyond the classroom including summer internships and other research opportunities which connect students to the world of work, provide mentoring and lay out career options. An example is the Partnership for Minority Advancement in Biomolecular Sciences,¹⁹ PMABS, which is a consortium of historically minority serving institutions and the research university at University of North Carolina at Chapel Hill. PMABS involves comprehensive, complementary programs that span the years from secondary science education through post-

graduate study and involves faculty development, infrastructure revitalization, curriculum modernization, technology adoption, and collaborations for student development.

Too few educational institutions acknowledge that they are really part of an educational workforce continuum and most institutions act as if the action is only where they are.

The eighth principle is to recognize that where you are at any given point is not the end of the story. Bridging to the next level is a key principle. Too few educational institutions acknowledge that they are really part of an educational workforce continuum and most institutions act as if the action is only where they are. The best ones build relationships with corporations, build relationships for the students with research organizations and help students to develop the personal skills and the work habits that enable them to transition into the workplace. And that's what graduate study was for me. It was a natural extension. It was not a decision point that was fraught with worry at a given point in time.

An example of bridging is the UCLA Center for Excellence in Engineering and Diversity,²⁰ which draws support from both higher education and industry while monitoring student progress from one milestone to the next. The program focuses on the development, recruitment, retention and graduation of underrepresented engineering students and includes a pre-college program for parents, public school teacher training, as well as support for graduate students.

The ninth principle is predicated in a question: "Did you achieve what you set out to achieve?" If not, good intentions do not matter. This means that assessment is important. In fact, the assessment benchmarks should be used to design the program in the first place. If you have to evaluate a program, and a program has been put together without any thought to the endpoint, then it's a lot harder to measure achievable goals. An example is the Gateway Coalition,²¹ which began at Drexel University and now encompasses nine universities. It shows continuous progress on student retention, GPA, and completion of the engineering baccalaureate. The program has driven change throughout the engineering curriculum, development of student skill and leadership presentation, organization and management and in the faculty culture.

Now I could not end if I did not do my own personal advertising and tell you the lessons we have learned. We do believe we have to develop the pipeline. The GEAR UP Program,²² which was originally funded with a grant from the U.S. Department of Education in 1999, leads a coalition of institutions that adopt

seventh grade classes. It helps to prepare low-income students from six school districts for college, the six lowest income districts in the capital region of New York, by offering after school, weekend and summer learning programs at Rensselaer and other area colleges. It includes a residential program for these low-income students in the summertime. It also provides financial education and financial planning services for their parents, beginning in the tenth grade.

The GEAR UP participants now number 900 students entering their junior high school year. They have been with the program since the 7th grade. A second program is called Bridge, a residential summer program for entering underrepresented minority students. They receive academic credit in the university for an introduction to engineering course that gives them a head start. A third program is for talented rising seniors. We also have programs that are targeted to middle school teachers, including one that's specifically focused on achievement in mathematics, science and engineering.

The last program that I will tell you about is the Women at Rensselaer Mentor Program.²³ It is a peer-mentoring program that is designed to assist freshmen and transfer students, make a smooth transition into university. First year women students are paired with an upper class woman in the same or related subject to help that student avoid pitfalls, consider multiple options or solutions to problems, and make choices for success. Now we are extending that to having the graduate students be the mentors for the upper class women and so on. In spite of some institutions' retrenching because of worries about the outcome of the University of Michigan cases, we are actually going the other way. We're going to start a six-week residential program not unlike those that a number of campuses have had for a number of years.

As I look back at what I have just described in terms of what BEST has found works for developing a sustainable and diverse student body there are lessons in it for faculty development. However, I want to leave the discussion of this topic for Shirley Tilghman. Based on my experiences, I believe that if we really are serious about developing all the talent available, we need a firm national commitment as well as a comprehensive national plan even as we work off the models highlighted by and the principles developed by groups like BEST.

If we really are serious about developing all the talent available, we need a firm national commitment as well as a comprehensive national plan.

⁷ National Science Foundation. "Graduate Education Reform in Europe, Asia, and the Americas and International Mobility of Scientists and Engineers: Proceedings of a NSF Workshop," <http://www.nsf.gov/sbe/srs/nsf00318/summary.htm>

⁸ Council on Competitiveness. World Class Workforce. The BEST Initiative, <http://www.compete.org/wd/best.asp>

⁹ Committee for Economic Development, <http://www.ced.org/>

¹⁰ The National Academies. Government-University-Industry Research Roundtable, <http://www7.nationalacademies.org/guirr/index.html>

¹¹ Building Engineering and Science Talent. Publications and Presentations, <http://www.bestworkforce.org/publications.htm>

¹² University of Maryland, Baltimore County. Meyerhoff Graduate Fellows Program, <http://www.umbc.edu/meyerhoff/Graduate/>

¹³ National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc., http://was.nd.edu/gem/gemwebapp/gem_00_000.htm

¹⁴ Preparing Future Faculty, <http://www.preparing-faculty.org/>

¹⁵ Council of Graduate Schools, <http://www.cgsnet.org/>

¹⁶ Women in Science and Engineering Residential Program, http://www.undergraduate.research.umich.edu/WISE_RP.html

¹⁷ Stevens Institute of Technology. The Lore-El Center for Women in Engineering and Science, <http://attila.stevens-tech.edu/lore-el/>

¹⁸ University of California Berkeley. Summer Bridge, <http://summerbridge.berkeley.edu/>

¹⁹ Partnership for Minority Advancement in Biomolecular Sciences, <http://www.unc.edu/pmabs/>

²⁰ UCLA Center for Excellence in Engineering and Diversity, <http://www.ceed.ucla.edu/main.htm>

²¹ Gateway Engineering Education Coalition, <http://www.gatewaycoalition.org/>

²² U.S. Department of Education. Gaining Early Awareness and Readiness for Undergraduate Programs, <http://www.ed.gov/programs/gearup/index.html>

²³ Women at Rensselaer Mentor Program, <http://www.eng.rpi.edu/wmp/>

***Dr. Shirley Tilghman**, President of Princeton University, emphasized programs that have been successful in recruiting a diverse population into science and engineering. Whereas Dr. Jackson concentrated on recruiting students, Dr. Tilghman focused on recruiting faculty. Through an interesting encounter with M.D./Ph.D. students at Johns Hopkins, Dr. Tilghman illuminated the importance of opening doors for women to move from Ph.D. programs into faculty positions at colleges and universities.*



I will be able to be brief for the reason that I agree with almost everything that Shirley Jackson said about what are the important components of undergraduate programs that succeed in attracting underrepresented minorities and women into science and engineering. The Meyerhoff Program,¹² at the University of Maryland, Baltimore County, is one of the finest examples of a success story but by no means the only one. The characteristics that successful programs have in common are among the things that Shirley Jackson outlined in her set of BEST's nine principles.

One that strikes me as especially important is an intense engagement with students as individuals. In successful programs, undergraduates are often rapidly integrated into research laboratories, where they are able to have very individual experiences. Such programs take faculty who are committed to the program and to the individuals in their laboratories. Successful programs create “vertically integrated” communities, composed of undergraduates, graduate students, postdoctoral fellows and faculty. This collegiality is one of the most attractive aspects of an academic life in science and introducing undergraduates early to what it means to be part of a community of scholars is critically important.

Carnegie Mellon developed a very successful program to increase the participation of women in computer science.²⁴

This program began by trying to understand why the participation of women in computer science had been declining with time, not increasing. The faculty knew that adolescent boys who are future computer science majors can often be found in their bedrooms, the lights out, the curtains closed, playing on their computers. Yet it is the rare thirteen-year-old girl who would be engaged in such activity. As a result, by the time those teenagers reach university, they have had different experiences and acquired different computer skills that make it difficult to put them into the same classroom.

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If colleges and universities always accept the ground conditions as given, they are unlikely to make significant progress in enhancing the participation of women and minorities.

With this in mind, Carnegie Mellon developed two tracks into the computer science major: one for students who had been programming in C since the age of thirteen, the other for those who had no previous experience but wanted to study computer science. These two tracks eventually merge, and the net result is that the percentage of women graduates in computer science has soared at CMU. The clear lesson from this program is the importance of recognizing and adjusting to your student constituency. If colleges and universities always accept the ground conditions as given, they are unlikely to make significant progress in enhancing the participation of women and minorities.

Dr. Jackson and I agreed that I would focus on strategies for increasing participation of women and minorities within the faculty in science and engineering. I want to begin with what for all intents and purposes looks like the great success story in academia: the very dramatic increase in the number of women in the biological sciences. At the Ph.D. level in the biological sciences, we are now close to parity; yet a precipitous drop persists in the percentage of women who, after postdoctoral studies, assume faculty positions. The drop is less dramatic at four-year liberal arts colleges than at research-intensive universities, but it is present at both kinds of institutions.

So now that we are attracting women into pursuing doctorates in life sciences, why are they not choosing to go on to academic careers? More precisely, are these women not choosing to go on to academic careers or is academia not choosing them? I believe that both are occurring.

For several years now the presidents and senior faculty and administrators of nine research-intensive universities have participated in meetings sponsored by MIT that focus on how to improve the hiring and retention of women in the science and engineering faculty. At a recent meeting this spring, one of the large California research universities reported that they had looked at the applicant pool for academic positions in the biological sciences over the last five years and found that the number of women in the pool was 20-25 percent, half of what is expected given that the percentage of women receiving Ph.D.s in life sciences is approaching 50 percent. If this one example is representative, then it is deeply disturbing and suggests that women are themselves choosing to move out of, and not into academia. Why is that the case?

It is my belief that one important answer can be illustrated with a story. Seven or eight years ago I was invited to have dinner with a group of M.D./Ph.D. students at Johns Hopkins, in part to discuss careers in science. Johns Hopkins has one of the most prestigious M.D./Ph.D. programs in the country, and these students were the *crème de la crème* of the nation's highly selective group of medical students.

After I had gone on for ten or fifteen minutes, one of the women in the audience put up her hand and said, "You have nothing to tell us about our careers. Nothing about your story is relevant to us." I was a little taken aback and said, "Well, I am perfectly prepared to believe that but I think you need to explain what you mean." The student proceeded to tell me that my experience was not relevant today because it was much easier to succeed in science in the late 1970's and early 1980's when I was coming up through the ranks. She pointed out that the profession is much more competitive today, and that it takes much longer to obtain a faculty position. She claimed that today's students face extraordinary hurdles to survive into academic medicine.

That encounter was my wakeup call when I realized that for women today, the path to a career in academia looks long, hard and incompatible with having a family. I think that we cannot go away from a workshop like this without acknowledging this issue, which has been with us for a long time, but has not been solved. In fact the competitiveness that characterizes the biological sciences today has only made it worse.

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The length of time to Ph.D. or M.D./Ph.D degree in the biological sciences has increased by two years in the last 25 years. Furthermore the likelihood of taking on additional postdoctoral training has increased and the length of that training has increased from approximately two years to sometimes five or six years over the same period. During that elongated time a postdoctoral fellow is earning relatively little money and accumulating no retirement benefits, and the likelihood that an attractive academic job is the reward for delayed gratification is diminishing.

This is simply an unattractive career path for *everybody*, males and females. However, for women it is an especially difficult career path because of the degree to which the problem of balancing family and work remains primarily a greater issue for women than men. If I have one take-home lesson that I would like to deliver to this workshop, it is that if we are trying to understand why we are

not making more progress, particularly with women, I believe that the current design of the training path is the problem. My fear is that we are actually losing ground in terms of the participation of women.

If we are trying to understand why we are not making more progress, particularly with women, I believe that the current design of the training path is the problem.

So what can we do? I would like to suggest several things. First, we need to send loud and clear signals of encouragement to women and to underrepresented minorities. Programs are needed that essentially bridge the period between graduate school and the first academic job. The program that I was the most familiar with no longer exists but I think was a wonderful model, the Markey Charitable Trust Scholar Program.²⁵ This program funded salary and research funding for postdoctoral fellows one or two years into their postdoctoral fellowship and through five faculty years. Symbolically, this program said, “We are going to make it as easy as possible for you to make that transition between trainee and faculty member.” Needless to say, this program identified and then set up for success extraordinarily gifted scientists who have gone on to have successful careers.

Universities too have to think long and hard about the way in which they support their young faculty during the critical the first years. There is no silver bullet, by which I mean no single thing that universities can do to suddenly transform the landscape for women trying to make this difficult transition. But it is essential that universities signal that they are family-friendly places by sponsoring accessible and affordable daycare that is nearby and conducting the work of the university within the hours that are consistent with parenthood. For example two years after I arrived at Princeton, I was appointed to a very influential committee that the president chaired and I was told it met at 7:30 in the morning. I said, “Well, not if I’m going to be on it, it’s not going to meet at 7:30 in the morning.” It was virtually impossible to be a parent getting children up, getting them to school, and arrive in time for a 7:30 meeting. And I’m happy to say that the president permanently changed the time of the meeting.

Another area that needs further thought is the tenure process, and its impact on the retention of women and minorities. I am convinced that the process needs to reward quality, not quantity. Science moves forward on the basis of discoveries of high impact, not with small incremental work. That argues that it is the impact and the quality of the work that should be evaluated, and not the quantity. One paper that changes the way the field thinks is worth ten that dot the i’s and cross the t’s. Such a perspective will help

all junior faculty, but will especially help women struggling to balance family and work. Signaling to the faculty that being a parent is not incompatible with being able to be successful in the university is extremely important if we are going to continue to hope that young women are going to be attracted to careers in academia.

Third, let me just say a few words about how universities go about the process of hiring faculty. If the diversity of the faculty is a high priority the signal must come from the top, from university presidents, provosts and deans. Unlike undergraduate admission, which is conducted centrally at most colleges and universities and therefore can have policy imbedded in the process, faculty hiring is a disseminated process. For the central administration to have an impact, the signals have to be loud and clear, and the incentives transparent.

At Princeton, we have taken advantage of a “target of opportunity” search process that I know many universities use. A committee, chaired by the provost or the dean of the faculty, and composed of faculty who are among the most distinguished in the university, consider candidates who are nominated by departments. The only criterion is that the candidate must increase the distinction *and* the diversity of the faculty. We encourage the departments to look in unexpected places for candidates to counteract the “pedigree problem,” the belief that there are only two or three places that could possibly harbor people worthy of our attention.

This strategy has succeeded at Princeton because it has the imprimatur of the strong senior faculty, and because it has shown that it can attract to the university some of the finest scholars in the world. Thus it has become a badge of honor to have come to Princeton through this university-wide search process. The other key has been the provision of additional resources to departments that nominate successful candidates. Those additional resources stay with the department as long as the recruit is a member of the faculty, and do not disappear over time.

Although the target of the opportunity search process has been very successful in bringing women into science and engineering as well as bringing underrepresented minorities to the university, it is important to say that its success critically depends upon chairs of departments who care about this issue. If the committee does not receive nominations, the members cannot appoint them. Therefore it is important to appoint chairs who themselves believe that

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diversity is essential to the future vitality of the university.

It is occasionally helpful to remind departments that there are excellent candidates for them to consider. One strategy is to ask a chair to submit a list of women and underrepresented minorities that they would like to appoint if resources were available. When such a list fails to appear, it is sometimes helpful to ask the members of the department's external advisory council to compile the list, whose purpose is to bring to the faculty's attention the fact that there are excellent candidates that meet their very high standards.

I do not think any one of these ideas is sufficient: all of them are levers that we have to be pushing at all times. This is surely an uphill battle for all of us, but a highly worthy one.

²⁴ Carnegie Mellon University. Women in Computer Sciences: Closing the Gender Gap in Higher Education, <http://www-2.cs.cmu.edu/~gendergap/>

²⁵ National Academy of Sciences. "Evaluation of Markey Charitable Trust Programs," http://www7.nationalacademies.org/BHEW/Markey_Evaluation.html

Dr. Norbert S. Hill, Jr. stated in his presentation that students need two things to survive in academia: safety and permission. He then proceeded to outline factors that affect the safety of a student in an academic environment and that affect the ability of a student to succeed. Dr. Hill stressed differing cultural values between institutions and the need to support all students in their education to improve diversity.



Students need two things to survive. They need safety and they need permission. Unless you are in a safe place, you cannot do your work. Unless you have permission from your advisors, your committee or an infrastructure of web-based support, you cannot do your work. You need permission to become brilliant at the places you are at. All of this is based on relationships, and if those relationships are not there, it can have harmful effects.

You need permission to become brilliant at the places you are at.

The dance called tenure is another thing. I know that many of our faculty members get involved in the community but when push comes to shove and they are up for tenure, they find the door just slams in their face. I can see why people do not want to audition really long to do this.

We all know that we need to increase the pool of minority students at all levels, especially the graduate level. To help accomplish this, I think that teaching fellowships should have the same status as research fellowships. Where does one learn their craft to teach? One can both do research and learn to teach but somehow the system has to be structured in a way so teaching is of value.

If I get a student off the reservation who wants to teach and they are from Montana or they are from the Navajo Reservation, they do not want to come out East because first of all, they know it is not safe and second of all, there is a different set of values. If you come from the inner city or you come from a bayou or you come from a reservation, there is a whole different set of values and relationships where one would never fit. Somebody who wants to teach at Billings and Bozeman or in Gallop and work at community colleges or other places where there are native students, wants to do so because in these places, there are people who look like them and who they can relate to. It is in these places that certain people can thrive as a faculty member. So it is not always going to a Research One institution that is the solution and I do not think that Research One institutions always have all the solutions. They have some of the solutions.

