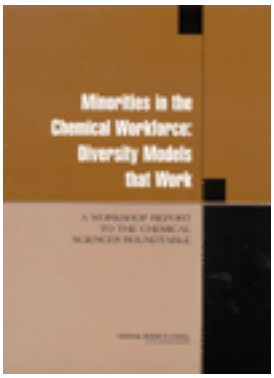


**Minorities in the Chemical Workforce: Diversity Models that Work - A Workshop Report to the Chemical Sciences Roundtable**

Chemical Sciences Roundtable, National Research Council

ISBN: 0-309-50767-7, 174 pages, 8 1/2 x 11, (2003)

# Minorities in the Chemical Workforce: Diversity Models that Work

A Workshop Report
to the
Chemical Sciences Roundtable

Chemical Sciences Roundtable
Board on Chemical Sciences and Technology
Division of Earth and Life Studies

NATIONAL RESEARCH COUNCIL
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This study was supported by the Research Corporation under Grant No. GG0066, the Camille and Henry Dreyfus Foundation under Grant No. SG-00-094 and SG-02-025, the National Institutes of Standards and Technology, Grant No. NA1341-01-W-1098, the U.S. Department of Defense under Grant No. MDA-972-01-M-0038, the U.S. Environmental Protection Agency under Grant No. R-82823201, the National Science Foundation under Grant No. CHE-000778, the National Institutes of Health under Contract No. N01-OD-4-2139, and the U.S. Department of Energy under Grant No. DE-FG02-95ER14556. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

International Standard Book Number 0-309-08539-X

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# Preface

The Chemical Sciences Roundtable (CSR) was established in 1997 by the National Research Council (NRC). It provides a science-oriented, apolitical forum for leaders in the chemical sciences to discuss chemically related issues affecting government, industry, and universities. Organized by the NRC's Board on Chemical Sciences and Technology, the CSR aims to strengthen the chemical sciences by fostering communication among the people and organizations—spanning industry, government, universities, and professional associations—involved with the chemical enterprise. The CSR does this primarily by organizing workshops that address issues in chemical science and technology that require national attention.

The topic of "Minorities in the Chemical Workforce: Diversity Models that Work" was selected by the CSR in response to concerns in the chemical sciences community about diversity in chemistry and chemical engineering. There is general recognition that future success of the chemical enterprise will require the full participation of all demographic groups, but such participation has not been achieved. After years of discussions on this topic, a workshop was planned for March 2002.

The workshop on *Minorities in the Chemical Workforce: Diversity Models that Work* brought together leaders in chemistry and chemical engineering from government, industry, academia, and the not-for-profit sector to gather information and explore approaches that would optimize participation by the full range of intellectual talent in the chemical workforce. Its primary focus was to expose the participants, primarily chemists and chemical engineers from all sectors, to examples of successful efforts to recruit and retain minorities—at the undergraduate level, in graduate programs, and in the chemical workforce. The focus was practical and realistic needs of institutions and opportunities for minorities in the chemical sciences. The workshop explored opportunities and challenges for transferring the prior successes into a variety of new settings in which those trained in the chemical sciences are employed.

The papers in this volume are the authors' own versions of their presentations, and the discussion comments were taken from a transcript of the workshop. In accord with the policies of the CSR, the workshop did not attempt to establish any conclusions or recommendations about needs and future directions, focusing instead on issues identified by the speakers.

Joseph S. Fransico and Isiah M. Warner
*Workshop Organizers*

# Acknowledgment of Reviewers

This workshop report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

James D. Burke, Rohm and Haas Company (retired)
Krishna L. Foster, California State University, Los Angeles
Rigoberto Hernandez, Georgia Institute of Technology
W. Christopher Hollinsed, E. I. du Pont de Nemours & Co.
Stanley C. Israel, Southwest Texas State University

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the content of the report nor did they see the final draft of the report before its release. The review of this report was overseen by Robert L. Lichter, who was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authors and the institution.

# Contents

# Summary

Joseph S. Francisco
*Purdue University*
and
Isiah M. Warner
*Louisiana State University*

A Congressional Commission reported in 2000 that the United States faces a critical shortage of technically skilled workers for a society that increasingly relies on science and technology, although the shortage could largely be ameliorated if women and minorities were brought into the technical workforce.[1] The report specifically suggested that if ". . . the United States continues failing to prepare citizens from all population groups for participation in the new, technology-driven economy, our nation will risk losing its economic and intellectual preeminence."[2] Such concerns, mirrored in many such reports,[3] led the Chemical Sciences Roundtable to organize two workshops to explore ways that the chemistry and chemical engineering communities could respond to these workforce issues. The first workshop, "Women in the Chemical Workforce," was held in 2000,[4] and the present report summarizes the presentations and discussions of the second workshop, "Minorities in the Chemical Workforce: Diversity Models that Work."

The historical background for minority participation in the workforce is best documented for African Americans. For example, as late as 1987, African Americans made up less than one percent of all U.S. citizens who earned a Ph.D. in chemistry. This fraction has increased over the last decade, but for the year of 1999, of the 2,134 Ph.D.s awarded in chemistry in the United States, only 56 went to African Americans.

However, the modest increases in Ph.D. degrees are not reflected by representation across the workforce. It was recently reported that the top research-intensive chemistry departments have very few

[1] *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology,* Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development, 2000 (*http://www.nsf.gov/od/cawmset/report/cawmset_report.pdf*).

[2] *Ibid.,* p. 1.

[3] See, for example, *The Quiet Crisis: Falling Short in Producing American Scientific and Technical Talent,* Building Engineering & Science Talent (BEST), 2002 (*http://www.bestworkforce.org/PDF_docs/Quiet_Crisis.pdf*).

[4] *Women in the Chemical Workforce. A Workshop Report to the Chemical Sciences Roundtable,* National Research Council, National Academy Press, Washington, DC, 2000.

minority faculty. Of more than 1,600 faculty at the 50 departments studied, only 22 were Hispanic and 18 were African American. Each of these minority groups constitutes about 1 percent of the total faculty, although African Americans and Hispanics earned 2.4 and 3.0 percent, respectively, of the Ph.D. degrees awarded in chemistry over the preceding decade. The numbers for Native Americans are even lower, with this group earning only 0.4 percent of the Ph.D. degrees awarded in chemistry.[5,6]

The workshop "Minorities in the Chemical Workforce: Diversity Models that Work" was organized to explore how the chemical science community could respond to this challenge. Of the workshop's three sessions, the first was a general overview that examined why diversity is important for the chemical science community and how and where the value is added. The second session looked at the pipeline issue beginning at the undergraduate level through graduate school. Are there lessons to be learned from successful pipeline producers that can be replicated at other universities to increase the number from the pipeline? The third session focused on successful activities in industry to attract and retain minorities to the chemical workforce. Are there valuable lessons that universities could learn from industry? In addition to presentations by invited speakers, there were discussions within breakout groups focusing on whether there are opportunities for change and, if so, what they are.

## CONTEXT AND OVERVIEW

**Clifton Poodry** (National Institute of General Medical Sciences) opened the session with a presentation on the importance of diversity and why it has been an important agenda item for the National Institutes of Health (NIH). In 1998, the Clinton administration set forth a national goal to eliminate long-standing disparities in health that affect racial and minority groups. In the process of addressing this goal, several important questions were raised. As related by Dr. Poodry, these are "Why focus on increasing the number of underrepresented minorities who are trained as biomedical researchers? Can the problems of health disparities not be solved as well by people of any ethnicity? Does representation matter?" Two observations made the NIH feel that representation matters. In the field of health, when experts are from nonminority groups, there is reluctance for minorities to participate in research or clinical trials that could lead to new treatments for these groups. Moreover, the presence of a significant number of minorities in a field often increases its legitimacy, as well as increases the value of its work in the perception of the public. These observations provided the motivation for the NIH to develop a talent pool of underrepresented minorities, while not denying opportunities to nonminorities. Dr. Poodry described two key elements for success in increasing the pool of talented underrepresented minorities that the National Institute of General Medical Sciences has discovered through its minority programs: to devise programs that focus on outcomes rather than individuals and to assist educational institutions in preparing and graduating increased numbers of minority students.