I do not think that Research One institutions always have all the solutions. They have some of the solutions.

This whole issue is multi-layered, from research universities to liberal arts colleges to land grant institutions to comprehensive universities and community colleges. You have got to talk about displacement of culture and values to minority folks.

Also consider what happens when the money is gone. If you throw money at the problem, then what happens to the sustainability of programs when the money is all gone? Most likely the program dies. When state budgets are cut, the first thing that is cut is education benefits for people of color. Institutions are very nervous now when they hear the word “minority” because of the Michigan case.

People are still worried about lawsuits and the administration has created a climate of fear in this country. Institutions are reframing and renaming their programs. What is wrong with calling it an American Indian program for people whose land you stole and that you are building a university on! It is a funny time. It is about leadership. It is about institutional intention and it is about relationships. Commitment without cash is counterfeit so I think there is some cost-sharing that can be done and some other ways to make programs survive.

The Indian Health Service has a program that it calls “forgivable loans” in terms of if you teach for five years, 20 percent of your loan burden is reduced. So maybe there are some ways to structure a loan program and give money to the students, not to the institution. I heard on National Public Radio recently that people in academia are talking about law students getting forgivable loans if they do public service work and I know that there are other places where that can be done.

If you are going to spend twelve or thirteen years with a student, making them the best they can be, you want to keep them. Some institutions cannot always do this. In order to retain someone, you have to provide networking, mentoring, long-term financial support, travel, seminars, symposia, and training on how to teach. It is the interconnecting web of support and from identification of a student to tenure that helps institutions retain their own.

Dale Smith writes a lot about this in the Claremont Graduate Schools and she calls it “change interrupted,” and “institution interrupted.” You really need to look at the larger question of institutions and how they are structured and what they do rather than placing Band-Aids on this. We need to be diverse in our approach and I will finish by saying that change only comes when it is in everyone’s self-interest.

Change only comes when it is in everyone’s self-interest.

DISCUSSION

The discussion mainly focused on two issues. First, an audience member asked Dr. Norbert S. Hill, Jr. to comment further on his view that fear is contributing to a lack of diversity in the science and engineering workforce. Second, an audience member asked Dr. Shirley Tilghman to propose ways to remedy the “arms race” that is going on within biology graduate programs.

Stemming from comments made in his speech, an audience member asked Dr. Norbert S. Hill, Jr. to elaborate further on fear and its role in limiting participation.

Dr. Norbert S. Hill, Jr.

I think safety [as students go through their doctoral research] is really important for people. When people are afraid, you do not get their best work because they are worrying about other things. Safety also involves feeling good about where you are, financial support and knowing that you have the support of your colleagues. You need genuineness in your relationship with the institution itself.

An audience member directed a comment toward Dr. Shirley Tilghman. The member expressed concern that there is a problem with the number of years it takes to attain a Ph.D. and the “arms race” going on in biological sciences because of fierce competition, and questioned how to remedy this.

Dr. Shirley Tilghman

To provide a break on the lengthening of training, my recommendation to the NIH was to limit the number of years in which they would fund a graduate student on research grants. I believe that would be the single, quickest, most effective way to get time-to-degree under control in this country.

With regard to reducing the arms race, we put into place at Princeton a pretty controversial policy where we limited the time of institutional support and the time during which a student may be enrolled. When the policy first went into effect, there were a lot of students who had been around for too long who suddenly were finishing their Ph.D.s and some of them went off to excellent jobs.

CHANGING DEMOGRAPHICS AND CHALLENGES OF THE FUTURE

Dr. Diana Natalicio, President of the University of Texas at El Paso and Vice Chair of the National Science Board, began the panel by noting recent demographic shifts throughout the country. These shifts have created tremendous potential for higher education in science and engineering; however, currently there is a deficiency in the number of minorities in the science and engineering workforce. The major challenge is therefore to embrace changing demographics by opening up opportunities to these underrepresented populations.



It is no secret to any of us that the demographics of the United States are changing. The 2000 Census²⁶ reveals a 58 percent increase in the U.S. Hispanic population between 1990 and 2000. These numbers continue to grow as states across this country try to adapt. These shifts are not only a challenge for elected officials; they represent a major wakeup call and a huge opportunity for U.S. higher education, especially in science, math, engineering and technology.

To put things in perspective, consider the following rankings of the University of Texas at El Paso. It ranks first in the Nation in the number of master's degrees awarded to Hispanics in geological sciences: the University has awarded two such degrees. It ranks first in the number of physics master's degrees awarded as well: the University has awarded two of these degrees. The University ranks first in awarding master's degrees in environmental engineering with six and first in awarding master's degrees in metallurgical and materials engineering with four. At the doctoral level, El Paso ranks first in computer engineering degrees awarded to Hispanics with one. Everyone should consider what this means in the context of the demographics changes reflected in the 2000 Census.

The situation is not limited to Hispanics either. People of color are grossly underrepresented in graduate schools, master's programs, Ph.D. programs, and as a consequence, on university faculties as well. The implication is that if we do not increase the size of the pool of available candidates, then Universities are just going to steal from each other, which is exactly what has been occurring. The highest bidder wins the prize. We all know that this is not

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good enough and we are all here today because we recognize the challenge that we have before us.

²⁶ U.S. Department of Commerce. Economic and Statistics Administration. U.S. Census Bureau. United States Census. 2000. "The Hispanic Population," <http://www.census.gov/prod/2001pubs/c2kbr01-3.pdf>

Dr. Beverly Daniel Tatum, President of Spelman College, discussed the importance of recognizing racial biases in our society. She argued, based on studies by social psychologists, that affirmative action programs and thus, attempts to increase diversity at universities, are threatened by unexamined evaluative biases.



This “aversive racism” must be scrutinized if the United States is to appropriately respond to demographic shifts and the needs of the science and engineering workforce.

As one of the small number of black women who has been a tenured full professor, as a mother of two young black men, both of whom aspire to careers in the academy, and as president of Spelman College where we are both producers and consumers of a diverse faculty, I have many personal and professional connections to this topic and I’m glad to be a part of this discussion. Although I wear multiple hats, I want to speak today from the perspective of a psychologist who has written about racial issues.

The NSF plays an important role in advancing the knowledge for the whole nation and producers of that knowledge need to reflect the multiple perspectives of this nation. Since I will be addressing the issue of bringing diversity to university faculty, I want to begin by reflecting a little bit on the demographics.

According to the 2000 Census,²⁷ there are approximately 280 million people in the U.S. One percent are American Indian, four percent are Asian, twelve percent are black, thirteen percent are Latino or Hispanic and seventy-five percent are white. By the year 2050, whites are projected to be fifty-three percent of the population in the U.S and by 2010, Latinos are expected to surpass African Americans as the largest racial or ethnic group of color.²⁸ Though the Asian population is smaller than both of these groups, it is expected to increase in number more rapidly than any other group.

College enrollment among students of color has increased dramatically. According to the Department of Education,²⁹ students of color represent approximately 28 percent of those participating in higher education today and the percentage is rising.

Though the population is shifting, it is still the case that there exists social segregation. Students go to college with little

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knowledge of one another's backgrounds beyond the stereotypes that are so pervasive in our society. The residential segregation patterns currently in place do not serve our children very well in this regard. White children are the most likely to grow up in segregated neighborhoods and consequently, have the least experience learning to negotiate diverse settings. The average white person lives in a neighborhood that is more than 80 percent white, while blacks live in neighborhoods that are on average approximately 60 percent black and 30 percent white. Hispanics live in neighborhoods that are roughly equal: 40 percent white and 40 percent Hispanic. Asian and Pacific Islanders are the most urbanized group: 94 percent reside in cities and they are most likely to be in neighborhoods that are composed of a mix of whites, blacks, Hispanics and other Asian and Pacific Islanders.

What is true for students is even truer for faculty who are even less likely to have grown up in diverse neighborhoods or to have been educated in diverse school environments. This lack of exposure makes both students and faculty very susceptible to a subtle but pervasive form of racism that John Dovidio³⁰ and his colleagues have called "aversive racism." Aversive racism is defined as, "an attitudinal adaptation resulting from an assimilation of an egalitarian value system with prejudice and with racist beliefs." In other words, most Americans have internalized the espoused cultural values of fairness and justice for all, while at the same time breathing what I call the smog of racial biases and stereotypes pervading the popular culture.

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We breathe this smog not because we want to but simply because it is the only air available. The existence of almost unavoidable racial biases and the desire to be egalitarian and racially tolerant forms the basis of an ambivalence that aversive racists experience. This creates a desire to be fair on the one hand, but on the other hand, your thinking is unavoidably influenced by these biases in the culture. Pointing to the findings of several impressive research studies, social psychologists such as John Dovidio and Samuel Gaertner³¹ argue that because aversive racists see themselves as non-prejudiced and racially tolerant, they generally do not behave in overtly racist ways. When the norms for appropriate non-discriminatory behavior are clear and unambiguous, they do the right thing because to behave otherwise would threaten the non-prejudiced self-definition that they hold.

Dovidio and his colleagues assert that in situations where it is not clear what the right thing is, or if an action can be justified on

the basis of some factor other than race, negative feelings toward blacks will surface. In these ambiguous situations, an aversive racist can discriminate against blacks without threatening his or her racially tolerant self-image. For example, a study asked white college students to evaluate black and white people on a simple good-bad basis. Students consistently rated both blacks and whites on a subtle continuum of goodness, and clearly choosing bad rather than good to describe blacks might indicate bias. Whites were consistently rated better than blacks but blacks were not rated as bad. For instance, when the rating choice was ambitious versus not lazy, blacks were not rated as lazier than whites but whites were evaluated as more ambitious than blacks. Repeated findings of this nature led these researchers to conclude that a subtle but important bias was operating. In the eyes of the so-called aversive racist, blacks are not worse but whites are better.

Dovidio and his colleagues concluded that the aversive racism framework has important and direct implication for the implementation of affirmative action type policies. Affirmative action has often been interpreted as, when all things are equal, take the minority person. Because whites tend to misperceive the competence of blacks relative to themselves, insufficient competence, not race, becomes the rationale justifying resistance. The particular irony here is that the more competent the black person is, the more likely this bias is to occur. The research that I have just discussed has been framed, of course, in terms of black-white relationships and I have just mentioned the demographics of our society as moving us beyond just a black-white perspective. Yet the black-white emphasis in the aversive racism framework seems well placed when we consider that researchers have found that negative attitudes toward affirmative action are expressed most strongly when blacks are identified as target beneficiaries.

Certainly anyone involved in faculty searches knows that there are many opportunities for evaluation bias to manifest itself: in the initial recruitment and screening of applications, in the interview process and ultimately, in the final selection. Competent candidates of color are likely to be weeded out all along the way. Some of you may recall the book by Stephen Carter,³² *Reflections of an Affirmative Action Baby*.³³ In that book, he reflected on his experience as a student at Yale and his knowledge that he had been a beneficiary of affirmative action. Carter argued that affirmative action might not be so necessary when black candidates were “too good to ignore:” that if you were really good, then affirmative action would not be necessary. However, this research that I have

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presented suggests that it is those who are too good to ignore that are perhaps too good to hire in the way that this bias operates.

Though the research on evaluative bias is dismaying, it also points in the direction of an effective response. Remember that when expectations for appropriate behavior are clearly defined and a biased response can be recognized, whites are consistently as positive in their behavior toward blacks as toward whites. The role of institutional leadership is clearly important here. If administrators on campus and federal agencies or other entities off campus articulate the organization's diversity goals and the reasons that such goals are in the organization's best interest, the appropriate behavior in the search process should be clear. If we keep our eyes on the prize in this way, it is possible to get past this kind of evaluative bias.

²⁷ U.S. Department of Commerce. Economic and Statistics Administration. U.S. Census Bureau. United States Census. 2000. "Overview of Race and Hispanic Origin," <http://www.census.gov/prod/2001pubs/c2kbr01-1.pdf>

²⁸ U.S. Department of Commerce. Economic and Statistics Administration. U.S. Census Bureau. United States Census. 2000. "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," <http://www.census.gov/ipc/www/usinterimproj/>

²⁹ U.S. Department of Education. National Center for Education Statistics. *Digest of Education Statistics, 2002: Postsecondary Education*, http://nces.ed.gov/programs/digest/d02/ch_3.asp

³⁰ Dr. John Dovidio. Faculty Page, <http://departments.colgate.edu/psychology/web/dovidio.htm>

³¹ Dr. Samuel L. Gaertner, Faculty Page, <http://www.psych.udel.edu/people/detail.php?firstname=Samuel&lastname=Gaertner>

³² Stephen L. Carter, Faculty Page, <http://www.law.yale.edu/outside/html/faculty/slc2/profile.htm>

³³ Olson, Walter. "Breaking Ranks (review, Reflections of an Affirmative Action Baby by Stephen Carter)." *National Review*. October 7, 1991, <http://walterolson.com/articles/carteraa.html>

Dr. Shirley Malcom, head of the Directorate of Education and Human Resources for the American Association for the Advancement of Science, challenged the system of hiring faculty into academia and suggested that this a major obstacle for recruiting diverse student bodies into science and engineering careers. She asked, “Do minority students see teachers and faculty who look like them? Why is this important? I think that everyone needs an existence proof. When you have to become something you have never seen it is really tough. A lot of us in this room had to become things we never saw and we had to somehow be convinced by somebody at some point that we could in fact become these things.” Arguing that universities are making the same systematic mistakes in recruiting faculty, she argued for the sharing of ideas amongst universities on how to achieve a diverse faculty to prevent ‘reinventing the flat tire.’”



I want to start off by telling you that I wear a lot of different hats, meaning that I speak from multiple perspectives. I will be wearing a couple of different hats today as a minority and a female. I hope that the National Science Board will learn from my experiences as such and that we can all work together to bring diversity to science and engineering.

The AAAS Directorate Education and Human Resources Programs houses the National Postdoc Association. It is interesting for me, because we have responsibilities that range from pre-K through postgraduate, to look at issues across the spectrum and at those that relate to women, minorities and people with disabilities, there are some issues and some perspectives that emerge from the breadth of our responsibilities.

One of the things that has always been very useful about having women’s issues in our portfolio, was that I never believed that if we got the numbers right, we would get the positions right. I never believed that because I saw the numbers of degrees awarded to women in Science and Engineering change, and I saw nothing happen for them within the institutions. In the case of people with disabilities, a lot of the problems early on that those individuals faced were because the laws were not on their side. You had to get the law right first. But even once you got the law right, you still had a lot of work that had to be done in faculty pipeline; they are not even present at the assistant professor level among S/E faculty.

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The situation with postdocs was very instructive because I came to understand that you had a group of people who had played by the rules; they had done everything that everybody told them that they were supposed to do to get through the system, and yet they still couldn't get into the system. I now refuse to believe that just because you play by the rules and do everything right, that a way will be made for you.

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Many of my colleagues say, "if it ain't broke, don't fix it." Well, it's broke. This has been one of the crucial tenets that has not been accepted.

In America today, we have a group of people who are marginalized, disenfranchised, treated as children to a certain extent, not supported in assuming independent lives and not paid adult wages so that they can support families. These are people who are advancing in age. These are people with families. Yet, this kind of perspective (a recognition of their roles and responsibilities) really is not one that seems to be in place within institutions. The bottom line to all of this is that the problem is the system. The things we have put in place over the years have basically been Band-Aids: programs that have been in the margin. The only way that you can in fact accommodate the needs of the majority is to reengineer the system so that it serves the majority. And until it serves the majority, the system does not really work. Yet we have not really looked at ourselves as addressing a system that does not work.

When radical changes have been proposed, such as in the way we support students or develop careers, many of my colleagues say, if it ain't broke, don't fix it." Well, it's broke. This has been one of the crucial tenets that has not been accepted. The other thing that I would say is that students are walking away from science and from academics; they're voting with their feet. It's not a choice when you have no choice. People are not just voluntarily leaving. They're being pushed out. They're being given unhealthy academic climates, be it smog, fog or whatever you want to call it, and then asked to perform in ways that just make no sense.

John Gardner once said, "We are continually faced with a series of great opportunities, brilliantly disguised as insoluble problems." Thus, I want to pose a question and seek the opportunity it provides to question the system. Do minority students see teachers and faculty who look like them? Why is this important? I think that everyone needs an existence proof. When you have to become something you have never seen it is really tough. A lot of us in this

never saw, and we had to somehow be convinced by somebody at some point that we could in fact become these things.

Regarding the role of faculty in research, we know what the role is and we know what the expectations are. However, I think that there is a much larger issue, namely, the faculty role as educator. The question of faculty role as educator - transmitting knowledge and know-how, culture and values, socialization and networking, guiding intellectual development - is the role that we really are talking about. In the university that role has to be in place, in addition to the role as researcher.

So how do we create the next generation of scholars and educators? How do we provide future faculty with the kind of career guidance, the notion of societal responsibilities and the ideas of cultural competence that are necessary? The notion of cultural competence was introduced in medicine and in other areas where it makes a difference how people relate those who are at the other end of whatever service they are providing. We have not really had this kind of discussion within education. The notions of being able to understand where people are coming from, what they need, what they value, and how to work with them in ways that are respectful to get the best out of all kinds of people, are crucial. I think that it is time to really have a serious discussion about cultural competence in the context of a faculty role and of creating the next generation of scholars and educators. It is the next generation of scholars and educators that we are addressing in this panel.

Looking at current figures for the education pipeline we see that there is an increasing minority student population and a declining white student population. This is happening in the face of decreasing numbers of minority faculty at the K-12 level and no gain in minority faculty in higher education. We talk about this as being a national issue, but I think that the important thing is that it not be seen as just a national issue. It is a regional and state issue as well, because it is more exaggerated in some places than in others. The numbers are real on a national level, and they are even more real and more immediate on a state-by-state basis. That is where a lot of the action has to happen within the institution. Already in California and Texas, we have school age populations where no single group comprises the majority. And in other states such as Florida, New Jersey, New York and Illinois, similar trends are emerging. But the student changes are not being accompanied by changes in faculty makeup.

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The thing that really makes this tough to get a shift in share (of faculty) is that it requires very large numbers. Yet minorities are not even in the faculty pipeline; they are not even present at the assistant professor level among S/E faculty.

Now I think that Beverly's (Tatum) presentation is quite telling because it calls into question everything that we hold dear. When we speak of "peer review," what do we mean by peers? Do we have a sufficient expectation of fairness? We know that there is research that says when you evaluate teaching competence, if you show the same things to students and one person being evaluated has a female name and the other has a male name, they consistently rate the female lower. If you have this phenomenon and you know this is happening in the evaluation, how can we continue to do what we have always done? If the system is the problem, then somehow the system must stop being the problem. It must first do no harm and then try to do good.

What are some possible strategies? I think that everything has to be on the table, and that has never been the case. We talk for example about academic freedom but I seldom hear discussions of academic responsibility. One of the other quotes from John Gardner is "liberty and duty, freedom and responsibility, that's the deal." That is the deal in a society where it is the taxpayer who is supporting research and where the agencies are the stewards of the public dollar. That is the deal.

We have to reduce the time to degree because right now, science and engineering does not look like a good life.

I know that everybody has to have their own context and I know that everybody wants to look at things their own way. It may even be okay to reinvent the wheel, but we keep reinventing the flat tire and that is where the problem really occurs.

I think the question becomes one of how do we begin to affect the way that we make decisions about the processes that are in place. We have to reduce the time to degree because right now, science/engineering does not look like a good life. I was trustee of an institution that saw too many students that had been there too long. When told that they were not going to be supported for longer periods, it was amazing how fast these students then graduated. These kinds of strategies can be effective. We have some models that look like they may be exemplary, but they have taken on only parts of institutions, not the entire thing. We have no example of real structural change, where the money and the positions and everything follow this vision, and yet, that is the one thing that we have to create. We have to start looking at each other's models and programs so that we stop reinventing the wheel. I know that everybody has to have their own context, and I know that everybody wants to look at things their own way. It may even be okay to reinvent the wheel, but we keep reinventing the flat tire and that is where the problem really occurs.

A large part of the problem with regard to faculty hiring relates to the fact that the systems are poorly managed and that there is no transparency. But the lack of transparency is something that I think presents a real challenge to the NSF and to the way it relates to its grantees.

When you are giving large grants for centers that are supposed to have education as well as research purposes, you have the right to talk to the people who have benefited from these grants; you have the right to insist that there are processes and procedures in place that could lead to a desirable faculty and student makeup. If Xavier, Morehouse, Spelman and other institutions can produce students who go on to get Ph.D.s in science and engineering fields (where they are not expected), why can't others? Why can't we hold accountable some of the other institutions whom we continue to fund but without asking for accountability with regard to the way that they run their programs?

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Dr. Richard Tapia, Professor of Computational and Applied Mathematics at Rice University, highlighted the importance of retaining, not just admitting, students from underrepresented groups. Retention success follows from the creation of a community within an academic program. He believes that what we are dealing with is not a supply problem, but rather a demand problem because minority students are not demanding careers in science and engineering. Also, not enough minority students are being led to graduate programs, which is translating into a lack of minorities at the faculty level. He calls for the need to recruit “the precious few,” the minority students who have the skills and potential to fill top positions in the science and engineering workforce.



The Rice Department of Computational and Applied Mathematics,³⁴ which I represent, is number one in the production underrepresented minority Ph.D.’s in mathematical sciences of any school in the United States. And we’ve been that way for many years. On occasion, we’ve been told, you have 50 percent of the productivity of the country. Since 1998, our department has produced 23 Ph.D.’s. Of the 23, 12 have been women. Of the 23, 8 were underrepresented minorities. Of the 8 underrepresented minorities, four were African American, four were Mexican American. Next year’s freshman class will have eight people coming in. Of the eight, four are underrepresented minority, two are African American, two are Mexican American. Two are males, two are females. We do a sort of a Noah’s Ark approach to everything.

When the data that I have just quoted was published in *Science*³⁵ a month or two ago, I had a lot of calls. One of them was, “Okay, Richard, how many are foreign?” I said, “Zero.” “How many did you steal from other schools who could have gotten into Stanford?” I said, “Zero.” The issue is retention, not admission. It’s easy to admit. If I judge a school, I’m not going to judge on the percentage they admit, I’m going to judge on the percentage that they retain.

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I gave a talk recently at the University of California, Berkeley, and they said that there is something wrong with our Computational and Applied Mathematics Program at Rice because our retention rate is too high. They claimed that we have to get rid of some of the people in the program, otherwise we cannot have a quality

program. I believe that our retention of students is our greatest asset because it shows that we have a community. We have critical masses in the department and problems across divisions. We essentially have an inverted pyramid where I am at the top. I do not spend every day with all the students: I have a hierarchy of students and senior graduate students who mentor the less senior, down to the undergraduates and even to the high school students.

I hear from a graduate student that X has failed the qualifying exam and is getting kicked out of the program. I tell them, "Let me take care of it. X has another chance." X then takes the exam, passes, and goes on to get a Ph.D. At Rice we do well and we are able to recruit students, minority students, who are thinking of other elite schools: Stanford, Princeton, Harvard. But these students visit Rice and they say, "I have been accepted at these elite schools but I am turning them down to go to Rice." They see a strong model and they want to be a part of it.

We have a model that works but it is difficult to place our Ph.D. students because of this pedigree syndrome. The students want to go into academia, and they do get jobs, but it's also true that in many of the schools where we sent an application, we don't get close to the short list.

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Concerns regarding representation are not just lamenting the injustices of the past; rather we understand that underrepresentation endangers the health of the nation. It is not the health of the discipline that we worry about because the disciplines will go on with or without minorities or women. Maybe the disciplines will be better with them, I agree, but the discipline is not in danger. The danger is basically the health of the country because people are becoming second-class citizens for generations and generations. We must be concerned with our United States born and raised black, brown and red.

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As we go up the ladder from high school to undergraduate to graduate to faculty the representation gets worse. Evaluations also get worse, with the pinnacle of faculty hiring being the absolute worst, in terms of representation and in terms of hiring. I am going to step out and say a bold statement here. In spite of increasingly poor evaluations as we go up, the number one enemy of underrepresentation in this country is poor preparation of minorities at all levels. Number one. The number two enemy is maybe evaluation. We cannot focus on evaluations without addressing the fact that there are extremely poorly prepared

minorities at all levels. Cities are problematic and ninety percent of all minorities live in cities.

Let me tell you a bit about Houston Independent School District. If I get a valedictorian out of Moody High School, which is 98 percent Mexican American, or a valedictorian out of Yates, which is 98 percent African American, or a valedictorian out of Bel Air and Lamar, the two premier schools in Houston, I will have to go to the ones that come from the minority schools and say, “You have not been told this and you do not know this, and you are very good, but you are not prepared to run with the big dogs.” However, it could be that Bel Air and Lamar come up with a minority valedictorian and that minority will be prepared to run. So the lack of homogeneity in urban public K-12 education is one of our number one problems in terms of representation.

So what we are dealing with is really not a supply problem but a demand problem. The students are not demanding the career that we have been talking about. It is not that they rationally said, “no.” I gave the commencement address at Jones High School, a minority school, last year. I was introduced as a mathematician and I was given huge round of boos. The fellow who introduced me was very embarrassed and he said, “Wait, wait, wait, this is not just your normal mathematician. Wait until the talk is over, okay?” After my speech, a young woman came up to me and said, “You were right, it was a great talk. Are you sure you are a mathematician?” So this is what accounts for the loss of the masses.

Now I want to focus on a bigger problem and a bigger sin: the loss of the precious few. Positions of national leadership are produced in major research universities. If we want to produce minority leaders, then we must have minorities represented in these universities. The same is true of faculty. We break them, burn them out, make it unfriendly for them, take away their self-confidence and take away their self-esteem. These people do not know how good they really are and they do not know how well they have been educated.

The loss of the precious few is a bigger sin than the loss of the masses. Those few are the ones that should have been essentially going to graduate school, becoming our leaders, and they stopped with their bachelor’s degree because the environment is so unfriendly. Another thing you find is that minority students come into engineering and science and then move to the humanities.

The number one enemy of underrepresentation in this country is poor preparation of minorities

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Huge percentages of minority students nationwide in selective schools do this and we have to hold schools accountable for this.

The Peter Principle says that you are promoted to a level of incompetence. There is also a modified Peter Principle for minority students. They enroll at a university one level above what the preparation should be. So the student who should have gone to University of Houston ends up at the University of Texas and the student who should have gone to the University of Texas ends up at Rice, one step out of phase. If we had pushed them back, they would probably all go on to graduate school.

I went to community college and that is where I built self-esteem. I was the hottest thing they had seen in community college. They told me that I was great and they were going to take me to UCLA and I said fine. At UCLA I survived because I had thought I was so good at community college and I went on. But what is happening today is that we are losing these groups of students who are the very, very best because we are sending them to environments which will not lead them into graduate school and in turn, to a faculty position. That is a critical issue and I see it every day. I see it across the board. My job is to tell these students that they should go to graduate school. It does not matter that you got a "C" as a freshman, you should go to graduate school. As a result of this, I have had success with taking undergraduate students from Rice directly to graduate schools and they do very well.

³⁴ Rice University. Department of Computational and Applied Mathematics, <http://www.caam.rice.edu/>

³⁵ *Science*, <http://www.sciencemag.org/>

DISCUSSION

The discussion concentrated on two issues: statistical discrimination and bringing a level playing field to academia. With regard to statistical discrimination, each panel member expressed the view that faculty hiring committees are afraid of hiring a poor candidate but not afraid of not hiring a good candidate. This is one of the reasons for a lack of diversity in university faculty because those who are different are looked over. Dr. Tapia responded to the second issue of level playing fields in academia by saying that teachers must be made to feel part of a larger community: a community of educators, as well as scientists and engineers. By doing this, teachers will realize the importance of bringing high quality education to all students at all levels, ultimately creating qualified students for faculty positions and positions in the science and engineering workforce.

An audience member brought up the issue of statistical discrimination before the panel.

Audience Member

Statistical discrimination is the idea that in the system there are two kinds of error. One kind of error is hiring somebody who turns out to be a failure. We are utterly terrified university faculties are making that kind of error. The other error in a statistical term is to fail to hire a star. For some reason we do not worry about that. If someone went to the same school you went to, studied with the same mentors, looks like you, talks like you, thinks like you, you are never going to make the first kind of error. If somebody is different, if somebody went to the wrong school, studied the wrong thing, studied with the wrong advisor, is female or black or Hispanic or does some kind of research that you have never seen, you are likely to make the other type of error.

Dr. Richard Tapia

I have convinced our departments in terms of admissions, not faculty but in terms of admissions, that these errors really do happen. Our success has been this holistic approach both at graduate and undergraduate level and really looking to see if that person has something to offer. However, you are right that we have not adequately convinced faculty on this issue.

Dr. Shirley Malcom

One of the concerns I have is that in a lot of cases, when you ask about hiring, what will be said is that the faculty knows the people who are good. This kind of statement will then be enough that the discussion shuts off. The thing that I have raised in my role as a trustee is that I do not care who you know: everybody can learn from training and going through some kind of experience where you are walked through the process.

Institutions are leaving themselves open for quite a number of lawsuits when they do not provide training because there are a number of questions that search committees can, through ignorance, ask that are patently illegal to ask.

Institutions are leaving themselves open for quite a number of lawsuits when they do not provide training because there are a number of questions that search committees can, through ignorance, ask that are patently illegal to ask. I think that if training were raised as an issue of liability as well as one of perhaps not getting the best candidates, then there might be more openness to this notion of error, and we might get around this idea that “my people know the best people in the field.”

Dr. Beverly Daniel Tatum

Prior to going to Spelman, I was a faculty member, department chair and ultimately dean at Mount Holyoke College. At Mount Holyoke, one of the things that I did was serve as the chair of the faculty affirmative action committee. Something that I learned from that experience was that most departments were actually quite open to rethinking this ordering process and establishing a threshold of excellence over which anyone who exceeded that was considered a viable candidate. The problem was that no one knew how to recruit a diverse pool.

One of the articles that we were given as background reading for recruiting a diverse pool talked about how the usual passive placing of ads in the *Chronicle of Higher Education* or whatever professional publication it was, was not sufficient to recruit. However, if members of the faculty affirmative action committee talked with department members well before the search process began, for example, in the spring in the spring when the dean of the faculty announced who was going to have openings, then there was time to meet with the search committees, and in the spring to talk about the difference between goal-oriented versus process-oriented hiring. This allowed us to talk about strategies for effectively increasing the diversity of the pool. As a result, at Mount Holyoke we found tremendous success in being able to recruit faculty of color, even to South Hadley, a small town that is not particularly attractive for many people of color to come and live.

An audience member next asked the panel to address the issue of “gatekeepers,” and creating a level playing field for minorities so that minorities are qualified for faculty positions in science and engineering departments.

Dr. Richard Tapia

The best way to address bias on the part of the faculty, and there is no doubt about this, is to have some really good success. If you have enough success stories with underrepresented minority students, you go forward. If you have enough failures, you move back. One aspect of success is to get students to believe in themselves. Poverty is the worst kind of violence. It is not about students being smart: it is about being ready. If you can get students to believe in themselves, then they can be successful no matter what the situation.

Another one of the things that I think you have to remember is that the field is not necessarily level from the beginning. If you have teachers who have seniority, guess where they are not going to want to teach? If you have teachers who are really top teachers, they are going to want to teach your AP classes, not bottom level classes. If you have minority schools, you will often have schools without AP classes even available so the opportunity to even be challenged is not available.

I believe that community is important for teachers in the same way that it is for students. You have to make teachers feel they are not just a member of the education community: they are also members of the scientific and mathematics communities.

DIVERSITY GAP BETWEEN STUDENTS AND FACULTY

***Dr. Esin Gulari**, Division Director, NSF/ENG Division of Chemical and Transport Systems introduced panelists and moderated public discussion following panel presentations.*



Dr. Evelyn Hu-Dehart, Director of the Center for the Study of Race and Ethnicity in America at Brown University addressed the deficiency of minority faculty at Research One universities. Dr. Hu-Dehart attributed this problem to a cultural bias in the system. Namely, that top universities fail to look outside their ranks for qualified candidates. Because minorities are often educated in community colleges and state universities, they are overlooked, even though they are as capable as those coming from Research One universities, at fulfilling the role of a successful and productive faculty member.



Looking at the total number of faculty in science and engineering by race and ethnicity, blacks and Hispanics are not changing significantly. The largest number of Ph.D.s in the African American and Hispanic population is in education, then social sciences and humanities. The reverse is true for Asian Americans. Asian Americans receive a very disproportionately large number of higher degrees in engineering and in all science fields. Most of the space taken up by so-called minority scholars or scholars of color in the last decade or so have therefore been taken up by Asian Americans. If you take out the Asian American numbers, then the progress really is not impressive at all: it has basically been at a standstill for the last ten years.

Now I want to very quickly explain why it is that Asian Americans have made the progress. Looking at numbers in the back issues of *The Chronicle on Higher Education*³⁶ July issue, notice the institutions that Asian Americans have received their doctorates: they are very predominantly Research One universities. Every single major Association of American Universities, AAU, Research One institution is represented in this list. That to me in a nutshell explains why so many of them have moved on to the faculty positions at top-rated universities. These universities tend to hire their faculty from similar universities and it is in these institutions that they find a large Asian American pool.

In contrast, consider what happens with African Americans, Latinos and Native Americans. If you look at the African American list, you will be hard pressed to find the Research One institutions. This list is very different from the Asian American list. We can clearly see that Asian Americans are in the right kind of pipeline and in significant enough numbers so as to be recruited

Most of the space taken up by so-called minority scholars or scholars of color in the last decade or so have therefore been taken up by Asian Americans.

These universities tend to hire their faculty from similar universities and it is in these institutions that they find a large Asian American pool.

into the professorate of these Research One institutions. These numbers are just not there for the other major ethnic minority groupings.

Now what is the problem? The problem comes down to the faculty culture at the department level, at the search committee level, at the hiring level. I am not even talking about retention because before you can even tackle retention, you have got to talk about recruitment.

The good news is that we are producing black or Latino or Native American scholars in the science and engineering fields; however, they are being produced at institutions that are generally not on the radar screen of the big Research One universities.

The good news is that we are producing black or Latino or Native American scholars in the science and engineering fields; however, they are being produced at institutions that are generally not on the radar screen of the big Research One universities. There is an incredible coalition called the Southern Regional Education Board,³⁷ SREB. The SREB represents Ph.D. granting institutions primarily in the southern region of the United States and they have organized themselves into a coalition called the Compact for Faculty Diversity³⁸ to promote doctoral education for all students of color but primarily black and Latino with a smattering of Native Americans and a very small number of Asian Americans. The amazing thing about the SREB is that they meet every year and conduct an institute called the Institute on Teaching and Mentoring and it is specifically aimed at Ph.D. candidates. While there is production of graduate students of color, when I go and work with these students every year, I do not see the major Research One institutions represented.