**Sylvia Hurtado** (University of Michigan) addressed the issue of preparing students for a diverse democracy. Dr. Hurtado noted that in the workplace, organizations find that managing diversity is becoming increasingly important. In the business world, working groups that have more diverse perspectives and diverse people exhibit greater creativity. As a result, there is less "groupthink," and different viewpoints emerge—including the nature of the questions asked. In the context of preparing students, Dr. Hurtado raised the questions of what cognitive and social skills are needed, and can these

[5]Nelson, D.J. The Nelson Diversity Surveys. Norman, OK, 2002 (*http://cheminfo.chem.ou.edu/faculty/djn/diversity/top50.html*).

[6]*Chemical & Engineering News,* June 4, 2001, *79*(23):67.

skills be identified? In a nine-year longitudinal study of 8,000 white students who grew up in predominantly white neighborhoods across 184 different colleges and university campuses, there were some interesting findings. Those students who went to colleges with greater minority populations subsequently embraced diverse friendships, lived in diverse neighborhoods, and tended to seek employment with companies that had a diverse workforce. They also showed more civic involvement. The study showed that students who had frequent interaction with diverse peers during their college years' demonstrated greater intellectual, social, and civic engagement during and after college. The empirical research indicates that diversity is an asset to learning and new thinking that is needed in the workplace. Dr. Hurtado concluded that colleges and universities can play key roles in preparing their students for a diverse democracy by the extent to which they create the climate, the diversity of the learning environments, and the extent to which individuals in the diverse environments can engage.

**Cornelia D. Gillyard** (Spelman College) discussed training and preparing African American women for careers in chemistry. She offered a unique perspective from two vantage points: first, Spelman is an HBCU, the acronym for Historically Black Colleges and Universities, and second, it is an all-women's college. Professor Gillyard reported that the rate at which Spelman graduates African American women with B.S. degrees in chemistry was not always as high as the current level. Even though Spelman is a 120-year-old institution, its chemistry department was not established until 1977. Thus, the number of chemistry faculty and students was originally small, but a major change took place. Professor Gillyard outlined the initiatives implemented by the faculty that set the stage for its current success as a department. It involved visionary leadership, faculty commitment to the vision, and departmental leadership that included alteration of its divisional infrastructure, recruitment of talented students, instituting unique mentoring programs, and providing research opportunities for the undergraduates. Another significant catalyst for change in the chemistry program at Spelman was the recruitment of a faculty that looked like the students. This had two important consequences. First, it engendered a bonding relationship between students and faculty, and second, the students developed greater confidence and self-esteem. In the short 25-year history of the department, 26 students from the Spelman chemistry program have gone on to earn Ph.D.s in chemistry and related fields. At least 25 more students are currently enrolled in Ph.D. programs around the country. Professor Gillyard highlighted goals for future improvements. These include broadening the research experience and using collective faculty expertise more effectively to secure extramural funding.

## UNDERGRADUATE AND GRADUATE EDUCATION

**Michael F. Summers** (University of Maryland, Baltimore County) presented an overview of the Meyerhoff Undergraduate Scholars Program. This is one of the most successful programs in this country for preparing minority students to enter Ph.D. programs in the sciences. Over the thirteen years of the Meyerhoff Program's lifetime, more than 95 percent of its participating students have earned a bachelor's degree in science, engineering, or mathematics. Why is the Meyerhoff Program successful? Summers gave much of the credit to the program's pioneer, Freeman Hrabowski, currently president of the University, who recognized a major misconception about the pipeline of minority students. While many have believed that there are few minority students who are interested in science, the opposite is true. The Meyerhoff Program demonstrated that there are large numbers of talented and qualified minorities with an interest in science, engineering, and mathematics. However, a large number of these students lose interest early in their college careers. A strong attribute of the Meyerhoff Program is that it was designed as an intervention. Critical and essential elements of the program include a summer bridge program designed to provide time-management and group-study skills to the incoming students; mentoring by

faculty and by minority mentors outside the university; and research experience for the students. Studies conducted at UMBC found that students who qualified for the Meyerhoff Program but enrolled elsewhere did succeed in college. But a much smaller fraction of that group graduated in science, engineering, and mathematics.

Careful nurturing during the freshman year of these students could significantly impact the talent pool available for graduate school. Professor Summers also highlighted a new program modeled after the Meyerhoff, but aimed for graduate student training. He concluded with the suggestion that these programs could be replicated elsewhere in ways that would have a substantial national impact on the recruitment and training of underrepresented minorities in science.

**Steven F. Watkins** (Louisiana State University) provided an overview of the history of the chemistry department at LSU and how it came to be the leading producer of African American Ph.D. chemists. In 1990, the majority of students in the graduate program were international students of mostly Asian descent. Prior to 1991, only four African Americans had been awarded Ph.D. degrees in chemistry at the LSU main campus. Subsequently, the faculty made a conscious decision to recruit domestic students as well as hire an African American faculty member.

Another element to LSU's success in its minority program is its close proximity to HBCUs in a state where a third of the population is African American. LSU found that minority students were the best recruiters for other minority students who visited the department.

Professor Watkins reported that the LSU chemistry faculty confirmed earlier results that the Graduate Record Exam (GRE) is not a good predictor of success in graduate school, and they were successful in convincing the graduate school that this is the case. Other measures were found to be more useful in selecting graduate students. Professor Watkins highlighted the importance of mentoring and support, and the need for a diverse faculty; these factors have enhanced the success rate of graduate students at LSU. About 60 percent of the students graduate with a Ph.D. degree, another 20 percent leave with a master's degree. The numbers are too small for reliable statistics, but Dr. Watkins indicated that the African American students may have a success rate that is above the average.

**Freeman Hrabowski** (University of Maryland, Baltimore County) presented an informal lecture following the workshop banquet. He provided a highly personal view of his experiences in preparing minorities for research careers in science. In a series of anecdotes, he described the origins of the Meyerhoff Program and other efforts at UMBC in support of minority education in the sciences. He provided background by relating some of his personal experiences as a young man learning firsthand the challenges that he would face as a minority entering the field of mathematics. He related several stories that made clear to the audience the importance of his leadership in creating a highly challenging atmosphere at UMBC—an atmosphere that is at the same time supportive and designed to encourage academic success for minorities in the sciences.

## THE CHEMICAL WORKFORCE

**D. Ronald Webb** (Procter & Gamble) discussed the problem of academia having a diverse workforce within its institutions. He brought out the fact that 30 years ago industry looked like academia today. However, industry—and specifically P&G—saw this as a problem and made a conscious decision to change. Dr. Webb outlined his view of the important steps for a company to successfully embrace diversity. At P&G, a corporate commitment to change was made from the top down. Moreover, the CEO went a step further and developed a diversity leadership council that tracked and measured how organizations within the company were doing in achieving their goals. This council reported directly to the CEO; and accountability is a key to the company's success. Dr. Webb described the four R's of

diversity as recruit, reward, recognize, and retain. Each of these was discussed in the context of how it contributed to increasing diversity within the company.

**James D. Burke** (Rohm and Haas, retired) discussed the differences between affirmative action and diversity. He noted that affirmative action is a means to ensure equal employment opportunity, but often is viewed as a mechanism by which some advance at the expense of others. In contrast, Dr. Burke argued that diversity is a deliberate business strategy for a company, one that is viewed as a business opportunity to improve the workforce, invigorate innovation, and spur customer appeal. He argued that culturally diverse teams foster intellectual diversity, which in turn leads to more robust and profitable solutions to problems and convergent decision making. Dr. Burke suggested that diversity has given new life to organizations and, in most cases, has revitalized them.