I want to tell you about this because I find it quite disturbing that so many of the Research One institutes are not involved with this Compact for Faculty Diversity but I know why. It is because the institutes that are part of the compact are not on the right list. They are not the pedigree institutions but they are producing a significant number of students of color, particularly the underrepresented.

The other amazing thing is the fields that participants in this compact represent. If you look at the list, there is tremendous representation of science and engineering. The social sciences and humanities are also represented but the emphasis of this particular group, the Compact for Faculty Diversity, is in the sciences and engineering. They are producing graduate students of color in science and engineering but when I go and work with these students every year, I just do not see the major Research One institutions represented there recruiting from these institutions. To increase visibility, what the Compact has now done is network

the Bridges to the Future Program of the NIH,³⁹ The McNair Program⁴⁰ and the Alfred P. Sloan Foundation Minority Ph.D. Program.⁴¹ But still I ask, where are these students and why are they not being recruited? Based on my experiences, I know why. I know where committees start looking for candidates and should a candidate from these non-Research One institutions accidentally end up in the pool, they are very quickly eliminated simply on the basis of the fact that their pedigree is wrong. In other words, most search committees do not actively go out and identify all candidates and then bring them on campus and give them a chance or look them over seriously. That is a serious problem that I have and that I think all of us should begin to examine our practices. It is admittedly hard to examine though, because it is hardened in our culture. It is not something that is verbalized but there is a general consensus in a lot of search committees that this happens all too often.

If you consider the data I have presented, you can see why these students are not where we want them to be. Many students of color today are immigrants, have lower income, are first generation, begin their higher education experience in the local community college or maybe a public institution. Hopefully, if they have the right mentoring and the right guidance and the right encouragement, then they may go on to higher education Ph.D. granting institutions. Yet in the end, these students cannot be competitive candidates at Research One institutions and this is why we find ourselves fishing from very limited, small pools.

Clearly this is a cultural problem and it is one that must change. When we do change, we cannot do so in a superficial and cosmetic way simply to placate those who put the pressures on us to advance diversity. We need to take the next critical step and look at these young scholars, young scientists, young faculty and potential faculty, even if they do not have every one of those things we expect them to have. We need to ask the question, “With the right kind of mentoring and the right kind of environment, can they become successful?” I feel that often times, we do hire people but they do not succeed, not because of their own shortcomings or failures or lack of hard work but because we hire them and then we abandon them.

A lot of things have to be in place but let me just conclude by stating that this is a cultural problem. Where the candidates are, where the pools are, and why search committees at Research One universities do not even know about these pools, do not search

When we do change, we cannot do so in a superficial and cosmetic way simply to placate those who put the pressures on us to advance diversity.

I feel that often times, we do hire people but they do not succeed, not because of their own shortcomings or failures or lack of hard work but because we hire them and then we abandon them.

them out, do not identify them is a cultural problem. It is not even that these candidates are missing from higher education. It is just that we lack the practices to find them. I want to pass around a list of those who are Compact for Faculty Diversity graduate students who have completed their degrees.

I want to show you that the pipeline that we are creating is a big and expanding pipeline. Please pick up a copy, look at this list of about 50 or so institutions, and ask yourself, “How many of these would even stand a chance at my institution if we were hiring in that field?”

³⁶ *The Chronicle of Higher Education*, <http://chronicle.com/>

³⁷ The Southern Regional Education Board, <http://www.sreb.org/>

³⁸ Compact for Faculty Diversity, “A Summary of ‘Progress and Promise: An Evaluation of the Compact for Faculty Diversity,’” <http://www.aypf.org/rmaa/pdfs/Compact.pdf>

³⁹ National Institutes of Health. National Institute of General Medical Sciences. Minority Programs: Bridges to the Future Programs, <http://www.nigms.nih.gov/funding/bridges.html>

⁴⁰ The Ronald E. McNair Postbaccalaureate Achievement Program, <http://www-mcnair.berkeley.edu/national/>

⁴¹ The Alfred P. Sloan Foundation. Sloan Ph.D. Program, <http://www.nacme.org/sloan/>

***Dr. Emilio Bruna**, Assistant Professor at the University of Florida, presented on three areas. First, he highlighted the importance of changing the recruiting process for hiring junior faculty. Second, Dr. Bruna advocated increasing the funding opportunities for junior faculty to help secure larger grants. Lastly, Dr. Bruna challenged the NSF to hold grantees accountable for creating impacts through their grants and bringing a diverse body of researchers into the pipeline. By creating opportunities at the undergraduate level, he believes that we ultimately create candidates for junior faculty and faculty positions.*



I have been asked to speak to you today about the experience of junior faculty and the way in which we deal with issues related to diversity. Before I do that, I would like to highlight some of the issues that we have hit upon earlier in today's session and make four very small but concrete suggestions for the National Science Foundation on ways that it can help people like me can get tenure. I hope they will take them in the spirit in which they are intended, since I am a product of the National Science Foundation (I had a NSF International Dissertation Enhancement Grant⁴² as well as a NSF postdoctoral fellowship).

We really cannot ignore the pipeline concept. A number of studies have come out "debunking the pipeline myth." I think it is really important to be critical about looking at the pipeline, and particularly looking at disciplinary boundaries within the broader field of science and engineering.

When it comes time to the pre-recruitment and pre-hiring process, we should really become aware of how we search for the potential candidates. I will give an example from our own department. We are currently doing a search for a junior hire, and the way the search committee asked the faculty to come up with a list of potential underrepresented candidates was to send an email to the faculty (all twelve of us), asking if we knew of any qualified candidates. It was only in coming here that I heard about some of the places where we can go and look at the CV's of potential applicants that might fit our position's profile. I think we need to do more to centralize this information so that search committees in relatively small departments like ours can become aware of the potential candidates who are out there.

This culture has to change. The idea that we cannot contribute to sessions like this - that I have to get up at 6:00 in the morning to work on my manuscript before coming to get donuts over here in the lobby - has to change.

A third concern is the tenure process. I am like most people in that I know exactly what I have to do to get tenure and promotion - I have to just publish insanely and bring in copious amounts of grant dollars. But I also know that doing things like this workshop will *not* get me tenure and promotion. This culture has to change. The idea that we cannot contribute to sessions like this - that I have to get up at 6:00 in the morning to work on my manuscript before coming to get donuts over here in the lobby - has to change. This has to change because otherwise, the people who are deciding about diversity for my work environment for the next 20-30 years are people who are maybe halfway through that process themselves, sometimes a little further along. This includes things like search committees. I was shielded, so to speak, from being on search committees in our department because of the fact that I should really be contributing to my research. This means I don't have a forum in which I can voice my opinion regarding these issues.

The final thing I wanted to suggest is that my institution is looking to me to be Richard Tapia, and I think that's an unfair burden to place on people like me. We come from different backgrounds - not incompatible backgrounds and not backgrounds that may not merge on the same end point - but I think it is unfair to assume that I have all the answers for a student who either comes from an elite institution and is Latino, or who comes from the barrio and is Latino, or who is African American, or who is Filipino. We need to think about the apparent blanket assumption that I know exactly what it's like to be "underrepresented" and to face some of these problems.

Now I would like to talk about incentives to diversify and what the NSF can do. These suggestions are based on discussions I have had with some of the other junior faculty in our department on issues that we have had to deal with, so I cannot take all the credit for them myself. Perhaps the NSF or people in this room are already aware of some of these suggestions. If they are and I am repeating them, then it suggests that these are issues that have been recognized for a long time and we potentially still have a long way to go.

The first thing I suggest you do is expand the NSF's fellowship program for minority scholars. I am a product of the NSF and I had a Doctoral Dissertation Improvement Grant. The research starter grant that is associated with my postdoctoral fellowship helped me negotiate a better startup package, helped buy me

more research time and helped buy me more support for graduate students. The NSF needs more of these, and needs them in more disciplines. They work.

It was very interesting to me when I was being interviewed by the University of Florida that everyone introduced me as an NSF postdoctoral fellow. The word “minority” seemed to drop off every time, even though it was prominently displayed on my CV. Another thing that seemed to drop off was that I had a prestigious dissertation year fellowship from the Ford Foundation. The Ford Foundation has a pretty good name; however, I never got introduced as a Ford fellow. The NSF has that name recognition, and I think that this is something that really helps and should be taken advantage of.

Secondly, I think we need to increase funding opportunities that are targeted at junior faculty and those from underrepresented backgrounds. I have just completed my first year at UF and I can tell you right now that the biggest hurdle to overcome as a junior faculty member is getting that first grant. This grant supports graduate students and gets productive postdocs into your lab, and at some institutions getting a grant from the NSF is a good way to buy out of your heavy teaching load. Getting that first grant is really important and can set you on the path to tenure. Despite the importance of these grants for getting people established, new faculty have to compete with labs that are well established, have an army of postdoctoral fellows and graduate students in them, have more preliminary data that they can put into the proposal, and have more experience writing grants.

At some institutions getting a grant from the NSF is a good way to buy out of your heavy teaching load. Getting that first grant is really important and can set you on the path to tenure.

The third suggestion is to make REU’s available to faculty that do not have full NSF grants. The Research Experiences for Undergraduates Program¹⁰ is a great opportunity for both undergraduates and the faculty who mentor them. It is an opportunity to get undergraduate students in a faculty member’s lab doing research. As an undergraduate, I volunteered for six months in a lab so that I could get the kind of experience needed to prove myself to the PI before they actually hired me. Students can’t afford to do this anymore.

The REU students that I know have gotten their funding one of two ways. First, they have been in a field station or a site that has an REU program. As a result, researchers who do not have an REU program on their field site cannot take advantage of the opportunity. Second, they come as a supplement to an NSF grant.

Research experiences with undergraduates can lead to very good science and publications.

We need to hold grantees accountable.

So if you do not have an NSF grant, then you cannot get an REU student supplement. The interesting thing is that a lot of times, the undergraduate students are the ones who are doing the kinds of preliminary research that you put into an NSF grant.

Research experiences with undergraduates can lead to very good science and publications. I have three papers with undergraduates and three more on the way. Yet because of the fact that I have now become a faculty member at the University of Florida and I do not have an NSF grant, I can no longer tap into this resource. I think that we need to consider divorcing at least some of those REU funds from these two programs. That way, faculty who have a smaller research project that is done locally, or who are interested in submitting an NSF grant, can call a program officer and show them the benefits to including a well-qualified student in faculty research. I think this would be a really good way of making labs productive.

Finally, we need to hold grantees accountable. When I was getting ready to submit my first NSF grant just a couple of months ago, I collected copies of successful proposals from colleagues and looked at their “broader impact statements.” I know there was a sincere effort on the part of a lot of people I worked with to fulfill the impact statement, but I am curious as to how many people who put certain goals in their proposal then went on and achieved them. Were they successful? If they were, how did they do it? If they were not successful, why not? We need to reward those faculty who go ahead and achieve these impacts - who actually beyond lip service to actually do something right and get people into the pipeline.

⁴² National science Foundation. International Opportunities for Scientists and Engineers, <http://www.nsf.gov/pubs/2003/nsf03559/nsf03559.htm>

⁴³ National Science Foundation. Research Opportunities for Undergraduates program, <http://www.nsf.gov/home/crssprgm/reu/>

***Dr. Lilian Shiao-Yen Wu**, Program Executive, University Relations, IBM Corporate Technology, drew on her experiences at IBM and as a member of committees for the National Research Council and the National Science Foundation to recommend how to bring diversity to faculty in universities and colleges. Dr. Wu discussed the progress that has been made over the past two decades and pointed to strategies used at IBM to promote this progress. Dr. Wu stressed that while diversity in the workplace has evolved, it does not do so naturally, and thus we must continue to press the issue by applying outside pressure and undertaking studies to evaluate the current status and what works.*



My remarks this afternoon will come from three perspectives. The first will be from my work at International Business Machines, IBM. The other two will be from two committees that I serve on: the National Research Council's Committee on Women in Science and Engineering⁴⁴ and the more recent committee that I have joined, the National Science Foundation's Committee on Equal Opportunities in Science and Engineering.⁴⁵

First, I will start with my experiences with IBM. In the last five years, I have seen tremendous progress in IBM and some of the reasons for this may be useful for our discussion today. There is no question that in IBM we have made progress in whom we hire and whom we advance. The first reason for this goes back to the mid-1990s when we changed our thinking from treating diversity as a moral imperative to treating diversity as a business imperative.

To give you some idea, back in the mid-1990s, when you thought about the employees of IBM, you typically thought about a white male in a white shirt. This was out of sync with the increasing diversity in the US labor force and the increasing buying power of minorities and women. So it was really important for IBM to think about this and have discussions on what to do.

The second reason was that once it was recognized that diversity was a business imperative, we at IBM took this very seriously, and have tried a number of things. For example, we hosted regular conferences of women with technical backgrounds from around the world. We would get together and discuss the situation, how we can change and what actions we have to make in order to create change. We had conferences of multicultural technical people,

getting together to talk about barriers, how we can hire more people and how to nurture young people and foster their success. I have personally participated in these conferences and they work.

Mentoring is very effective if it is really a part of the culture. It really does work.

Another strategy that I have seen at IBM is mentoring. If you have mentoring that is of the form where women are expected to mentor young women, you are immediately asked questions, such as, how many women are you mentoring? Who are they? What has worked? How many people are mentored? This is something that we discuss often in our meetings at IBM and we take very seriously. Mentoring is very effective if it is really a part of the culture. It really does work.

Another effort began back in 1950 when we established eight executive level taskforces. These are groups of executives of different races, genders, sexual orientations, persons with disabilities, and so on. If you get groups of executives together, they are very competitive and if you put them on a problem, they will come up with answers. The result is executives are now personally involved in diversity and from this is significant increase in diversity of our management and leaders.

A third reason that we work so hard to solve these situations is because there is an outside push. *Working Mother* annually ranks its 100 Best Companies for Working Mothers.⁴⁶ Catalyst,⁴⁷ an important non-profit organization that studies women in industry, also does an annual report on women on Corporate Boards. This kind of reporting is very similar to the push from the US News and World Report on Colleges and Universities. They put us in the spotlight. You routinely see articles on how diverse a particular company is in major news media. Also, many professional societies like the Society of Hispanic Professional Engineers⁴⁸ give awards to companies on diversity. As a result, companies brag on their website about what programs they have. IBM, for example, has on its website the numbers of employees in different areas by race and by gender and other information on company diversity. We also report over the years what changes there are in these numbers so you can see what kind of progress IBM is making. In 2002, one third of IBM's professionals, who are mostly technical, were women, eight percent were black, four percent were Hispanic and half a percent are Native American. These numbers are out there for everyone to see and judge. There are also statistics comparing diversity statistics in the managerial and office ranks.

From my experience at IBM, it is possible to make significant progress on diversity in five years, but not by natural evolution. It will take real push from the leaders of an organization to make diversity a part of what everyone does day-to-day. Also pushing from the outside and requiring more transparency on the performance of an organization can make a big difference.

This leads me to the next two perspectives, which are efforts to increase faculty diversity by pushing from the outside. The first is a major piece of work that we are starting at the Committee on Women in Science and Engineering.⁴⁴ This work focuses on women and has been mandated by Congress to assess the gender difference in careers of science, engineering and math faculty. It focuses on four-year institutions and is built on a report that we published in 2001 on gender differences in career outcomes.⁴⁹ The study was based on a survey of doctoral recipients from 1973 to 1995.

I want to summarize some of the results, none of which were terribly surprising. The first finding was that there has been progress over time on any measure you look at in women's participation. Second, there are sizable differences by field, with the physical sciences, math and engineering being the worst. Third, women are less likely to be in tenure positions and hold senior faculty ranks even if you make all the adjustments for age. The fourth finding was that the top research institutes have fewer women overall.

Women are less likely to be in tenure positions and hold senior faculty ranks even if you make all the adjustments for age.

For this mandated study we are undertaking, it will be in three parts. Part one will be to see how much progress we have made since the first statistical study ended, in 1995. Part two will be a synthesis of many of the major studies that have been done by universities looking at themselves. For example, people have cited studies by the University of California system,⁵⁰ University of Wisconsin-Madison,⁵¹ Georgia Institute of Technology,⁵² Massachusetts Institute of Technology,⁵³ the National Science Foundation's ADVANCE program,⁵⁴ so we will be synthesizing what has been found in those major studies. Part three will be a small survey in five disciplines of the top 20 departments and we will report on the status of those departments and survey the climate there.

Before I go on I would like to recognize the contribution of Jong-on Hahn to the congressionally mandated study and Charlotte Kuh to the Career Outcomes Report.

Now I want to draw on my experience with the National Science Foundation's Committee on Equal Opportunities in Science and Engineering.⁵⁵ I want to show you some statements from the National Science Foundation Science and Technology Center⁵⁶ proposals that have been awarded. These are major National Science Foundation grants, about \$1½ million to \$4 million per year for five years. In year four, these projects are reassessed for funding for years six through ten. The objectives of the STCs are very broad: they include technology transfer, education, and diversity.

Here are some of the statements: "Our program will focus on inner city youth in the Oakland Unified School District, one of the most ethnically diverse in the country." Another, "the center will address this problem by recruiting women and minorities for faculty and postdoctoral positions. This proposal will expand research and educational programs to serve the needs of the Atlanta University Center with more than 95 percent minority students." Another one, "a significant fraction of these teachers will reach minority students with particular emphasis on Native Americans in Arizona and New Mexico." I can share with you others but you can see the general theme.