Dr. Burke addressed the question of how diversity can be achieved within industry, making a series of suggestions that could be adopted by others. As a first step, employers need to articulate the business value of diversity to their units and understand where it fits into the business. They have to be visible in promoting it, and middle management has to be rewarded for supporting change at the lower ranks. Diversity should be evaluated as a performance element for every manager's annual performance review. Dr. Burke discussed Rohm and Haas' approach to increasing diversity by explaining a self-analysis uncovered by an internal study group. They discovered that many of their problems with recruiting minority candidates were self-inflicted. This led Rohm and Haas to redesign the process of recruiting. Dr. Burke outlined the critical components of the process and highlighted the outcomes of the program that resulted in a recruitment acceptance rate of more than 50 percent annually. He also talked about how barriers to achieving diversity can be broken down. He highlighted examples of other industrial organizations where these barriers were broken down very quickly by proactive top management.

# 1

# Diversity: Why Is It Important and How Can It Be Achieved?

Clifton A. Poodry
*National Institute of General Medical Sciences*
*National Institutes of Health*

Over the years, the National Institute of General Medical Sciences (NIGMS) has sought and supported programs to increase the number of underrepresented minorities participating in biomedical research. Indeed, the Division of Minority Opportunities in Research was established in NIGMS to support that mission.

Why is increasing the participation of minorities in biomedical research important to NIGMS and the rest of the National Institutes of Health (NIH)?

Unfortunately, there exists a substantial disparity in disease morbidity and mortality among subpopulations of the United States. Clearly, there are large segments of the population that have not fully enjoyed the benefits of the research that NIH has funded. The people in those populations are biomedically and educationally underserved. In 1998, the Clinton administration issued an initiative that set a national goal of eliminating, by the year 2010, longstanding disparities in the health status of racial and ethnic minority groups. One focus of that initiative is the training of investigators who come from minority communities.

Why focus on increasing the number of underrepresented minorities who are trained as biomedical researchers? Can the problems of health disparities not be solved as well by people of any ethnicity? Does representation matter?

## THE NEED FOR MINORITY RESEARCHERS

One answer can be found in the reluctance of minority group members to participate in biomedical research or clinical trials. This reluctance is accentuated when few of the scientists doing the research or running the trials are themselves members of minority groups.

In her essay "Women, science, and society"[1] published in 1998 in *Science*, Sandra Harding pointed out some benefits of diversity: "…these days, the presence of significant numbers of women in a field

[1]Harding, S. 1998. Women, Science, and Society. *Science, 281*:1599-1600.

often increases its legitimacy and the value of its work in the public perception." She also wrote that "Gender diversity in policy-makers enhances the quality of decision-making in science and technology. To stress the importance of women's perceptions and analyses, especially around issues that most affect them, is simply to point out that allowing for different viewpoints can have immense value in scientific and technological work." Similar thoughts have been expressed with regard to the inclusion of minorities. These comments reflect the notion that representation in the scientific workforce matters because scientists, as individuals with their own points of view on what is important, make critical decisions for society on what should be studied and supported.

## MAKING FAIR SELECTIONS

In recent years there have been gains in the number and percentage of minorities obtaining baccalaureate degrees in the sciences. Underrepresented minorities make up about 12 percent of the bachelor's degree recipients in biology and chemistry (Figure 1.1). However, they make up only a little over 5 percent of the Ph.D. degrees awarded in those disciplines (Figure 1.2). It is important to recognize that

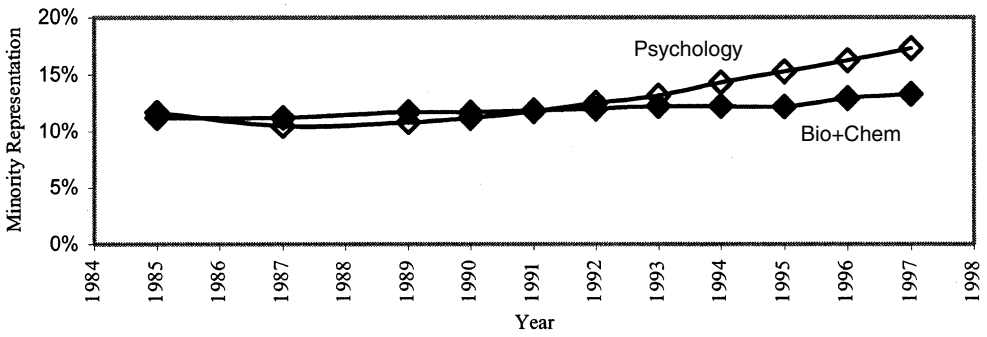


FIGURE 1.1 Minority representation among bachelor's degree recipients in biology + chemistry and psychology (all U.S. institutions).

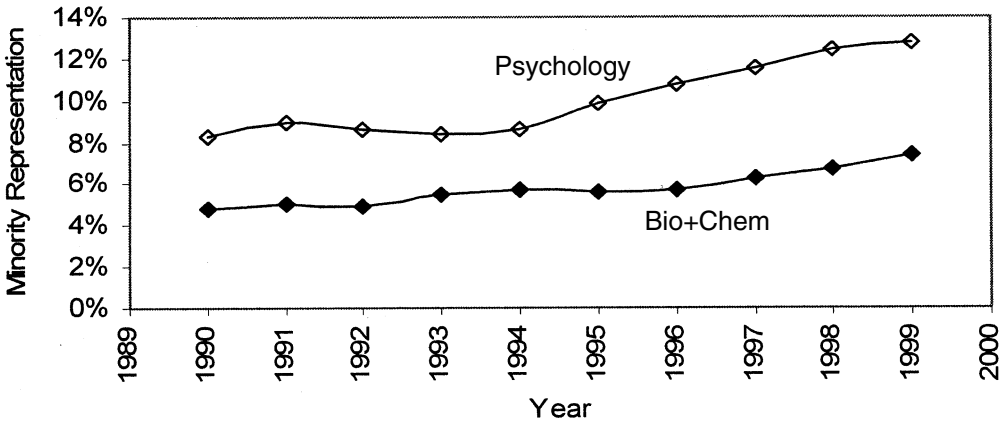


FIGURE 1.2 Percent of Ph.D.s in biology + chemistry and psychology awarded to underrepresented minorities (U.S. citizens and permanent residents).

the current underrepresentation of minorities in graduate science programs has occurred despite policies that were put in place to ensure fairness. That does not deny any unintended negative effects on minority groups, but it recognizes that academic decisions are based on the application of multiple, overlapping values. Whenever resources are limited, some people will be left out. In graduate admissions, for example, if there are more applicants than there are labs or graduate stipends, some applicants will not be accepted. Faced with that dilemma, admissions committees apply various criteria. One criterion is to select those who can best take advantage of the opportunity. A second is to select students who will quickly become assets to the research program of their graduate advisor and to the graduate program as a whole. In an effort to make unbiased judgments, graduate admissions policies gradually shifted toward the use of objective criteria in preference to subjective criteria in student selection. To remove the possibility of bias influencing the decision, dispensing with the use of subjective measures became a standard. As a result, standardized testing became an increasingly important way to be objective and fair. Conversely, current standards encourage a diverse and inclusive group of students in our training programs. Although objective testing may appear to have removed a source of overt bias, there is a great deal of uncertainty about what the tests measure and whether different communities are at a disadvantage in their abilities to perform on such tests.

Does support of our value of diversity necessarily mean that we must abandon objective standards designed to ensure fairness? A question that we have wrestled with for some time is how to increase opportunities for the development of a pool of underrepresented minorities without denying any opportunities to nonminorities.

In 1997, NIGMS convened a small working group to consider alternative criteria that might help guide the design of future Minority Biomedical Research Support and Minority Access to Research Careers programs so that NIGMS could meet the desired outcomes but avoid having race-restricted eligibility for the programs. The group considered alternatives to race and ethnicity, such as defining eligibility by a surrogate marker, such as disadvantage based on geography or quality of schools. The concept that emerged from the discussions was that programs should emphasize (1) the motivation and willingness of the participants to pursue training; (2) the motivation and desire to improve their skills and abilities; and (3) the provision of some service to underserved, underrepresented communities. The group members recommended that an advertisement for a program might say, "This program particularly encourages applications from individuals who have experienced and worked to overcome educational or economic disadvantage, individuals from underrepresented groups, and individuals who have other personal or family circumstances that may complicate their transition to the next stage of their biomedical research career." The message to NIGMS was to devise programs that focus on outcomes rather than individuals.