These statements are really in the right direction. These are the right kinds of things to think about and the next step planned will be to review what they consider to be a success on these issues. These are great goals to set but what are the plans to achieve those goals? If we come back for site visits year after year and especially in year four, what has been accomplished that is demonstrable? I will be taking a look at whether we can get more tangible, describable statements of success and understanding of how to achieve these goals. There are reasons to be very hopeful that these are places in which change can happen. These are very important ways in which the NSF is investing in the future. If we keep an eye on what they can accomplish, ask them to tell us what they are planning to do, and see how they go about doing it, this may be a good opportunity to apply some push.

Changing the mindset from this being a moral imperative, meaning that this only is the right thing to do, to being an education and research imperative, that this is about the business of the university, is a must.

In closing I want to say that from what I have seen at IBM, I believe that meaningful progress in diversity can happen in a reasonable period of time. In five years I saw real change happen. This change will probably have to come from the inside however. Changing the mindset from this being a moral imperative, meaning that this only is the right thing to do, to being an education and research imperative, that this is about the business of the university,

is a must. And from the 2 committees which I am serving on I believe that there really are ways in which we can push effectively from the outside as well.

⁴⁴ The National Academies. Committee on Women in Science and Engineering, <http://www7.nationalacademies.org/cwse/index.html>

⁴⁵ National Science Foundation. Committee on Equal Opportunities in Science and Engineering, <http://www.nsf.gov/od/ceose/start.htm>

⁴⁶ “The 100 Best Companies for Working Mothers, 2003.” *Working Mother*, <http://www.workingmother.com/oct03/100BestList.shtml>

⁴⁷ Catalyst, <http://www.catalystwomen.org/>

⁴⁸ Society of Hispanic Professional Engineers, <http://www.shpe.org/>

⁴⁹ The National Academies, *From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers*. 2001, <http://www.nap.edu/books/0309055806/html/>

⁵⁰ The University of California, <http://www.ucop.edu/welcome1.html>

⁵¹ The University of Wisconsin-Madison, <http://www.wisc.edu/>

⁵² Georgia Institute of Technology. The Center for Study of Women, Science, and Technology, <http://www.wst.gatech.edu/>

⁵³ Massachusetts Institute of Technology, <http://web.mit.edu/>

⁵⁴ National Science Foundation. STC: Science and Technology Centers, <http://www.nsf.gov/od/oia/programs/stc/index.htm>

DISCUSSION

The discussion session opened with a focus on the diversity that exists within companies, particularly research portions of companies. These areas often resemble university faculty in that they both lack diversity. Thus, ways to improve diversity in companies and universities were pursued. The point was made that universities often rely on outdated systems of recruiting and university departments often have no incentive to change because department rankings do not take diversity into account. The session concluded by discussing the idea that we can no longer rely on foreign students to fill science and engineering positions, especially teaching positions, as a result of recent security concerns. As a result, to promote diversity in America, we must prepare minorities for successful careers by fostering development as early as grade school and work with organizations that promote career advancement for minorities.

Dr. Richard Tapia

I concede that IBM has done great things in one part of the company; however, I think that there is perhaps a difference between industry and university. Two years ago, Paul Horn asked me to evaluate the T.J. Watson Research Center at IBM in terms of diversity. I found that it was nothing like what you are saying, Lilian. I told them that I was very disappointed at the lack of diversity that I saw and really felt that it was like a university. So while IBM as a company has done great things and I applaud them, T.J. Watson Research Center, looking like a department in a university, was not coming through with flying colors.

Dr. Lilian Shiao-Yen Wu

I think you may be surprised if you go back but I will just give you my perspective. I come from the research community. When I joined IBM, I found that everyone had come from 20 schools: a very short list. Today if you go and look, it is much, much wider. T.J. Watson is not as sterling as the rest of IBM but I think that there is progress there, too. For example, we have women and diversity groups that get together and discuss what it is that really needs to be changed. Recommendations from these groups are taken seriously. I think that change is happening there, just slower.

Dr. Richard Tapia

When I was on the National Science Board, NSF criterion two

for NSF grant applications was a controversial topic. At Rice, we surveyed the faculty. Basically 70-75 percent of the faculty said that criterion two had no bite whatsoever. Essentially their life would be made easier if they could get funding for minority students. But they could not do it without special, additional funding. Criterion two, to them, would just say good things but it didn't have any bite in it.

Dr. Lilian Shiao-Yen Wu

I want to bring up the point that the Science and Technology Centers have done great things and there is no doubt about it. However, it has not changed the culture of the universities because an STC was doing good things.

One of the things that came out was the criticality of the department as a unit on campus where the decisions are made, particularly the first recommendation for the faculty position and recruiting graduate students. I think we still have to handle that one in order to bring about change. The Centers are wonderful. We can pull and push through them our large investment but the Centers depend on the units on campus.

This helps explain the very great difference between the demographics of the undergraduate student body where admission is handled centrally and where policy can be imposed versus what happens when it's done at the level of the departments. Even with the dean of a graduate school, the decisions are largely being made at the level of the department. Therefore, the demographics look very different. So there are good departments and bad departments and we should be able to recognize them.

This is why we hope that our report from the National Research Council will be a first step in looking at five disciplines in the top 20 departments and reporting on the status of those departments. That will be a first start.

Dr. Evelyn Hu-Dehart

I think it is interesting that "women" have done so well. It was mentioned that in biological sciences and engineering, women as a group are doing well, but of course, when we say "women," we are really saying "white women." These terms sometimes are not precise. We separate our women from minorities and I ask, "Where are the women of color?" These women fall between the cracks. When we say "minorities," we generally think of minority men and when we say women, we think of white women. But

When we say "minorities," we generally think of minority men and when we say women, we think of white women.

be that as it may, what can we learn from the fact that women, particularly white women, have done very well in my experience in higher education?

I think there is some comparability to the relative success of white women to the relative success of Asian Americans as a group. It really comes down to class distinctions as well. Many Asian Americans are what we call middle class in their makeup and their background. These are some of the difficult things for us to crack as institutions of higher education unless we are willing to go way beyond what we are used to thinking of. We are dealing with people who come from very fundamentally different socio-economic backgrounds. How are they going to overcome all of those kinds of barriers in addition to the racial ethnic differences as well as gender?

Dr. Richard Tapia

Your point is well taken. In my talk, I said women as a group are educated in parallel roles. So they do not have that extra baggage along to carry with it. Schools like MIT and Rice are getting closer to parity between admission of men and women. So there are as many women with good educations as there are men but this is not true of minorities.

I do think this was alluded to: there is oftentimes a hidden double standard. The expectations for minority scholars are so high and it starts with where you get your degrees from. If you do not have the right degrees, then they do not even look beyond that. I have found that when it comes to white males, those same high standards are suddenly loosened. Now what is wrong with this picture?

Dr. Pam Ferguson,

Member of the National Science Board

I am on the National Science Board. I want to comment on the issue that faculty are very accustomed to treating one another with deference and courtesy and I think the time for that is over. Our department is aging: a third of it is retiring in the next two years. It became extremely ugly when we wanted to consider hiring a woman from a Research One Institution who met "all the criteria." Comments came out that took your breath away. I think there comes a time when you do not politely sit and listen to that any longer and that has to come from the department. You have to be willing to take on some unpleasantness.

It is certainly the case that I have been in places where the provost fails to search, the pool is not diverse, a good job was not done in recruiting, and the process should really start over. I think we have to have provosts and presidents who are willing to start over. If you are very clear about what your goal is, which is to diversify your faculty, then you can establish a threshold of excellence and consider anybody who meets that threshold. Once you have established your pool, anybody in that pool is considered qualified. It is who is qualified that helps us meet our goal. Obviously the faculty in general has to believe that this is important.

Dr. Beverly Tatum

My experience is that some departments, and I am thinking now about Mount Holyoke – the place where I was for 13 years – clearly did better than others. The departments that were doing well started to shame the ones that were not delivering. Even though there were some disciplinary differences because it was very clear that the departments that were having success were doing things differently than the other departments who were pretty much doing business as usual.

Diversity is about sharing power. It is that part that we have not been able to really significantly change. Departments do not want to change. It is not in their best interests to change.

Dr. Evelyn Hu-Dehart

Whoever is doing the national ranking of departments does not take the kind of values and concerns we have on the table today into consideration. Diversity is not even anywhere near those things. So at Brown, a provost would tell the history department, “you are doing just great; keep doing what you are doing because you are getting good ranking” but in reality, it is the least diverse department on campus.

Whoever is doing the national ranking of departments does not take the kind of values and concerns we have on the table today into consideration. Diversity is not even anywhere near those things.

Dr. Elizabeth Hoffman,

Member of the National Science Board

Having been a historian, having left history, history has not changed. It is the least diverse field in the humanities. I moved into economics, which was not extremely diverse in 1970’s is now, among the hard social sciences, the most diverse among women. However, these women are primarily white women. I actually did a study of women at AAU institutions and what you observe is that about 40 percent of the assistant professors are women, about 15-20 percent of the associate professors are women, about 10 percent of the full professors are women and ten percent of the presidents

are women. With the passage of the Civil Rights Act, there was a critical mass of white women who had the education, they had been to the right schools but they had not had an opportunity to go to graduate school. They had been barred from the top graduate schools but they had the right undergraduate education.

Between 1968 and 1972 these women went to the right graduate schools in huge numbers. I graduated from college in 1968. You can see that at Smith College, almost everybody in my class had a career like a man. Almost everybody in the class of '64 did not. That is the transition that I am talking about. What happened was we went to graduate school in huge numbers, we had careers very similar to our male counterparts, and we are now in our 50's and we have had a career. We have moved up the ladder just like our male counterparts and there is now a large enough pool of us that in some sense, we can afford to fail.

Some of us can afford to fail without damaging the careers of everybody else because there is a critical mass. I think when we talk about the pipeline coming through high school and whether or not you went to the right college, we are really dealing with two very fundamental pipeline issues. I think the reason why there is a critical mass of white women in certain fields is because these women went to the right schools, then took advantage of the Civil Rights Act, went to the right graduate schools and have now moved up through the pipeline.

Dr. Jaime Oaxaca

Let me give you a perspective from the businessman who is on the National Science Board and spent a lot of time addressing this problem. I was in on the founding of the Mesa Program¹² and many other programs. The thing that I heard today is the kiss of death in business and that is the top-down analysis. We are worried about tenure tracks and we cannot get them to graduate from high school. This is the reality that we are dealing with.

In California we are producing 20,000 science and engineering teachers. We need 34,000. Forty-three percent of our 6 million kids in grades K-12 are Hispanic. The thing that I strongly suggest to the National Science Board is to look at the bottom-up analysis.

America has a serious problem. We can no longer count on folks from Pakistan and Afghanistan and India. Security issues are going to be very strong and you are seeing it now. You are seeing it along the US-Mexico border. You are seeing it along the Korean border. The thing that the National Science Board must do is to

set the policy issues that are going to address the issue. I see two fundamental issues.

One issue is that minority students are coming out of high school ill-prepared. If you add up the population of minorities in the United States, it is about 80 million people. The kids of those 80 million people are graduating ill-equipped to have any kind of a real chance to make it just for the B.S.; forget all the other stuff that has been talked about today.

It is the same thing in every state similar but distinct. California is different from Texas. It is different from New Mexico. It is different from New Hampshire. This issue has to be addressed as target areas and how you solve this problem. First and foremost, you have got to define the problem. I never heard the problem defined once today. The problem is that we are not producing the correct number of people. Northrop Corporation is advertising for 2700 engineers. They cannot get any because there is a requirement in one of the largest industries to have a security clearance.

The next issue that has not been addressed is the fact that if you look at the studies of the California Council on Science and Technology⁵⁶ and all the other studies that have come out along the way, probably no more than 14 percent of the teachers of K-12 that teach math and science are certified to teach math and science. You have to treat this as a total problem with the end result being that we are not producing the right people.

Dr. Keith Jackson

As President of the National Society of Black Physicists,⁵⁷ I have made it my goal to increase our membership from something that was lingering around 120 to numbers now that number like 600. On February 22, 2004, we are going to have our annual meeting in Washington, D.C. and our goal is to have 600 African American physicists and students of physics attend.

I want to share a bit about the struggles I have faced during my membership with this society. Time and time and time again the resource center has set up at historical black colleges and universities and then after eleven years or five years, they say, "Well, this is just seed money and now you are supposed to be independent." I say, "We cannot be independent." This is the market and National Science Foundation is the primary supporters of research in the physical sciences of the United States.

We do not get long-term support. People approach me about the resources required for a Ph.D. program. Does anybody here know about Gravity Probe B? Gravity Probe B⁵⁸ is an idea that started in 1964, first funded in 1969, at an average rate of \$15 million a year for \$600 million. It still has not launched. Maybe it will launch in November, maybe not. Maybe the results will be relevant, maybe not. The point is that they produced 25 Ph.D.s at roughly \$24 million per Ph.D., which is greater than the entire support for all the HBCUs for one year just to produce one student.

At the end of the pipeline, there does not seem to be anything. There does not seem to be a job that can lead to a middle class existence.

There are people out here. We have talked about the pipeline issue. One of the problems that we have is at the end of the pipeline, there does not seem to be anything. There does not seem to be a job that can lead to a middle class existence. I have a number of members now who have completed Ph.D.s and they are asking me where they can get jobs, where they can get postdocs and unfortunately, they have been unemployed for a long time. Not all of them come from HBCUs either. A lot of them come from places like M.I.T. and the University of Heidelberg and they are unemployed.

I want to know how seriously the National Science Board takes this. When I read the Board's draft paper, it said this was as serious, maybe not as serious, as weapons of mass destruction in Iraq. Well, it is as serious as the weapons of mass destruction here. We need to put some teeth in this and we need to define and we need to work with people who have been successful. One of the people you need to work with is the National Society of Black Physicists.

⁵⁵ Santa Ana College. Mathematics, Engineering, and Science Achievement program, http://www.sac.edu/students/counseling/transfer_center/mesa/mesa.htm

⁵⁶ California Council on Science and Technology, <http://www.ccst.us/>

⁵⁷ National Society of Black Physicists, <http://nsbp.org/cgi-bin/nsbp.cgi?page=home>

⁵⁸ Stanford University. Gravity Probe B, <http://einstein.stanford.edu/>

POLICY OPTIONS DEVELOPMENT

Dr. Judith Ramaley, Assistant Director, NSF Directorate for Education and Human Resources, opened the panel on policy options development by summarizing some of the key issues that had been raised in the workshop so far. She touched on traps that policy makers can fall into, such as failing to realize the assumptions and biases we have from our own experiences, as well as the shifting demographics of the United States and future challenges we have in educating all Americans. Dr. Ramaley highlighted some of the progress policy-makers have made, as a result of asking questions and challenging assumptions, in bringing diversity into the science and engineering workforce.



What we are talking about today is the kind of problem that requires a great deal of care as we think about our approach to decision making. There are four sets of traps we can get into. The first one is how we frame the question. Although much of our discussion today is about where our next generation of faculty will come from, the environment in which people prepare for various kinds of careers and identifying critical questions that would give rise to policies and investment strategies for institutions and the federal government, we must not forget state policies that interact with all of the above.

The second trap is the question of how honest you are about your current condition. Today we must be open and willing to probe underneath the surface of the language we use, of the assumptions we have, not only about ourselves and what we are trying to achieve, but also the environment in which we are trying to do the work.

The third area that is often riddled with pitfalls is how we assemble our options; how constrained or how broad we are in our interpretation of what is possible and whom we involve in that discussion. The final set of traps occurs largely because nobody thinks about doing certain things as part of the decision making process. Are we in fact asking the kinds of questions that will draw people's attention to what they really need to be taking seriously and attending to? Are we learning from our experience?

When I was preparing for my first presidency, I was walking down the hall one day and a member of the staff stopped me and said, “I have some advice to give you.” The advice he gave me came from the fact he had served as a field commander in Vietnam. His advice to me was, “You are probably heading in the wrong direction.” He was not talking about combat. Rather, he was referring to the fact that as a commander, he learned very quickly the questions he asked of his people determined what they paid attention to and whether they stayed alive. I learned very early and have tried to follow that up as a member of the leadership team here at the National Science Foundation to pay very careful attention to the questions I ask.

So what do we seem to be agreed upon from this morning and this afternoon and how do we connect the dots of what we have heard today? First of all, I think we have some agreement on the challenges we face. But there were a couple of things that were brought up that I had not thought enough about and so I may overemphasize them just because for me they were particularly remarkable.

The demography of this country is shifting quite rapidly toward a much more diverse nation, described by some as the underrepresented majority.

Our institutions are still designed by and for the overrepresented minority.

The first thing I think we all agree on is that the demography of this country is shifting quite rapidly toward a much more diverse nation, described by some as the underrepresented majority. As I listened further, I realized our institutions are still designed by and for the overrepresented minority. We have very significant gaps in the participation and achievement of men and women who have not traditionally been well represented in the establishment. Even when we do have people to consider, we often do not know where to look for them which gets to the second point which is that it is important to know where the students are and where the candidates are. They are not necessarily where we are accustomed to looking for them.

In the 1999-2000 year based on the National Center for Education Statistics,⁵⁹ there were 103 historically black colleges and universities, 215 Hispanic-serving institutions and thirty-four Tribal colleges and universities. The actual number of Hispanic serving institutions, by the way, has continued to increase because it is based not on federal definitions as are the Historically Black Colleges and Universities⁶⁰(HBCUs) and Tribal Colleges and Universities⁶¹ but on enrollment statistics. So the remarkable growth of Hispanics within our K-12 and undergraduate populations are driving more and more institutions and the influence of those institutions toward being Hispanic serving.

What proportion of students who define themselves as Hispanic or black or Native American actually are studying at these institutions? In 1999, only 16.7 percent of African American students were in HBCUs. Only 8 percent of American Indian students were in Tribal colleges. In contrast, almost 58 percent of Hispanic students were in Hispanic-serving institutions.

I mention these figures because I think it demonstrates that at the federal level, we tend to focus on minority-serving institutions. Every federal agency with which I have any contact at all has programming for minority-serving institutions. However, depending on the population we are trying to reach, the institutions may not be in the right place. They may be elsewhere and as a result, be underutilized.

The third point I think we agree on is that too few high school graduates are prepared to pursue careers in science, technology, engineering and math. Although we could improve the attractiveness of careers in academia, we can also improve how we look at candidates for the positions at our colleges and universities. We still will be limited by the fact that although about 94 percent of high school students take biology, less than 30 percent take physics and approximately half take chemistry. When we look at mathematics, the story is considerably worse. Only about 60 percent of the students graduating from high school last year had taken algebra II and far fewer had taken more any more advanced mathematics.

Now when you unpack those numbers to view the experiences of different groups of students within a larger population, the story gets a good bit worse. I just received a report from the Rossier School of Education.⁶² They did a similar unpacking of the experiences of students in a number of cross sections of California institutions showing exactly the same thing. Although the total remediation required at the college level in math or in science or in English was about 35-40 percent, when you unpack those numbers, 80 percent of African American students and a very high proportion of Hispanics required remediation. The argument I would make from this and other related numbers is that one piece of advice we must take from what we have heard today is that it is not enough to look at aggregate numbers when we are examining the effects of investments at the federal level or at institutional level. We need to unpack them and examine the experiences of different groups of students coming to us with different levels of preparation and with different career aspirations and having taken different routes to the point where we meet them.

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The next point I want to make is that most of us, I think, still have an image of the student as an individual who studied full time, who completed an undergraduate education in 4.2 years, maybe 4.5, maybe even 5 if we were engineers, who went immediately, or almost immediately, on to graduate study and completed it in a reasonable amount of time, then went immediately on into an illustrious career in academia or industry.

We need to understand who our students are, what their educational goals are, how they are getting their education and how federal as well as institutional intervention can influence what I have learned to call “pathways” rather than “the pipeline.” The term pipeline works fine if you are a Research One institution serving particularly well-prepared students. It does not work at all if you are anybody else.

In fact, only one out of six students today looks like that, acts like that, or takes that kind of route. So we really have to think carefully about what “success” means. We have to think about the relationship of institutions to each other and how they produce educational environments. We need to understand who our students are, what their educational goals are, how they are getting their education and how federal as well as institutional intervention can influence what I have learned to call “pathways” rather than “the pipeline.” The term pipeline works fine if you are a Research One institution serving particularly well-prepared students. It does not work at all if you are anybody else.

You need to use the concept of “pathway” in these other cases because there are so many varieties of experience. When I was at Portland State University almost a decade ago, we tried to map out those pathways. We found approximately 14 different basic patterns and within that, variations that led up to about 72 models by which students were acquiring the credits they needed for an undergraduate degree. Some students were co-enrolled at Portland State and a community college, some started at a community college and transferred, some started at Portland State and retrogressed to a community college and came back again, sometimes several times. Some students dropped out and returned, some completed an undergraduate degree and then went back to a community college for additional credentials and some went on to graduate study and then went back to a community college. We had an enormous range of pathways and we realized that our programs were simply not meeting the needs of the students.

A small proportion of the students who are prepared to study at an advanced level in science, technology, engineering and mathematics, actually go on to do so.

What else can we agree on? I think we can agree on the fact that a small proportion of the students who are prepared to study at an advanced level in science, technology, engineering and mathematics, actually go on to do so. Many of the reasons why they start and then continue in other fields has to do with both questions about the attractiveness of these fields as careers as well as how they experience with coursework and faculty. I think we may also be able to agree that we really do not know as much

as we need to about why people do choose careers in science, technology, engineering and math and the pathways they take to get there. And finally, I think I heard something that I have been focusing on a lot in recent months and that is that many of our expectations for what we need to do about all this are very much going to require transformational changes in our nation's educational institutions and their relationships to society. We do not know a whole lot about those underlying processes of institutional change, and in particular, for the purpose of this meeting, how federal policy, state policy and institutional policies can aid and abet in the process of making the kinds of changes we want.

What kinds of policies should the federal government as well as institutions consider? So that all of our citizens can acquire a high level of competency in science, technology and mathematics and so that we can ensure a diverse and capable workforce not only for the professorate but more broadly in these fields. The first thing I would like to mention is that we must model our policies on good evidence. My experience in several states and since coming to the Beltway is that most of our policies are based on one story, one anecdote, or one person who is upset about something. We have to base our choices on careful analysis, which is what I believe we have been trying to do here today.

We have to base our choices on careful analysis, which is what I believe we have been trying to do here today.

Secondly, we have to move beyond wishful thinking and toward genuine evidence that we gather from those we support. Whether it is at an institution level or at the federal level, what we ask for defines what we get. Finally, we need to take time to understand the realities of the context we are trying to influence. Most of us have particular experiences in research, often at Research One institutions and have been department chairs or deans or presidents or academic officers. As a result, our assumptions about how the world works, and thus what we include in our thinking, can be quite limited. We have got to look at unexamined assumptions and be willing to examine them.

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Which institutions are we focusing on? Who are our students really? How are they pursuing their education? What are their goals? How are they making their choices? What assumptions do we have about what we are looking for?

Lastly, I think what came out of our discussion today is that we need to think about the impact of our policies and the investment strategies of the federal government and institutions. What sets

these policies and investments in motion and both the intended and the unintended consequences of that. I want to talk about these intended and unintended consequences before I conclude. Consider how the federal government's behavior prolongs graduate study and the time spent as postdoctoral fellows, for example. As one illustration of unintended consequences, it appears quite likely that while trying to support research, what we are doing is supporting an elongation of a credentialing process, which is quite unnecessary.

We do not ask tough questions about capacity to broaden participation or to integrate research and education in the same way we ask what research support will be provided to this investigator or group of investigators in the computing environment or information technology environment or technical support. This is something we have to learn to do.

One suggestion that was made earlier on this issue is that we limit the number of years we support a student. Suddenly I saw the enormously confusing and complex set of documentation that would be required for that and I thought, no wonder we do not intervene at that level because we would have a great deal of difficulty establishing that person A was in continuous good standing as a student and should not be cut off and person B was not. What we ask for is what we get, as I said earlier, and we do not usually require the same level of documentation of institutional capacity to support our second merit criterion as we require for our first merit criterion. There is similar language used at other agencies. I will just use the ones I have learned here at the NSF because this second criterion is still fairly new in our repertoire. We do not ask tough questions about capacity to broaden participation or to integrate research and education in the same way we ask what research support will be provided to this investigator or group of investigators in the computing environment or information technology environment or technical support. This is something we have to learn to do.

What are we already doing differently to raise issues, revisit assumptions and insist on attention to certain important issues that might get us unstuck? Some of our special requirements for some of our programs are beginning to call attention to institutional capacity and our ability to support and sustain promising work. My favorite example, because it absorbs so much of my life, is our math-science partnership which now has quite rigorous discussions of the capacity of institutions to consider the changes that they would need to adopt in order to work in a K-20 partnership and supportive improvement of science and math in the schools.

Also consider what we talk about when we bring our principal investigators together, what we make them pay attention to, the kind of material we offer them and the questions we ask them. The composition of our review panels is increasingly diverse in a

number of ways as is the composition of our program officer staff and our leadership at the NSF. This is a major commitment of the senior leadership to diversify and strengthen our representation of the overall talent and interests of scientists, technology, engineering and math workforce in this country. The data we ask for and the questions we ask are changing because we have people with different perspectives.

The sense is that we really are making some significant progress. Bear in mind however, that the context of all this requires being extremely honest, learning to talk constructively about things that are very hard to talk about and taking seriously the contributions of people that we would not normally ask to participate in problem solving activity.

To model this, we have assembled a set of panelists, each of whom is going to talk about the gaps and unexamined issues that they heard today and what we can do at the policy level to move forward. Part of the question is, to what extent did our own behavior today illustrate why we have problems? Are we capable of looking at ourselves in that fashion and looking at our own experiences and the things we threw into the discussion? Are there some lessons here?

The context of all this requires being extremely honest, learning to talk constructively about things that are very hard to talk about and taking seriously the contributions of people that we would not normally ask to participate in problem solving activity.

⁵⁹ U.S. Department of Education. National Center for Education Statistics, <http://nces.ed.gov/>

⁶⁰ Educational On-line, Inc. Historically Black Colleges and Universities, http://www.edonline.com/cq/hbcu/c_state.htm

⁶¹ Department of Health and Human Services. Office of Minority Health. Tribal Colleges and Universities, <http://www.omhrc.gov/OMH/Tribal%20Colleges/>

⁶² University of Southern California. Rossier School of Education, <http://www.usc.edu/dept/education/>

***Dr. Clifton Poodry**, Director, Division of Minority Opportunities in Research, National Institute of General Medical Sciences, National Institutes of Health, stressed the importance of defining success for initiatives. In doing so, Dr. Poodry believes that diversity among the definers, and inclusion of all stakeholders in the conversation is essential. One proposed suggestion is to provide mentors to minority students to equip them with the skills for communicating their vision and goals at the highest level.*



In the realm of policy, I would like to focus my attention on the large centers that the NSF and the NIH support, as well as the training grant activities and the institutional programs for training. Any consideration of these activities needs to start with a definition of success. In formulating that definition, we really must have an inclusive authorship. It cannot be left up to just the program directors to dictate what should be accomplished. On the other hand, the program directors cannot sit back and let the grantees dictate what the definition of success is nor should we just all sit back and let the National Science Board or our advisory councils tell us what the definition of success should be.

One of the reasons that I am quite focused on the definition at the outset of a program is that we are struggling with the evaluation of programs that have been going on for some time at the NIH, at the NSF and at other agencies. It is always difficult to evaluate after the fact when defining success has not been part of the planning up front. You rewrite history as you go along. I think that the definition of success of major centers is really important and it is paramount that we have an inclusive authorship because within the definition of success, diversity, inclusiveness and providing value for all Americans would certainly be part of the criteria.

Once we have a definition of success and we know what we are looking for, then we have to be sure that the data is collected. With regards to the data, we need to go about actually looking at it and doing an assessment of it. Unfortunately, we often start with the question of assessment, then we ask what the data is on which to assess, and then we examine the data to find that we cannot ask or answer the questions we want to. We basically do things backwards.

I am concerned with the progression of students through middle

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school, high school and college. Problems with this progress have led to us to not having competitively trained underrepresented minority students who will be able to challenge for faculty positions. Our programs have actually done fairly well at increasing the number of potential candidates. The numbers of Ph.D.s produced each year is substantial but if you ask how many Ph.D.s were produced in biology and chemistry in the 1990s and over that time, how many faculty were hired by major universities the University of California's entire system, to take one example, you will be distraught.

How can it be for all those Ph.D.s that so few are competitive? We have to face the challenge that we need competitively trained Ph.D.s and postdoctoral fellows of all ethnicities. For me, that would be part of the definition of success of major centers and training grants. I would want to know for the various training programs that we have, what are the products, how have they done, and is there any disparity in the outcomes between the various men, women and ethnic groups?

I would like to change my focus now to leadership training for high achieving minorities. I think that this is very important for people of all ages, whether they be precollege students, college students, graduate students, young faculty, old faculty, senior government administrators, whoever. One of the things that we examine when hiring new faculty is not just their research papers or their graduate work. When we are trying to make a judgment of what they are going to be and what they are going to do, one of the things that is often cited as a failing of women and minority candidates is that we did not see their vision. They tell us very well where they have been and give a terrific seminar of their work but their vision of what is important and how they are going to have an impact on the world is not apparent. How much does individual affect and presentation style influence whether interviewers see an applicant as highly skilled and having a vision?

Mannerisms and presentation style may influence how one is perceived. If any of you know molecular biologists, you will know that 40 percent of the time, a molecular biologist starts out a conversation with "so." It is just part of the way they talk. "So" is the first word that begins a seminar. Well, if you do not talk this way, you are not quite as warm and fuzzy and you are not quite as much like us. I think that affect is quite important in those subtle judgments that are made in faculty hiring and I think some of those behaviors are teachable and coachable.

I have always longed for a mentor but I have not had that kind of good fortune. I once had a really good supervisor. She not only told me what was positive, she also told me what some limitations were. Furthermore, that supervisor told me what qualified for an “excellent” evaluation, and she went further to articulate what I would need to do if I really wanted to be “outstanding.” That kind of honest direction is empowering, but in my experience is seldom given. Perhaps some of us can provide it for each other. Mentoring is not just a word that involves teachers and students.

Let me close with a hypothetical situation. If you gave me a bunch of money and asked me what I would do to foster diversity in the scientific workforce, I think that I would provide flexible funds to institutions that are above average in their sending minority students on. For every minority student who went on to get a Ph.D., I would provide a little grant to the institution that would be a pat on the back showing that they have done well and that they are supported in their mission. How much would that cost? Maybe \$10 million to \$20 million per year. It’s not a large sum but I think it would substantially encourage institutions’ efforts.

If you gave me a bunch of money and asked me what I would do to foster diversity in the scientific workforce, I think that I would provide flexible funds to institutions that are above average in their sending minority students on. For every minority student who went on to get a Ph.D., I would provide a little grant to the institution that would be a pat on the back showing that they have done well and that they are supported in their mission.

Dr. Willie Pearson, Jr., Chair, School of History, Technology and Society, Georgia Institute of Technology, challenged the audience and all Americans to get involved in the issue of diversity. He stressed that this is not a problem that has come about overnight and in order to solve it, all Americans and American institutions must make a concerted effort to open doors for minority students in the science and engineering workforce. Dr. Pearson expanded the panel's focus on the lack of diversity to include minority serving institutions as well as Research One institutions. Dr. Pearson's analysis highlighted the pervasiveness of this important issue and noted that its resolution necessitates the participation of all universities and all Americans.



I will begin by discussing some of the deliberations of the Committee on Equal Opportunities in Science and Engineering,⁴⁵ CEOSE. CEOSE has been given very strong encouragement by Dr. Bordogna and Dr. Colwell to make policy recommendations and provide advice on a process for implementing the policies.

CEOSE has held several discussions regarding Dr. Wu's earlier comments about holding proposers accountable for accomplishing the goals of the two NSF evaluative criteria. The Committee has also focused on the issue of the representativeness of reviewers because program officers have considerable influence in the selection process. To date, CEOSE has recommended to NSF over 100 names of a diverse population of potential reviewers and panelists.

This brings me to my next point. I want to make it very clear that the sciences are inclusive of the social, behavioral and economic sciences. You have seen graphics of the percentages of underrepresented minorities receiving Ph.D.s in some sciences and engineering that hover around 2 percent. Do not assume that there is adequate minority representation in the social, behavioral, and economic sciences. While the overall representation of underrepresented minorities is higher in the social, behavioral and economic sciences than in other sciences and engineering, the level is far from being representative of the general or college-age populations. The fact of the matter is that there needs to be a greater production of degrees across all STEM disciplines for all underrepresented minority groups.

Let us not overlook the schools between the community college and the Research One university levels. There is a place in higher education for everyone in this country. There are institutions that meet the specific needs of various student populations and we should not minimize those institutions.

Some of the previous speakers have mentioned the underrepresentation of women and underrepresented minorities on the faculties of Research I institutions. This remains a serious problem. However, some minority serving institutions are facing problems recruiting U.S. citizens to their science and engineering faculties. For example, some HBCUs have few U.S. born science and engineering faculty members. Let us not overlook the schools between the community college and the Research One university levels. There is a place in higher education for everyone in this country. There are institutions that meet the specific needs of various student populations and we should not minimize those institutions. The larger issue is how the nation can attract talented individuals to the professorate so that there will be a diverse faculty in every institutional category.

It is very clear that some minority serving institutions lack the fundamental funding to develop an infrastructure in science, mathematics, engineering and technology. Yet, some minority serving institutions are very productive in developing human resources for science and engineering. For example, Spelman College, with a population of fewer than 2000 students, consistently ranks among the top baccalaureate producers of African American Ph.D. scientists and engineers.

We have not heard much discussion about the budgets of federal programs for broadening participation. Some of these programs receive very small allocations; yet there are high expectations that they contribute to the production of large numbers of underrepresented talent. Look at some of the programs like Alliances for Graduate Education and the Professorate.⁶³ Given its funding levels, it is unreasonable for it to meet all of the challenges in increasing graduate degree production among underrepresented groups in science and engineering. There has been no discussion of funding levels for programs to broaden participation in STEM fields today. In some ways, the Education and Human Resources Directorate is expected to bear the responsibility for programs related to the talent development of women, minorities and persons with disabilities. What are the responsibilities of the research directorates? They also have a major role to play in talent development.