## AN ALTERNATIVE VIEW OF THE PROCESS

A metaphor that has been used over the years to describe the production of minority scientists has been that of a pipeline—a leaky pipeline. At NIGMS, we do not believe that a pipeline captures the essence of the way people develop in the course of their lives. We believe that the course of personal development is more like a complex chemical synthesis. Some reactants are moved along the pathway, but reaction products are also lost to our main pathway (Figure 1.3). Although there may be an enrichment step, it may be at the expense of substrate. This metaphor raises new questions. Do we know something about the rate of the reaction? Do we know something about the quantities and concentrations? Do we know enough about alternative pathways that, if somebody drops out on the way to a bachelor's degree, we can predict if he or she will be likely to reenter the pathway or will they be lost? Perhaps most important, what are the catalysts that will help move reactions forward?

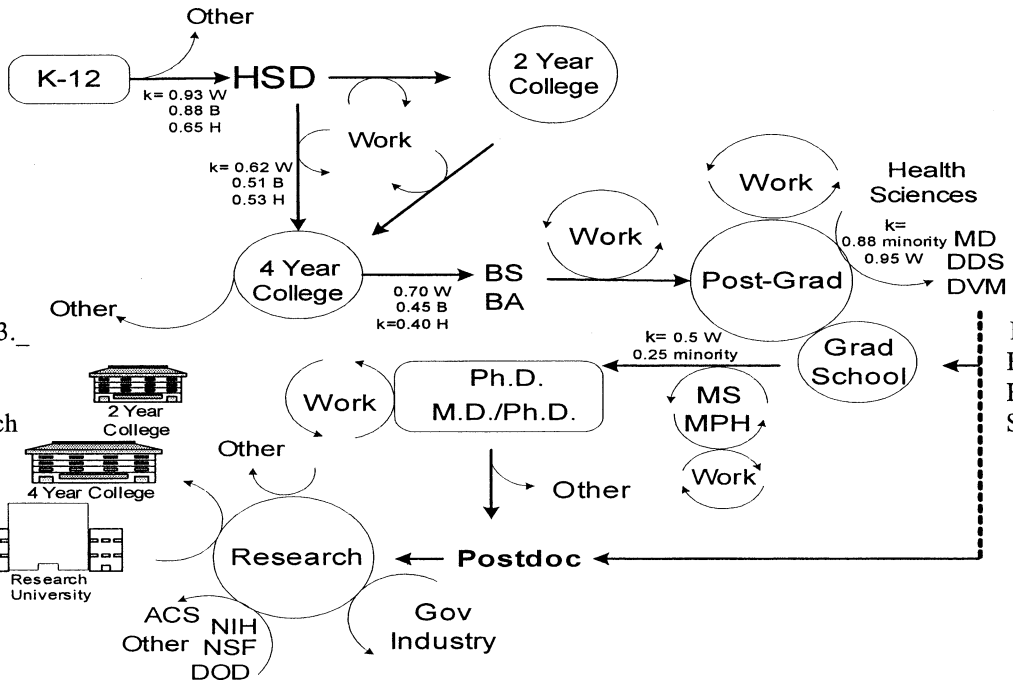


Figure 3._ Career URM Research Modeling Pathways for Biomedical Scientists.

FIGURE 1.3 Modeling career pathways for URM biomedical research scientists, where k= fraction of students graduating per year by ethnicity, W=white, B=black, H=Hispanic. At each transition, the fraction of minority students who go on to the next level is lower than for nonminority students. Fractional completion rates derived from data found in *Science and Engineering Indicators*, 1996, NSF.

Figure 1.3 shows that transitions in academic progress differ among various minority groups. For example, if the high school completion rates for Mexican Americans and American Indians are only 50 to 60 percent, limiting our efforts to interventions at the college level misses a major part of the problem. Because the completion rate of Ph.D.s is lower for minorities than for nonminorities, another conclusion that can be drawn is that if the difference in completion rate were eliminated, the number of minority Ph.D.s produced would double.

## MAKING A DIFFERENCE

Good examples of successful endeavors to develop minority scientists are included in the NIGMS booklet, *Scientists for the 21st Century*: *Biomedical Research and Training Opportunities for Minorities*.[2] In it, three individuals are featured who have come through our programs and are doing wonderful things. We do have great success stories—the programs can work. Although we pride ourselves on these outstanding outcomes, we are concerned about the difference between the completion

[2]National Institute of General Medical Sciences. 2000. *Scientists in the 21st Century: Biomedical Research and Training Opportunities for Minorities*. Bethesda, MD: National Institutes of Health (*http://www.nigms.nih.gov/about_nigms/more_brochure.pdf*).

rates for various groups and the overall low number of underrepresented minorities obtaining Ph.D. degrees.

When we ask how representation is different today from what it was 30 years ago, we are disappointed to find that we continue to have the same problems of underrepresentation. Consequently, our thrust is toward improving the ability of institutions to prepare and graduate increased numbers of minority students, as well as to promote the successes of the students.

In conclusion, at NIGMS we need to evaluate the effectiveness of our programs designed to diversify the scientific workforce and promote the most effective components. The activities highlighted at this workshop illustrate some of the outstanding positive examples. They should be studied and, where possible, emulated.

## DISCUSSION

**Isiah M. Warner, Louisiana State University:** As I was listening to you talk, I thought about a study that reported that aspirins are now a good antidote for prostate cancer. When asked, researchers said 100 percent of the patients involved in the study were white males.

We in the minority community know that prostate cancer is much higher among minorities, African Americans, for example. It makes me wonder how, in this day and age, can studies not include a diverse population. It is just mind-boggling that those things continue to go on.

As we proceed through this workshop, I hope we will recognize that there will be some things discussed that people can use as a template so that they will not have to reinvent the wheel.

However, that aspirin study showed me that we have not learned from the past. I know that we are anxious on many fronts to try to make sure that there is a diverse population and that there are such studies, but I think we still have a long way to go.

**Clifton A. Poodry:** I will agree, and that is why we need a diversity of people—in gender, race, and ethnicity—at the table with those points of view, helping to influence policy.

**C. Reynold Verret, Clark Atlanta University:** Many of the initiatives at the NIH and the other agencies to increase the pipeline occur at the college and higher level. What programs do the NIH and other divisions have that reach into the high schools? A question that has come up at other meetings is how many of us opted for science while we were in college. That decision is actually made earlier. The paucity of the pipeline has to do with something that occurs much earlier. What is being done to address that issue?

**Clifton A. Poodry:** It is the Ides of March. Our authority, the NIH, is for research and for research training. Generally, that is not interpreted as meaning educational support or other activities at the precollege level. Although there are some experimental programs that address the question of motivation and preparation in high school, they are very small. At NIGMS, high school programs have been discussed a number of times, and we would love to have further discussions on them, but we have not done much. I think that unless the President or Congress told us to do more—that is, if our authority was changed—we probably will not. I absolutely agree with you, but we do what we can.

**William M. Jackson, University of California, Davis:** You pointed out two things. One was, if the graduation rate for minorities was increased to what it is for the majority students, it would double the overall Ph.D. production. How does that work out in terms of absolute numbers? How many minorities

are entering the Ph.D. program? As far as I know, the number entering is significantly lower than their percentages of the population. That is one issue.

The other issue, which I thought was interesting, was the criteria for judging students and faculty, and they are at odds with the outcomes that you want for those students and faculty, but you never suggested any new criteria for judging.

**Clifton A. Poodry:** No, I did not suggest new criteria. That is why I want to engage more minds in helping us with those criteria. I can give you some examples. One of the things that you want is someone who can be a multifaceted team player. I do not remember whether years ago if it was you that gave the example of a basketball player. I attribute it to you. Maybe it was somebody else. Well, you cannot have somebody who just shoots. The person may be wonderful, but that is not a basketball player. You cannot have somebody who can play only defense. You need somebody who is a balance. Not all faculty have to be high-scoring shooters or the best defensemen or passers. In fact, you need a team of people that have a variety of talents.

One of the things we want of a faculty in a college are people who can think about the issues, whether it is education, how to teach better, whether it is the research community, the community of scholarship, or the various other functions that we provide. Unfortunately, when we recruit new faculty, we seldom look at the attributes that are going to be important for them to be complete faculty.

**David Bergbreiter, Texas A&M University:** One of the things you did not mention that NIH does that I think they should be commended for is that, if you have an RO1 grant and if you have a minority student, you can add that student onto your grant basically at no cost. It adds an increment to your grant.

The National Science Foundation (NSF) claims to do this, but it is not as transparent. For NIH, that is very important. What that means is that a faculty member has an incentive to recruit minority students. For example, if a student has trouble in his or her second year trying to get through the semester, the principal investigator does not have to worry about using a significant percentage of the grant funds to support the student while the student figures out what to do with his or her life. It does not hurt the program very much. I think that is an important measure, at least for people involved in research.

**Clifton A. Poodry:** I appreciate that comment a great deal. It is ironic. We initiated that program at NSF nearly 20 years ago, and it is a shame that it has not blossomed. I am at least pleased that NIH has adopted it.

**Patricia M. Phillips-Batoma, University of Illinois, Urbana-Champaign:** You pointed out the importance of consulting literature on these issues rather than relying on personal experience.

I was wondering whether there might be a central agency somewhere that might be able to develop a website that has references to published literature in this area that people could consult readily.

**Clifton A. Poodry:** That is a terrific suggestion. In fact, if you go to the NIGMS website, one of the things you will at least find there is a small link to 20 top references. The University of Maryland, Baltimore County, put together a list for us. We had wanted to provide something just like that.

In fact, a list of 1,000 references was put together, but there are still hurdles. Some of those hurdles Isiah Warner may help us with. We should be helping the community by at least putting a lead out there. Take a chance. Put some titles out there, and, if people disagree, they will tell us there is a better one, but that is a way to get it started. It is a technical assistance that we can and should be doing. I hope we can follow up on that.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** I was glad you pointed out the importance of individuals taking responsibility. It seems to me that one of the best things that NIH and others can do is to enable individuals to engage and to become champions for change. In the end, that is what counts.

To what extent are NIH's programs—your programs and related ones—taking into account the newest discussions relating to the lack of relationship between race and genetics? With the human genome project completed, there is a lot of discussion now showing that those things that we identify with ethnicity and race have little to do with health observations.

**Clifton A. Poodry:** Certainly that is a major continuing interest of the Genome Institute. NIGMS has a strong interest in that, not only because of the genetics division but also because of the pharmacogenomics program. We need to understand that the pendulum has swung from the belief that genetics was tremendously important to not important.

Clearly, we have genes and they interact with the environment. It is also true that people historically, from different geographies of the globe, have some differences. The amount of differences is much smaller than people might have thought ten years ago, but, nonetheless, there are differences and they may account for part of the reason that we react to the environment differently and have different susceptibilities. It is an important balancing act. We cannot lose the purchase that we have on being able to look at population genetics, but we also have to be cautious not to overascribe or to reinforce prejudice or stigma. That is one of the reasons why NIH has ethical, legal, and social-implications genetics programs, which both the NIGMS and the National Human Genome Research Institute subscribe to.

**Donald M. Burland, National Science Foundation:** NSF has a number of minority-related programs. In fact, any principal investigator can request a supplement to a grant for a minority graduate student or a minority postdoc.

There are minority planning grants, and a number of other programs, for a faculty member who needs to get those very important sort of preliminary results that always seem to be required to obtain funding. If I were to be critical of us, I would say that we have not done as good a job as we can to make sure that everybody knows about those opportunities. It is usually a small amount of money allotted per program officer, and it is limited by the amount of proposals that we receive.

**Clifton A. Poodry:** I appreciate your comments. When we started, Jane Paterson and I called every single grantee. We spent only about two-tenths of a percent of our budget. Our goal was to reach approximately half a percent of our budget. So, the budget was not the limitation. The limitation was, in fact, the number of applications that came in.

**Josef W. Zwanziger, Indiana University:** William Jackson raised this question about the absolute numbers, which we did not address.

If I remember correctly from the American Chemical Society data, the number of Ph.D.s per year in minorities is about 60. If I am wrong, please correct me. I think we just wrote up a report in our department about this, and I think that is the right number. Even if that number gets doubled, it is exceptionally small. I think that should be at least as big a concern as the actual rate of production, just because the numbers are very small right now.

**Clifton A. Poodry:** We have the numbers as of a couple of years ago. It is possible to download them from NSF databases. What I can tell you is that, if you combined biology and chemistry, and, unfortu-

nately, psychology together, the number of baccalaureate degrees for minorities is currently about 16 percent.

That is the pool that is immediately available to go on to graduate school. The number obtaining Ph.D.s is closer to 10 percent. Actually, that is not so bad, considering that the slopes of the curves are running somewhat parallel. Unfortunately, if you take out psychology and just have biology and chemistry, the number drops back down to around 6 percent. That means that there is a disproportionate loss in the graduate program compared with the baccalaureates that are available. I agree that the absolute numbers are necessary. We can get them.

**William M. Jackson:** In that 16 percent, how many are foreign students who are classified as minorities? I think that is an important issue, and we need to know that number.

**D. Ronald Webb, Procter & Gamble:** If you look at chemistry students who were granted with doctoral degrees in 2000, U.S. citizens or permanent residents only, we are talking about 1,200 degrees being granted, with about 3 percent going to African Americans. In absolute numbers, African Americans received only 44 doctorate degrees in chemistry that year. Also for the year 2000, a little more than 700 doctorate degrees in chemistry were awarded to foreign national students, but I am unaware of how many of these would be classified as minority.

**Clifton A. Poodry:** If you add Hispanic, it is probably another 3.5 percent. So, it is probably 6-7 percent.

**D. Ronald Webb:** Right, if you look at Hispanic and African American combined, there were about 90 doctorate degrees in chemistry awarded to these two minority groups in 2000. These numbers are very low.

**Michael P. Doyle, Research Corporation:** You made some statements regarding affirmative action and then new criteria that would define motivation and other factors that would bring people into the scientific workforce.

There is a sensitivity to the term affirmative action. At the NIH, and especially at the NIGMS, with all its myriad of programs that provide great directed benefit to underrepresented minorities, is there a reevaluation criteria for both the allocation of resources and for the definition of what represents the population or the pool, given the changes in judicial actions and in government oversight?

**Clifton A. Poodry:** Yes, we are aware of the judicial actions, the risks. For our programming in general, we have a goal of increasing the numbers.

For example, for a program that major institutions can apply for, not just minority-serving institutions, we ask the program managers to come up with a plan that increases the numbers.

They can add students but they are not limited to adding minority students. They can add any student as long as they can come up with a plan to increase the numbers. In fact, I can just imagine a program that would be inclusive, that would bring the best of all groups together and, a lot like the Meyerhoff Program, establish an esprit de corps and a work ethic to work on important societal problems.

I welcome anyone that would do that. I think it would be self-selected. It would be an enrichment for minorities, but it would be self-selected. We asked institutions to make the judgment. We do say that outcomes are to increase the number of underrepresented minorities, and we also define, but we also give them the opportunity to define, underrepresentation.

There is one program that started out not at our institute, but that we received management of, that specifically says that students paid on it have to be underrepresented students. In that case, it is up to the institution to set that. For example, the University of Kentucky has argued and made the case that residents of Appalachia underrepresent all ethnicities. So, they have made a case. There is nothing that stops them from appointing people that they have indicated are underrepresented.