The other issue that I would like to discuss is historical in nature. We have much to learn concerning the incredible jobs that both minority and majority men and women have done in producing human resources in STEM fields. For example, in the 1930s and

1940s, a White male at McGill University produced at least three Ph. D. chemists of African American descent. There was some overlap among the three. What can be learned from this? While on the faculty of Morehouse College, chemist Henry McBay is credited with producing over 20 undergraduates students who earned Ph.D.s from some of the country's most distinguished universities. What can be learned from the legacy of Henry McBay? Undoubtedly, there are other highly productive mentors lost in history. Where is the recognition for them?

Another issue that we constantly hear about is what can be done? About 20 years ago, Alexander Astin's (1982) *Minorities in American Higher Education* listed flagship institutions with severe underrepresentation of racial/ethnic minorities among their undergraduate student bodies. Some institutions, embarrassed by their ranking, implemented recruiting programs to begin to rectify the situation. At the time of the book's publication, some states with very large populations of Mexican Americans or African Americans had few among the undergraduate students at their flagship universities. Now, we are beginning to hear anecdotes about young underrepresented men and women doctoral graduates of some the most selective research institutions completing their degree with no predoctoral publications or access to significant postdoctoral fellowships. If true, how do we explain this? Some scholars refer to this situation as a "bare bones degree"—where students have the pedigree but lack critical pre-professional experiences. This can have a tremendously deleterious career impact.

Another issue that we have not discussed is tenure denials. We have talked about the hiring process, but what about people who actually get hired but do not make it through the tenure process? In a study conducted several years ago, my colleagues and I found that when some of the minority and women students witnessed their young minority and women professors experiencing difficulty with tenure, many responded that if their professors had no chance of getting tenure, then neither did they. Consequently, many did not plan to pursue academic careers.

Another challenge we have in this country, particularly those of us who are concerned about assessment, is the availability of data disaggregated by race, gender and ethnicity. This is a very serious problem. If one cannot get access to the appropriate data then how can one ascertain whether there is progress? If data are disaggregated, then we are able to have better informed policies and therefore, better practices.

When some minority and women students witnessed their young minority and women professors experiencing difficulty with tenure, many responded that if their professors had no chance of getting tenure, then neither did they.

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Solving this problem is going to take the effort of the private and public sectors and the commitment of citizens.

Finally, I believe that the NSF and the NIH alone are unable to solve the challenge of a diverse scientific and technical workforce. Solving this problem is going to take the effort of the private and public sectors, and the commitment of citizens. It is not a simple problem, nor did it develop overnight. This country has demonstrated that it has the will to solve very difficult problems. The challenge is to move beyond talk to actually making things happen.

⁶³ National Science Foundation. Alliances for Graduate Education and the Professoriate, <http://www.ehr.nsf.gov/hrd/agep.asp>

DISCUSSION

The brief discussion consisted of two points made by a panel member. We must recognize and minimize the elitism within science and also minimize the media portrayal of science to foster supportive environments for young scientists. By offering encouragement we can bring new students into the science and engineering field.

Dr. George Langford

I would like to bring up two issues that I believe that we need to confront. One is that we have a certain level of elitism in operation in many of the scientific communities. We have to figure out in addition to the pedigree problem, how we deal with this issue of who can come in and who is expected to achieve what. This is what we need in order to enjoy a healthy and wholesome environment to do science in. The other issue is that perhaps the National Science Foundation, the National Institutes of Health and others can find a way to work with the media to dispel or to minimize some of the discouraging language that our young minorities and all students hear every day about careers in science and engineering. I think that would do a tremendous thing to uplift young people to want to pull each other up and to network and move ahead.

CLOSING REMARKS

Dr. George Langford, Chair, Committee on Education and Human Resources, National Science Board, offered concluding remarks on the workshop. He stressed the importance of encouraging dialogues as a way to stimulate ideas, policies and eventually results, on key issues. He urged everyone in attendance to continue thinking about the issues raised during the various panel discussions and to stimulate discussions at respective companies, campuses and institutions. The National Science Board is always open to any feedback.



Thank you very much. Dr. Ramaley and I would like to thank the last panelists for their cogent remarks and summary of major events of the day. We are a little bit off the schedule but for me, it has been a terrific day. I hope you have enjoyed it as much as I have. It has been a great pleasure to host this workshop. The workshop has been very stimulating, I think, on many different levels. It is important to have this kind of conversation and I hope that each of you will take the conversation back to your home institution and engage your colleagues in some of the issues that were discussed here.

I think the real success will be when we see an increase in the hiring of faculty of color. This is the point in time from which we can begin to record whether changes take place. We will all be looking for those changes. What I hope will happen is that there will be a quantum jump and that we will not wait for 30 years to see a change. But, you know, it is going to be up to us. We have to make it happen.

I hope that each of you will take the conversation back to your home institution and engage your colleagues in some of the issues that were discussed here.

The real success will be when we see an increase in the hiring of faculty of color.

We have to make it happen.

APPENDIX 1
WORKSHOP AGENDA

NATIONAL SCIENCE BOARD WORKSHOP

BROADENING PARTICIPATION IN SCIENCE AND ENGINEERING RESEARCH AND EDUCATION

August 12, 2003
National Science Foundation
4201 Wilson Boulevard, Room 1235
Arlington, Virginia

- 8:30 Introductions and Opening Remarks
George Langford — Chair, Committee on Education and Human Resources, National Science Board
Rita Colwell — Director, National Science Foundation
- 9:00 Models of Success for Broadening Participation
Joe Bordogna – Deputy Director, National Science Foundation
(Panel Moderator)
Shirley Tilghman – President, Princeton University
Shirley Ann Jackson – President, Rensselaer Polytechnic Institute
Norbert S. Hill, Jr. – Executive Director, American Indian Graduate Center
- *Panelists will discuss successful models for expanding diversity of faculty and students in science and engineering.*
- 10:30 Changing Demographics and Challenges of the Future
Diana Natalicio – President, University of Texas at El Paso, and Vice Chair, National Science Board
(Panel Moderator)
Beverly Tatum – President, Spelman College
Shirley Malcom – American Association for the Advancement of Science
Richard Tapia – Noah Harding Professor of Computational & Applied Mathematics, Rice University
- *Panelists will discuss the current and projected demographic profiles of faculty and students at our nation's colleges and universities. Special issues associated with achieving a more diverse faculty in science and engineering research and education will be identified.*
- 11:30 Working Lunch and Breakout Sessions
- *Panelists and invited guests breakout into small groups to address questions developed during the morning sessions*

NATIONAL SCIENCE BOARD WORKSHOP

BROADENING PARTICIPATION IN SCIENCE AND ENGINEERING RESEARCH AND EDUCATION

(Continued)

- 1:00 Diversity Gap between Students and Faculty
Esin Gulari – Division Director, NSF/ENG Division of Chemical & Transport Systems (*Panel Moderator*)
Evelyn Hu-Dehart – Director, Center for the Study of Race & Ethnicity in America, Brown University
Lilian Shiao-Yen Wu – Program Executive, University Relations, IBM Corporate Technology
Emilio Bruna – Assistant Professor, University of Florida
- *Panelists will discuss issues affecting faculty diversity.*
- 2:30 Reports from Breakout Sessions
- *A spokesperson from each breakout group will be asked to provide a brief summary of issues discussed during the working lunch. This discussion is designed to provide broader input to policy development.*
- 3:00 Policy Options Development
Judith Ramaley – Assistant Director, NSF Directorate for Education and Human Resources (*Panel Moderator and Presenter*)
Clifton A. Poodry – Director, Division of Minority Opportunities in Research, National Institute of General Medical Sciences, NIH
Willie Pearson Jr. – Chair, School of History, Technology and Society, Georgia Institute of Technology
- *Panelists will discuss recommendations designed to broaden participation of women and minorities in science, math and engineering.*
- 4:00 Closing Remarks

APPENDIX 2
PRESENTER BIOGRAPHIES

**GEORGE LANGFORD, CHAIR,
COMMITTEE ON EDUCATION AND HUMAN RESOURCES,
NATIONAL SCIENCE BOARD**



Dr. George Langford

George Langford earned Master's and Ph.D. degrees in cell biology from the Illinois Institute of Technology. Dr. Langford has been at Dartmouth College since 1991 and currently holds the position of Ernest Everett Just Professor of Natural Sciences and professor of biological sciences. At Dartmouth, he established the E.E. Just Program, which provides internships to minority students in the sciences. In addition, he is an adjunct professor of physiology at Dartmouth Medical School. He was appointed to the National Science Board in 1998 and chairs the Board's Education and Human Resources Committee.

Dr. Langford took his first faculty position at the University of Massachusetts in Boston before moving to Howard University College of Medicine. In 1979 Langford joined the faculty of the University of North Carolina at Chapel Hill School of Medicine. Since the early years of his career, he has maintained a research laboratory at the Marine Biological Laboratory in Woods Hole, Massachusetts. Langford's primary area of research has been the study of molecular motors and the movements of the components in nerve cells. In 1992, Dr. Langford and his colleagues were the first to demonstrate that special filaments, long known to be responsible for the movement of muscle cells, were also responsible for the movement of particles within nerve cells.

From 1988 to 1989, Langford was the program director for the Cell Biology Program at the National Science Foundation. He has also served as chair of the Science Council for the Marine Biological Laboratory in Woods Hole and is a member of the American Society for Cell Biology, the American Association for the Advancement of Science and the North Carolina Society for Electron Microscopy and Microbeam Analysis.



Dr. Rita Colwell

Rita Colwell holds a B.S. in Bacteriology and an M.S. in Genetics from Purdue University and a Ph.D. in Oceanography from the University of Washington. Dr. Colwell became the 11th Director of the National Science Foundation on August 4, 1998. Since taking office, Dr. Colwell has spearheaded the agency's emphases on K-12 science and mathematics education, graduate science and engineering education/training, and the increased participation of women and minorities in science and engineering.

Her policy approach has enabled the agency to strengthen its core activities, as well as establish support for major initiatives, including Nanotechnology, Biocomplexity, Information Technology, Social, Behavioral and Economic Sciences and the 21st Century Workforce. In her capacity as NSF Director, she serves as Co-chair of the Committee on Science of the National Science and Technology Council.

Before coming to the NSF, Dr. Colwell was President of the University of Maryland Biotechnology Institute and she remains Professor of Microbiology and Biotechnology at the University of Maryland.

Dr. Colwell has held many advisory positions in the U.S. Government, non-profit science policy organizations, and private foundations, as well as in the international scientific research community. She is a nationally respected scientist and educator and has authored or co-authored 16 books and more than 600 scientific publications. She produced the award-winning film, *Invisible Seas*, and has served on editorial boards of numerous scientific journals.

She is the recipient of numerous awards, including the Medal of Distinction from Columbia University, the Gold Medal of Charles University, Prague, the UCLA Medal from the University of California, Los Angeles, and the Alumna Summa Laude Dignata from the University of Washington, Seattle.

Dr. Colwell has also been awarded 34 honorary degrees from institutions of higher education, including her Alma Mater, Purdue University. Dr. Colwell is an honorary member of the microbiological societies of the United Kingdom, France, Israel, Bangladesh, and the U.S. and has held several honorary professorships, including at the University of Queensland, Australia. A geological site in Antarctica, Colwell Massif, has been named in recognition of her work in the polar regions.

Dr. Colwell has previously served as Chairman of the Board of Governors of the American Academy of Microbiology and also as President of the American Association for the Advancement of Science, the Washington Academy of Sciences, the American Society for Microbiology, the Sigma Xi National Science Honorary Society, and the International Union of Microbiological Societies. She served as a member of the National Science Board from 1984 to 1990. Dr. Colwell is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society.



Dr. Joseph Bordogna

Joseph Bordogna received B.S.E.E. and Ph.D. degrees from the University of Pennsylvania and a S.M. degree from the Massachusetts Institute of Technology. Dr. Bordogna is Deputy Director and Chief Operating Officer of the National Science Foundation and served previously as head of the NSF's Directorate for Engineering. Complementing his NSF duties, he is a member of the President's Management Council; has chaired Committees on Manufacturing, Environmental Technologies, and Automotive Technologies within the President's National Science and Technology Council; and was a member of the U.S.-Japan Joint Optoelectronics Project.

Prior to appointment at the NSF, he served at the University of Pennsylvania as Alfred Fitler Moore Professor of Engineering, Director of The Moore School of Electrical Engineering, Dean of the School of Engineering and Applied Science, and Faculty Master of Stouffer College House, a living-learning student residence at the University.

Dr. Bordogna has made contributions to the engineering profession in a variety of areas including early laser communications systems, electro-optic recording materials, holographic television playback systems and early space capsule recovery. He was a founder of PRIME (Philadelphia Regional Introduction for Minorities to Engineering) and served on the Board of The Philadelphia Partnership for Education, community coalitions providing, respectively, supportive academic programs for K-12 students and teachers.

He is a Fellow of the American Association for the Advancement of Science, the American Society for Engineering Education, the Institute of Electrical and Electronics Engineers and the International Engineering Consortium. He also served his profession globally as president of the IEEE.



Dr. Shirley Ann Jackson

Shirley Ann Jackson holds a S.B. in physics from M.I.T. and a Ph.D. in theoretical elementary particle physics from M.I.T. Dr. Jackson became the 18th president of Rensselaer Polytechnic Institute on July 1, 1999. Her current research specialty is in theoretical condensed matter physics, especially layered systems, and the physics of opto-electronic materials.

Dr. Jackson's career prior to becoming Rensselaer's president has encompassed senior positions in government, in industry and research, and in academia. In 1995 President William Clinton appointed Dr. Jackson to serve as Chairman of the U.S. Nuclear Regulatory Commission (NRC). Dr. Jackson was Chairman of the NRC from 1995-1999. As Chairman, she was the principal executive officer of and the official spokesman for the NRC. She had ultimate authority for all NRC functions pertaining to an emergency involving an NRC licensee. Dr. Jackson represented the United States from 1995 to 1998 as a delegate to the General Conference of the International Atomic Energy Agency in Vienna, Austria.

From 1991 to 1995, Dr. Jackson was professor of physics at Rutgers University and from 1976 to 1991 Dr. Jackson conducted research in theoretical physics, solid state and quantum physics, and optical physics at AT&T Bell Laboratories in Murray Hill, New Jersey.

Dr. Jackson will become president of the American Association for the Advancement of Science (AAAS) in February 2004. Dr. Jackson will serve as president-elect in 2003, as president in 2004, and will chair the AAAS board in 2005. Dr. Jackson is a trustee at several universities and holds 21 honorary doctoral degrees. She is a member of the National Academy of Engineering as well as a Fellow of the American Academy of Arts and Sciences, the American Physical Society and numerous other professional organizations.

Dr. Jackson is the first African-American woman to receive a doctorate from M.I.T. in any subject. She is one of the first two African-American women to receive a doctorate in physics in the U.S. She is the first African-American to become a Commissioner of the U.S. Nuclear Regulatory Commission. She is both the first woman and the first African-American to serve as the chairman of the U.S. Nuclear Regulatory Commission and now the first African-American woman to lead a national research university. She also is the first African-American woman elected to the National Academy of Engineering.

Dr. Jackson was inducted into the National Women's Hall of Fame in 1998 for her significant and profound contributions as a distinguished scientist and advocate for education, science, and public policy.



Dr. Shirley Tilghman

Shirley M. Tilghman received her Honors B.Sc. in chemistry from Queen's University in Kingston, Ontario, and after two years of secondary school teaching in Sierra Leone, West Africa, she obtained her Ph.D. in biochemistry from Temple University. She was elected Princeton University's 19th president on May 5, 2001 and assumed office on June 15, 2001. Dr. Tilghman came to Princeton in 1986 as the Howard A. Prior Professor of the Life Sciences. Two years later, she also joined the Howard Hughes Medical Institute as an investigator. In 1998, she took on additional responsibilities as the founding director of Princeton's multi-disciplinary Lewis-Sigler Institute for Integrative Genomics.

During postdoctoral studies at the National Institutes of Health, she made a number of groundbreaking discoveries while participating in cloning the first mammalian gene, then continued to make scientific breakthroughs as an independent investigator at the Institute for Cancer Research in Philadelphia and an adjunct associate professor of human genetics and biochemistry and biophysics at the University of Pennsylvania.

A member of the National Research Council's committee that set the blueprint for the U.S. effort in the Human Genome Project, Dr. Tilghman also was one of the founding members of the National Advisory Council of the Human Genome Project Initiative for the National Institutes of Health. She is renowned not only for her pioneering research, but for her national leadership on behalf of women in science and for promoting efforts to make the early careers of young scientists as meaningful and productive as possible. She received national attention for a report on "Trends in the Careers of Life Scientists" that was issued in 1998 by a committee she chaired for the National Research Council and she has helped launch the careers of many scholars as a member of the Pew Charitable Trusts Scholars Program in the Biomedical Sciences Selection Committee and the Lucille P. Markey Charitable Trust Scholar Selection Committee.

From 1993 through 2000, Dr. Tilghman chaired Princeton's Council on Science and Technology, which encourages the teaching of science and technology to students outside the sciences and in 1996 she received Princeton's President's Award for Distinguished Teaching. She initiated the Princeton Postdoctoral Teaching Fellowship, a program across all the science and engineering disciplines that brings postdoctoral students to Princeton each year to gain experience in both research and teaching.

In 2002, Dr. Tilghman was one of five winners of the L'Oréal-UNESCO International for Women in Science Award, and the following year received the Lifetime Achievement Award from the

Society of Developmental Biology. She also was selected in 2003 by New Jersey Governor James E. McGreevey to co-chair the state's new Commission on Jobs Growth and Economic Development.