The state of California has made a case that Filipino Americans, not necessarily people who are from the Philippines but Filipino Americans, are underrepresented. So, in fact, in their programs, that is an allowable. It is a wiggly line, but we are very conscious of not denying people the opportunities.

**Marvin Makinen, University of Chicago:** I would like to raise an issue that I think is related to the part of your talk about raising the percentage of minorities completing Ph.D. programs. I am bringing this topic up because I would like to have some answers to this issue through the breakout discussion groups.

We have heard a lot about criteria and perhaps a need for "new criteria" in the selection of minority students for graduate study. I am not sure that we need new criteria. I would offer that perhaps we need to reweight the criteria that we presently use.

When one is in charge of a training grant, as I am at the University of Chicago, it is very easy to recognize applicant students who are strong candidates because they have high Graduate Record Examination (GRE) and high grade point average (GPA) scores. However, when one is dealing with students who have not had a tradition of focusing on higher education, I do not think that those criteria should be weighted in the same manner. Possibly other criteria are better indicators of probable success of completion of the graduate program.

This is a problem when it comes to trying to renew training grants. Faculty constantly worry over this issue because site-visiting committees look at the GRE and GPA scores of students accepted to the program.

If students are accepted with low GRE scores, as is often the case for minority students without a tradition of academic achievement, they lower the average, and the fear is that site-visiting committees mark that against you. On the other hand, if recruitment of minority students is not considered adequate by the site-visiting committee, this is also a mark against the program.

I want to know which studies have identified the factors that show a positive correlation with success in completion of graduate programs. Perhaps, for instance, it is better to weight the letters of recommendation, where someone has actually had a student in the lab and has seen the student work and knows that the student, in spite of initial difficulties such as poor study habits, is likely to complete the program because of his or her own personal commitment.

I believe that this is a critical issue to be addressed if one wants to increase the percentage of minorities getting Ph.D. degrees. It is not just numbers. The issue is how to identify those applicants who are going to make it through the program and the criteria to be used for their selection into the program.

**Clifton A. Poodry:** Excellent question. I wish I had access to the research, to the publications, and I think your point illustrates it. We need to know. We need good data to base decisions on. We need to have something that is good research—credible, believable, and publishable—that we can refer to. Currently, we do not have solid items to give you. Isiah Warner said that Steven Watkins will perhaps address that this afternoon.

**Tyrone D. Mitchell, National Science Foundation:** I am a program officer at NSF. I want to mention something that may cause many of you to say, this guy is really off the wall. One of the things that I am

concerned about is the use of the term minorities. I think I would like to challenge everybody to start thinking about moving away from that terminology.

To give you an example of my concern, we went to a group meeting at NSF to discuss working on issues to get more underrepresented persons into the pipeline in chemistry. In the meeting, some people were very vehement about what we are doing for the disabled. This group is underrepresented in some areas. I want to challenge us to use the term "underrepresented groups" in the workplace. The government, in its census, identifies about five or six categories of people that it tries to track, and Asians are in that category. We use underrepresented groups or underrepresented minorities because Asians are not underrepresented in the workplace even though their percentage in the population is small. However, they are underrepresented in the Chemistry Division at the NSF just as white males are underrepresented in certain administrative functions.

I think the use of the term underrepresented groups is quite a bit better, but we are probably not ready to start using this terminology especially in this workshop. We need to be more specific in trying to identify who are truly minorities. We have developed a lot of programs for women, and when you look at African Americans and women, they have one thing in common. For women, the bias is sexual, they cannot change their sex, and for African Americans, the bias is skin color and they cannot change their skin color. Some of the other minorities—Hispanics, Asians, and other groups—can leave behind the cause of much of the bias they receive (language, for example).

I think we ought to start looking at underrepresented groups and try to get people into those areas where they are underrepresented. I think the term minority is something that we might want to move away from in the future.

# 2

# Preparing College Students for a Diverse Democracy

Sylvia Hurtado
*University of Michigan*

I typically speak to educators and many national audiences about some of the work that is being conducted in the social sciences regarding diversity and college-level learning and the goal of preparing students for an increasingly complex and diverse society. This workshop is an opportunity to begin to think how this particularly applies to students and to individuals in the workforce that are in the scientific fields. One of the things that I like to see is that scientists are very excited about their work. I am pleased to share with you today some work that I am very excited about because of its implications for education and a diverse workforce. The focus of my research for the past three years has been on determining and measuring the skills, dispositions, and values among college-educated individuals that are necessary for this changing workforce. I focus on the identification of skills and dispositions that employers indicate are important; the developing theory that links these skills with diversity experiences; and the mechanisms that foster the development of these skills, dispositions, and values during the young adult years.

## SKILLS FOR A DIVERSE WORKFORCE

In the mid-1990s, several reports, including *Work Force 2000*, began to examine the demographic projections to anticipate some of the key skills that will be necessary in the new millennium. Eighty-five percent of the new entrants into the workforce are projected to be women, immigrants, and racial and ethnic minorities. The RAND Institute conducted a survey of employers who identified some key cognitive and social skills that are desirable (Bikson and Law, 1994). Among the skills identified that are particularly relevant to our research focus are (1) the ability to work effectively with diverse groups; (2) openness to new ideas and perspectives; and (3) empathy with other workers' perspectives, that is, the ability to see the world from someone else's perspective. Another idea that has emerged in the business literature is that managing diversity in the work environment is becoming increasingly important, not simply because of the increasing numbers of diverse workers, but for reasons of overall organizational performance.

Taylor Cox (1993) has conducted diversity experiments in a number of controlled studies with small groups. What he identified has also begun to be revealed in the business setting: There is greater creativity in working groups with diverse perspectives and diverse people. In a sense, the presence of diverse people and perspectives is important for its organizational rationale. There is less "groupthink"—meaning that everyone does not conform to one view or approach—but it also represents a level of complexity. How does one manage this level of difference in attempting to solve a work problem? To what extent are we actually preparing students to handle difference and possibly conflict in the work environment, or in construction of problems that affect populations? Must they learn these skills on the job or do they have opportunities during college to expand the cognitive development to manage differences that they are likely to encounter in the postgraduate years?

In our current research project we have identified a series of cognitive outcomes that are defined as "active thinking" skills. It is not just logical deduction that is necessary to handle more complex and messy social problems but, rather, complex thinking skills. We are exploring a variety of tests and ways of measuring this. The disposition to think critically is one of these skills and is composed of attributes that include openness to new ideas and inquisitiveness. It would seem that these dispositions are particularly important for scientists to possess.

There are also social cognitive skills that go along with more complex thinking in a diverse society. These include, for example, perspective-taking skills, or the ability to see the world from someone else's perspective, willingness to discuss and solve complex social problems with others, and social awareness. These are the characteristics that begin to address civic or democratic skills—all of which we are beginning to identify among undergraduates in our studies. That is, we are beginning to explore the extent to which we are preparing students to have a commitment to the public good in their work and in their daily lives that will help our pluralistic democracy thrive. Actually, in higher education there is a broad movement in terms of civic engagement, promoting service learning, and connecting or reconnecting with communities who are in need of the resource talent produced by colleges and universities. We believe that many institutions have the mechanisms in place to increase undergraduate engagement in these activities that will result in a distinguished citizen, one who can participate in a diverse democracy.

## A THEORY OF DIVERSITY AND LEARNING

Cognitive psychologists have been studying individuals in terms of thinking and learning for many years. Several of these psychologists have begun to conclude that most of our thinking is mindless. The important point that they are discovering—and they are doing it in a variety of ways—is that we rely on scripts, routines, and automated thinking. We are actually cognitive misers.

So many of our day-to-day interactions with individuals and work (for example, driving to work, students shuffling into large classrooms, or lecturing from "yellowed notes" to students) all consist of rather automatic thinking and behavior. In many ways, in higher education we cannot take for granted that individuals are actively thinking. If we begin with this premise, then we have a better sense of what we need to do in classrooms and in the workplace to inspire more active thinking and learning.