Dr. Tilghman is a member of the American Physical Society, the National Academy of Sciences, the Institute of Medicine and the Royal Society of London, the Advisory Council to the Director of the National Institutes of Health, the Scientific Advisory Board of the Whitehead Institute for Biomedical Sciences at the Massachusetts Institute of Technology and a trustee of the Jackson Laboratory.



Dr. Norbert S. Hill, Jr.

Norbert S. Hill, Jr. earned a B.S. in Sociology/Anthropology and an M.S. in Guidance Counseling from the University of Wisconsin. He is Executive Director of the American Indian Graduate Center in Albuquerque, New Mexico. Mr. Hill has devoted his professional career to helping Native Americans rebuild Indian communities, primarily through education.

Mr. Hill was Assistant Dean of Students at the University of Wisconsin-Green Bay, and the Director of American Indian Educational Opportunity Program at the University of Colorado.

He also served as the Executive Director of American Indian Science and Engineering Society (AISES) for fifteen years in Boulder, Colorado before joining the American Indian Graduate Center staff in June 2000.

Mr. Hill has been awarded three fellowships: Institute for Educational Leadership in Washington, D.C.; Community Builder Fellow with HUD; and Rockefeller Foundation Fellow.

He serves on numerous boards, including the North Central Association of Colleges and Schools, and has authored publications on educational issues for Native Americans. He was the founder and publisher of Winds of Change magazine, a publication of AISES.



Dr. Diana Natalicio

Diana S. Natalicio attended the University of Texas at Austin, where she was awarded a Ph.D. degree in linguistics. She was appointed to the National Science Board in 1994, served as Vice Chair from 1996 to 2000, was reappointed to the Board in 2000 and elected Vice Chair in 2002.

She spent a year as a Fulbright scholar in Rio de Janeiro, Brazil and held a Gulbenkian fellowship in Lisbon, Portugal. In 1971 she joined the faculty of the University of Texas at El Paso and two years later was named chair of the Modern Languages Department. She became dean of liberal arts in 1977 and vice president for academic affairs in 1984. In 1988 she assumed her current position as president of University of Texas at El Paso.

Dr. Natalicio serves on numerous boards and commissions, including the Governor's Council on Science and Biotechnology Development, the Board of Governors of the U.S.-Mexico Foundation for Science, the University Corporation for Advanced Internet Development and the National Commission on Teaching and America's Future. She also serves on the board of the Sandia National Laboratories, Trinity Industries, and the National Action Council for Minorities in Engineering.

Dr. Natalicio received the Harold W. McGraw, Jr. Prize in Education in 1997, was inducted into the Texas Women's Hall of Fame in 1999 and holds two honorary doctorates.



Dr. Beverly Daniel Tatum

Dr. Beverly Daniel Tatum is the ninth president of Spelman College, the oldest historically Black college for women, where she is continuing the Spelman tradition of academic excellence and leadership development. Prior to her appointment to the Spelman presidency in 2002, she spent 13 years at Mount Holyoke College, serving in various roles during her tenure there- as professor of psychology, department chair, dean of the College and acting president.

A noted scholar, teacher and race relations expert, Dr. Tatum is a clinical psychologist whose areas of research interest include black families in white communities, racial identity in teens, and the role of race in the classroom. She is the author of the critically acclaimed book “*Why Are All The Black Kids Sitting Together in the Cafeteria?*” *And Other Conversations About Race*, released in its fifth anniversary edition in 2003. Since its original publication in 1997, the book has been listed on the Independent Bookstore Bestseller list and was selected as the multicultural book of the year in 1998 by the National Association of Multicultural Education. The *New York Times* recommended the book as required reading for private school teachers and administrators in the greater New York area who were dealing with issues of race and class. She is also the author of *Assimilation Blues: Black Families in a White Community* (1987). In addition, she has published numerous articles, including her classic 1992 Harvard Educational Review article, “Talking about Race, Learning about Racism: An Application of Racial Identity Development Theory in the Classroom.” In 1997, Dr. Tatum participated in President Clinton’s national conversation about race and in 2000 she appeared as a guest on *The Oprah Winfrey Show* as a part of a Martin Luther King, Jr. Day broadcast concerning American youth and race.

Dr. Tatum earned a B.A. in psychology from Wesleyan University in Middletown, Connecticut and a M.A. and Ph.D. in clinical psychology from the University of Michigan. She also holds a M.A. degree in Religious Studies from Hartford Seminary. Prior to joining the Mount Holyoke College faculty in 1989, Dr. Tatum was an associate professor and assistant professor of psychology at Westfield State College in Westfield, Massachusetts, and a lecturer in Black Studies at the University of California at Santa Barbara.

The recipient of numerous honorary degrees, Dr. Tatum is also a member of the Board of Directors of the Association of American Colleges and Universities, and a trustee of Wesleyan University, and the Williston Northampton School.

She is married to Dr. Travis Tatum, a professor of education at Westfield State College, and the mother of two sons, a 21 year old and a 17 year old.



Dr. Shirley Malcom

Shirley Malcom holds a Ph.D. in ecology from Pennsylvania State University. Dr. Malcom is head of the American Association for the Advancement of Science (AAAS) Directorate for Education and Human Resources Programs. The directorate develops initiatives to address AAAS goals to improve the quality of education in science, mathematics and related fields, pre K – postgraduate, to broaden the talent pool in these fields to include women, minorities and persons with disabilities and to enhance public science and technology literacy.

Dr. Malcom has also been a high school science teacher, university faculty member and National Science Foundation program officer. She serves on the boards of the Howard Heinz Endowment and Caltech and is a Regent of Morgan State University. Policy experiences include past membership on the National Science Board and President’s Committee of Advisors on Science and Technology. In 2003 Dr. Malcom was awarded the Public Welfare Medal by the National Academy of Sciences.



Dr. Richard Tapia

Richard Tapia received B.A., M.A. and Ph.D. degrees in mathematics from the University of California Los Angeles. He is currently a mathematician and professor in the Department of Computational and Applied Mathematics at Rice University in Houston, Texas.

Dr. Tapia is internationally known for his research in the computational and mathematical sciences and is a national leader in education and outreach programs. In addition to his professorship at Rice University, he is the Associate Director of Graduate Studies at the Office of Research and Graduate Studies and Director of the Center for Excellence and Equity in Education. He is also currently an adjunct faculty member of Baylor College of Medicine and the University of Houston.

Dr. Tapia has authored or co-authored two books and over 80 mathematical research papers. He has delivered numerous invited addresses at national and international mathematical conferences and serves on several national advisory boards. Due to Dr. Tapia's efforts, Rice has received national recognition for its educational outreach programs and the Rice Computational and Applied Mathematics Department has become a national leader in producing women and underrepresented minority Ph.D. recipients in the mathematical sciences. Currently 31 mathematics students have received the Ph.D. degree under his direct supervision.

Under Dr. Tapia's direction, Rice's NSF-funded Alliances for Graduate Education in the Professorate Program provides opportunities for undergraduate and graduate students in science, mathematics and engineering to participate in university activities and work for the summer under the guidance of researchers at Rice. He impacts hundreds of teachers through two summer programs, the Mathematical and Computational Sciences Awareness workshop and GirlTECH.

Among his many honors, in 1996, Tapia was appointed by President Clinton to the National Science Board. Also in 1996, he received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. He received the 1997 Lifetime Mentor Award from the American Association for the Advancement of Science. Tapia was named the 1996 Hispanic Engineer of the Year by Hispanic Engineer Magazine, the first academician to receive this honor. He was elected to the National Academy of Engineering, the first native born Hispanic to receive this honor, and was given the Hispanic Engineer National Achievement Award for Education, the George R. Brown Award for superior teaching, and named one of the 20 most influential leaders in minority math education by the National Research Council. He was selected Professor of the Year by the Association of Hispanic School Administrators of the Houston Independent School District



Dr. Esin Gulari

Esin Gulari earned her Ph.D. in chemical engineering from Caltech in Pasadena, California, in 1973, and joined the Wayne State University (WSU) College of Engineering faculty in 1979. In addition to her professorship, Dr. Gulari is the Division Director of the Chemical and Transport Systems Division in the Engineering Directorate at the National Science Foundation. She was chair of the WSU Chemical Engineering and Materials Science Department from 1993 to 2000 and Acting Assistant Director for the Engineering Directorate from September 2001 to April 2003.

Dr. Gulari is the recipient of many awards. In 1995, she was awarded the Henry Ford Technology Award for her work in controlling oil mist in machining operations, an important innovation for environmental conditions in automotive plants. Dr. Gulari also was presented the Wayne State Distinguished Graduate Faculty Award in 1996 and the Outstanding Graduate Mentor Award in 1999. She is a fellow of the American Institute of Chemical Engineers, 2003 chair for the Council of Chemical Research, a member of the NRC Chemical Sciences Roundtable, a member of the executive board of the Committee for the Advancement of Women Chemists and Chemical Engineers.



Dr. Evelyn Hu-Dehart

Evelyn Hu-Dehart holds a Ph.D. in Latin American History from the University of Texas at Austin. She is currently Professor of History and Director of the Center for the Study of Race and Ethnicity in America at Brown University. She joined Brown from the University of Colorado at Boulder where she was Chair of the Department of Ethnic Studies and Director of the Center for Studies of Ethnicity and Race in America.

In 1988, Dr. Hu-Dehart left the City University of New York to become the CSERA Director at the University of Colorado at Boulder. She has also taught at the City University of New York system, New York University, Washington University in St. Louis, University of Arizona and University of Michigan, as well as lectured at universities and research institutes in Mexico, Peru, Cuba, France, Hong Kong, Taiwan, and China. She has written two books on the Yaqui Indians, and is now engaged in a large research project on the Asian diaspora in Latin America and the Caribbean.

Dr. Hu-Dehart speaks several languages, including English, Chinese, French, and Spanish, and her professional life has focused on what Cuban historian Juan Perez de la Riva calls “*historia de la gente sin historia*.” The goal of Professor Hu-Dehart’s diaspora project is to uncover and recover the history of Asian migration to Latin America and the Caribbean, and to document and analyze the contributions of these immigrants to the formation of Latin/Caribbean societies and cultures. It should also contribute towards theorizing diasporas and transnationalism. The importance and timeliness of this research was most recently demonstrated by the election of Alberto Fujimori, son of Japanese immigrants, as President of Peru. Dr. Hu-Dehart also hopes that her work would broaden the scope of Asian American Studies as well as contribute to an area not well covered within Latin American Studies. She has published numerous articles in English, Spanish, French, and Chinese on the topic, and expects to publish at least one book.



Dr. Lilian Shiao-Yen Wu

Lilian Shiao-Yen Wu graduated from Cornell University with a Ph.D. in Applied Mathematics. She received her B.S. from the University of Maryland at College Park. Dr. Wu is currently Director of University Relations at IBM's Corporate Headquarters in New York, and a member of the President's Council of Advisors on Science and Technology.

Dr. Wu chairs the National Research Council's Committee on Women in Science and Engineering and serves on the National Science Foundation's Committee on Equal Opportunity in Science and Engineering. She was a member of President Clinton's Council of Advisors on Science and Technology. Her major research interests are mathematical modeling and risk analysis in business, women in science and engineering, and energy and ecosystems. She also serves as Trustee of the New School, Director of the International Institute of Forecasters, and is on the Advisory Boards of the National Institute for Science Education, and the Douglas Project for Rutgers Women in Math, Science, and Engineering.



Dr. Emilio Bruna

Emilio M. Bruna received his Ph.D. in Population Biology from the University of California at Davis, then completed a National Science Foundation Minority Postdoctoral Fellowship at the Instituto Nacional de Pesquisas da Amazônia in Brazil. He is an Assistant Professor of Wildlife Ecology and Conservation at the University of Florida, with a joint appointment in the Center for Latin American Studies.

Dr. Bruna's research focuses on the consequences of deforestation and habitat fragmentation for plant-animal interactions and plant population dynamics. Much of this work has been conducted at Brazil's Biological Dynamics of Forest Fragments Project, where Dr. Bruna also helped develop and implement an internship program for Brazilian undergraduates interested in Amazonian ecology.

Dr. Bruna's research awards have included grants and fellowships from the National Science Foundation, The Ford Foundation, The Smithsonian Institution and the State University of New York International Development Group. Results of Dr. Bruna's research have been published in *Ecology*, *Nature*, and *Conservation Biology*.



Dr. Judith Ramaley

Judith Ramaley received her bachelor's degree from Swarthmore College in 1963 and conducted her graduate studies at the University of California, Los Angeles, where she earned a doctorate in 1966. She is currently the Assistant Director of the Education and Human Resources Directorate of the National Science Foundation (NSF). She served for two years as a post-doctorate fellow at Indiana University and was an American Council on Education fellow at the University of Nebraska Medical Center at Omaha, where she served as associate dean for research and development. She holds a presidential professorship in biomedical sciences at the University of Maine-Orono and is a Fellow of the Margaret Chase Smith Center for Public Policy.

Prior to joining the NSF, Dr. Ramaley became the chief academic officer at the State University of New York at Albany. She also served as executive vice president for academic affairs for two years and as acting president for one semester at SUNY-Albany. Dr. Ramaley was the executive vice chancellor at the University of Kansas from 1987 to 1990, President and professor of biology at the University of Vermont from July 1, 1997 to June 30, 2001 President and professor of biology at Portland State University in Portland, Oregon from 1990 to 1997.

Dr. Ramaley has a special interest in higher-education reform and has played a significant role in designing regional alliances to promote educational cooperation. She also has contributed to a national exploration of the changing nature of work and the workforce and of the role of higher education in the school-to-work agenda. She also plays a national role in the exploration of civic responsibility and the role of higher education in promoting good citizenship.

Under her leadership, The University of Vermont became a member of the Kellogg Commission on the Future of State and Land-Grant Universities that explored the role of research universities in the 21st century. The University has also established new partnerships in the state that support educational reform, economic and community development, and opportunities for Vermonters across the state. The most significant of these partnerships is the Vermont Public Education Partnership, an alliance of the Vermont Department of Education, the University of Vermont and the Vermont State Colleges to promote preK-20 collaboration throughout the state. In Vermont, Dr. Ramaley was a Director of the Vermont Business Roundtable, a member of the Human Resources Investment Council, a member of the Vermont Commission on Higher Education Funding, a member of the Governor's Council of Economic Advisors, a member of the Vermont Quality Council Board of Advisors and Co-Chair of the Vermont Campus Compact.

At the national level, Dr. Ramaley recently served as a member of the board of the Association of American Colleges and Universities and as a member of the National School-to-Work Advisory Board. She is a member of the presidential advisory panel for the Association of Governing Boards, Chair of the Board of Campus Compact, chair of the subcommittee on College Drinking of the Advisory Council of the National Institute on Alcohol Abuse and Alcoholism and is currently a trustee of Wilmington College in Wilmington, Ohio and a member of the Board of the American Association of Higher Education. She also is chair of the Greater Expectations Panel that developed a new approach to liberal education for the 21st Century.



Dr. Clifton Poodry

Clifton Poodry earned both a B.A. and an M.A. in Biology at the State University of New York at Buffalo, and received a Ph.D. in Biology from Case Western Reserve University. He is the Director of the Minority Opportunities in Research Division at the National Institute of General Medical Sciences.

Prior to assuming this position in April of 1994, Dr. Poodry had been a Professor of Biology at the University of California, Santa Cruz where he also served in several administrative capacities. As a professor, Dr. Poodry was involved with minority student development through the NIH sponsored Minority Biomedical Research Support and Minority Access to Research Careers Programs. Over the years, he also served on the NIH review committees for both programs.

Dr. Poodry has received and directed grants from several agencies, including the National Institutes of Health, National Science Foundation, and the Office of Naval Research. He was the Principal Investigator on a grant for undergraduate biological sciences from the Howard Hughes Medical Institute. He was for many years a faculty participant and advisory board member for the Headlands Indian Health Careers Program of the University of Oklahoma. Among the many Boards he had served on are the Boards of Directors of the American Indian Science and Engineering Society, the Society for the Advancement of Chicanos and Native Americans in Science, and on the Advisory Committee on Minority Science Education of the American Association for the Advancement of Science. Dr. Poodry is also a founding member of Openmind, an association for the achievement of cultural diversity in higher education.

He was the 1995 recipient of the Ely S. Parker Award from the American Indian Science and Engineering Society for contributions in science and service to the American Indian community. In 1999 the State University of New York awarded him an honorary Doctor of Science for his contributions in science and to the inclusion of minorities in research careers.



Dr. Willie Pearson, Jr.

Willie Pearson, Jr. holds a Ph.D. from Southern Illinois University. He is currently Professor and Chair of the School of History, Technology and Society at the Georgia Institute of Technology.

Dr. Pearson specializes in the sociology of science and sociology of the family. He is the author and co-editor of six books and monographs and numerous articles and chapters. He is completing a book entitled, *Beyond Small Numbers: Voices of African American Ph.D. Chemists*.

He has held research grants from the National Science Foundation, National Endowment for the Humanities, the Sloan Foundation, and the Department of Justice. Dr. Pearson has held postdoctoral fellowships at the Educational Testing Service and the Office of Technology Assessment, U.S. congress. He serves as a lecturer in Sigma Xi's Distinguished Lectureship Program and Chair, is a member of the Committee on Science, Engineering and Public Policy, and a member of the American Association for the Advancement of Science.

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