Ellen Langer (1978), a cognitive psychologist, found that encountering new and unfamiliar situations, people, and perspectives causes us to abandon routines and think actively. Changing routines or abandoning old scripts that do not work in new situations helps us to achieve this. When you think about the transition to college, some of the routines and habits that students followed in high school no longer serve them well. They have to adjust to new expectations, people, environments, living arrangements,

and exposure to others from different social backgrounds. From an educator's perspective, this is a primary time to educate students, because the learning curve can be extremely high.

Piaget (1975), one of the classic cognitive theorists, calls this moment of realization a "disequilibrium." That is, disequilibrium occurs when individuals encounter perspectives that depart from their own embedded world view and past experiences. That is, they cannot rely on the routines, traditional kinds of thinking, or even categorizations they used as a frame of reference. Sometimes, however, the individual resists this disequilibrium and refuses to process this new information and insists on relying on familiar frames of reference. This can occur upon exposure to new groups of people and takes the form of stereotyping. Stereotyping is a way to avoid active thinking in new encounters with others and relies on very limited past experience and impressions.

Disequilibrium can be very uncomfortable for students in the classroom. Some of the best educators know this and use it as part of their pedagogy to increase active learning. However, those students with the most discomfort with disequilibrium can reject or have adverse reactions to differences in the classroom, particularly if it is not facilitated well. They revert to what is familiar to them, and then we have lost the opportunity for learning to occur. One of the important premises in our research, then, is that we have an opportunity when these moments of disequilibrium are produced, either in the classroom or in the workplace or in other environments, to increase active thinking and learning.

A second important premise that underlies much of the learning and social development theory in the social sciences is that most development occurs in interaction with others, from the time that we are toddlers and into our adult years. Our interactions with others allow us to develop our own views in relation to others. Thus, facilitating interaction in the classroom can also enhance learning.

## EMPIRICALLY TESTING THEORY

What does diversity do for individuals in the workplace and in the classroom? It creates conditions of unfamiliarity, some level of disequilibrium and probably discomfort, differing perspectives, and contradictory expectations that then promotes learning and deeper complex thinking. This is the theory we are empirically testing in our studies of college students. We have undertaken a series of replication studies, one of which builds on the other, to try to understand the extent to which diversity experiences during college serve as a vehicle for connected learning, complex thinking, and civic development.

We defined and measured diversity experiences several ways. First, there is often reference to representation and the numerical representation of diverse peers—what we call structural diversity. In higher education we talk about availability pools, "token" representation when there are too few, or tallies of minority faculty and students. The importance of representation, however, which social scientists have identified since the 1950s (Allport, 1954), is that equal status peer groups are very important in breaking down stereotypes and overcoming "tokenism." Moreover, highly diverse environments provide more opportunities for daily interaction across diverse backgrounds, perspectives, and experiences. When numbers of diverse people are sufficient, individuals are less likely to fall into the same stereotype of social hierarchies, but can begin to recognize differences and similarities.

A second way of thinking about diversity in higher education is reference to knowledge about diverse people's history and cultural legacies, or diversity in the curriculum. One of the questions that was raised by the various lawyers in the Michigan affirmative action cases was whether the same outcomes could be achieved if we simply diversified the curriculum in higher education. Do you need to have diverse people present? We could empirically investigate this question, but no perfect test is possible because the campuses that have diversified their curriculum are also likely to have increased their enrollment of diverse students and employed diverse faculty. We used statistical controls for

campus racial and ethnic enrollment and faculty emphasis on diversity in research and teaching using national data of students from many institutions. We found curricular effects to be important, but informal interaction with diverse peers outside of the classroom was particularly powerful in terms of educational outcomes.

Many courses that have experiential components (service learning, for example) that can reinforce the learning process about diverse walks of life and social problems help students step out of their own world views for a time. When we speak about diversity curriculum, we may be referring to content knowledge, but these courses are also likely to have different levels of engagement with peers or communities that may also be part of the topic of study; there are even variations in how students learn about this in a more formal classroom sense. Aside from general education requirements, we might expect that science students would have less experience with diversity in the curriculum as they are trying to master the basic content knowledge of their disciplinary focus.

However, all students experience interactions with other students outside the classroom every day on a campus. We attempted to gauge individual involvement that is a result of having diverse groups in departments, in classrooms, on campuses, and in workplaces. This informal interaction with diversity is not particularly controlled by the institution. We often assumed that if we diversified the student body, that stereotyping and discrimination would dissipate because people would be able to interact with diverse people. We are finding that this is not always the case, as there remains a great deal of variability in students' interactions with diverse peers on campuses. The quality and the nature of those interactions with diverse peers are important, and we are monitoring the impact of this on educational outcomes.

A final area that we are studying and developing is understanding the intentional educational programs for improving interactions with diverse peers. We are investigating the form they take, their nature, and their eventual educational impact on outcomes outlined here.

## EMPIRICAL FINDINGS

In early work, I found that students who reported they had spent time studying with someone who was from a different racial or ethnic group also reported a variety of educational outcomes (Hurtado, 2001). The strongest positive effects occurred on learning and work-related outcomes, which were measured as students' assessments of critical thinking abilities, their ability to work cooperatively, and interpersonal skills. Those students who studied frequently with another group indicated higher self-ratings. In addition, strong effects were associated with civic outcomes, such as students' acceptance of difference, cultural awareness, and their tolerance of people with different beliefs. This provided the basis for more work using a variety of interaction measures and outcomes to replicate these results.

In subsequent work, my colleagues and I have identified students' postcollege activities in relation to other measures of diversity in college (Gurin et al., 2002). Figure 2.1 shows the effect of attending a more diverse college over the long term (nine years after college entry) for about 8,000 white students who grew up in predominantly white neighborhoods. These students were actually entering environments where unfamiliarity with racial and ethnic differences was most likely. Figure 2.1 shows the bivariate relationships, but we also conducted statistical analysis with all the controls (student background characteristics and characteristics of institutions) that confirms this pattern of findings.

Using data from the Cooperative Institutional Research program at the University of California, Los Angeles (UCLA), in a sample of former students who attended over 184 different institutions, students were asked to report the racial makeup of their current friends, neighborhoods, and workplace. Students who attended more diverse colleges (where at least 25 percent were students of color) had more diverse friendship groups, lived in more diverse neighborhoods, and worked in places that had more diverse

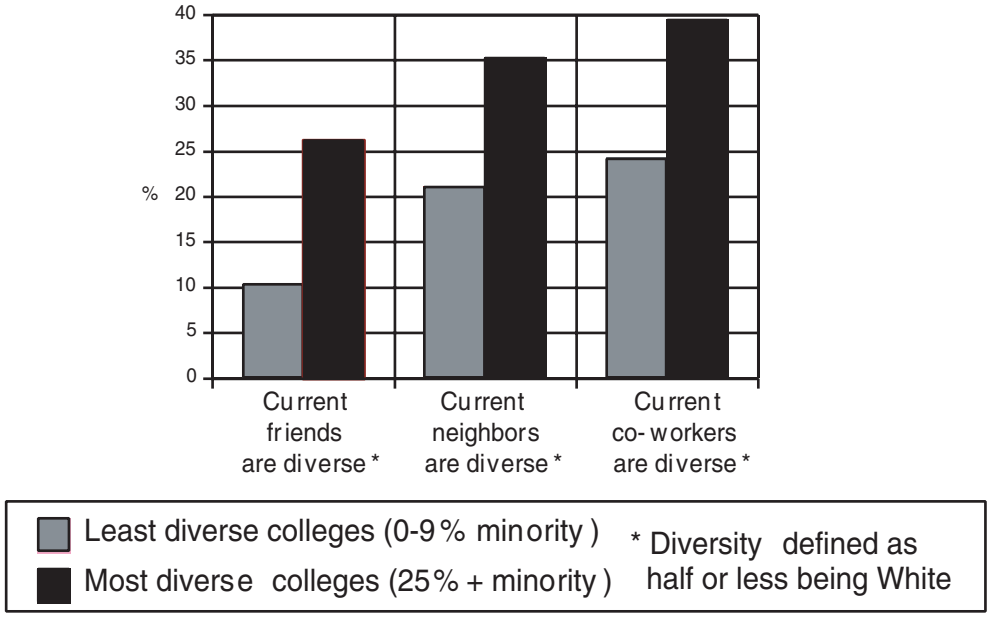


FIGURE 2.1 College diversity and postcollege interracial contact: white students who grew up in predominantly white neighborhoods.

coworkers than students attending colleges that had the least amount of diversity. Although this is self-reported behavior, it is compelling evidence that exposure to diversity in college can actually break the cycle of segregation in neighborhoods and the workplace in later years. These results confirm findings reported regarding the impact of attending desegregated schools, although the chance to attend such a school is diminishing in increasingly segregated living arrangements (Orfield et al., 1997). Therefore, college represents the next opportunity for students' interaction with diverse peers. These experiences in educational environments are very important and, barring these opportunities, we are confronted with diversity issues arising in the workplace.

Figure 2.2 addresses the issue of whether diversity in the curriculum has an impact on students. Using two factor-analyzed measures, intellectual engagement and citizen engagement, we explored this question breaking down the national sample into white, African American, and Latino college students. These analyses were conducted by each group, so, in a sense, this constitutes a replication study with each racial and ethnic group. The findings show that a higher proportion of students who reported having taken diversity courses also reported higher scores on the outcomes. It is important to note that these analyses were conducted with statistical controls for initial position on the outcome (measured during the first year of college), as well as student background characteristics (e.g., parental education, ability) and the type of four-year college they attended. We found a significant relationship between taking these courses and the outcomes after ruling out alternative explanations.

Figure 2.3 shows the results of our analyses in gauging students' informal interactions with diverse peers in opportunities outside of the class and sometimes affiliated with coursework. We are looking at the same two outcomes, intellectual engagement and citizenship engagement, as well as a third outcome

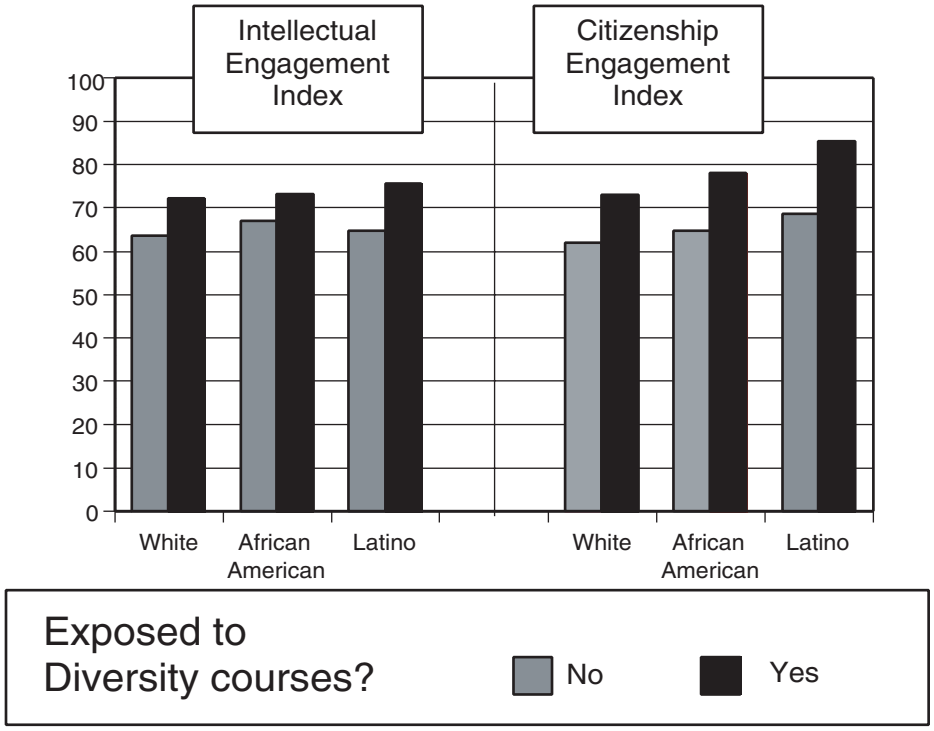


FIGURE 2.2 Diversity in the curriculum and student outcomes: white, African American, and Latino students.

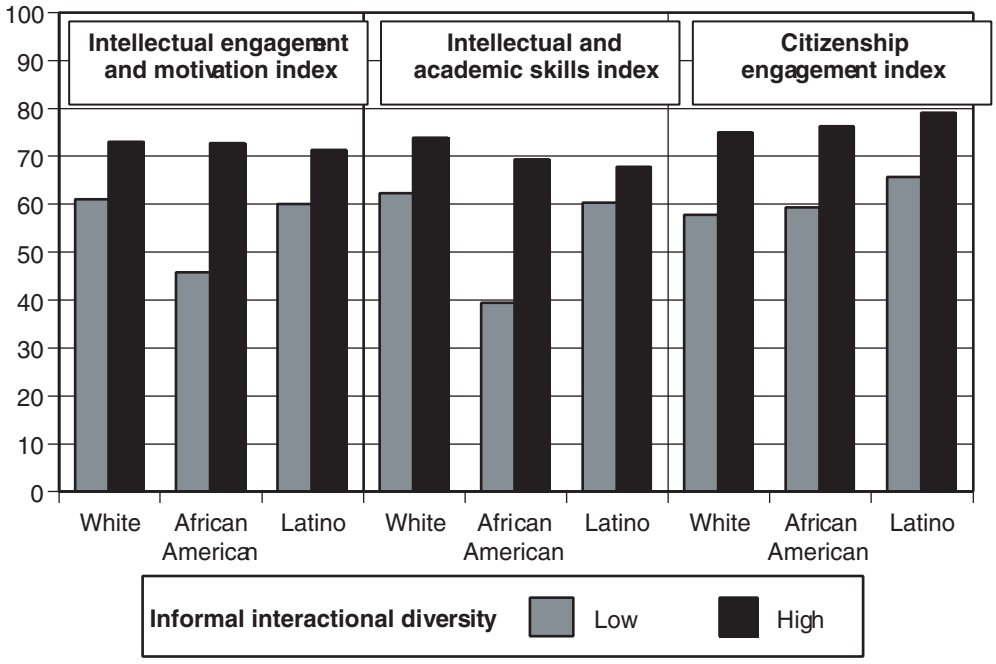


FIGURE 2.3 Informal interactional diversity and student outcomes.

based on students' self-assessment of their academic skills—an index that includes writing, mathematics ability, and general academic ability.

Each analysis was replicated with white, African American, and Latino student samples, and we found that informal interactions with diverse peers is significantly related to each of the educational outcomes in all student racial and ethnic groups. Here, again, we ran the more sophisticated analyses with the statistical controls for student background and type of college. Results showed that, with informal interaction, diversity maintains a significant effect on the outcomes. We also ran the analysis with controls for having been exposed to a diverse curriculum and found that informal interaction maintains its own unique contribution to the variance in the educational outcomes. Providing opportunities for students to discuss coursework and deal with the diversity of background and experiences on an equal status during college is very important for all racial groups; however, it was particularly important for African Americans' intellectual skills, engagement, and motivation to have the opportunity to interact with others in a diverse environment.

The survey that obtained the national longitudinal data (from UCLA) was not designed to answer our questions. Because we wanted to continue to test outcomes that were educationally important, we chose to analyze data that the University of Michigan had been collecting on its own undergraduates for over four years. This data had finer measures of outcomes that related to the theory we were attempting to test. The outcomes included information about active thinking, students' active thinking habits, and complex thinking. Figure 2.4 shows four-year longitudinal study results for students at the University of Michigan. Only the white and African American students are shown because those numbers were largest in the sample pool.

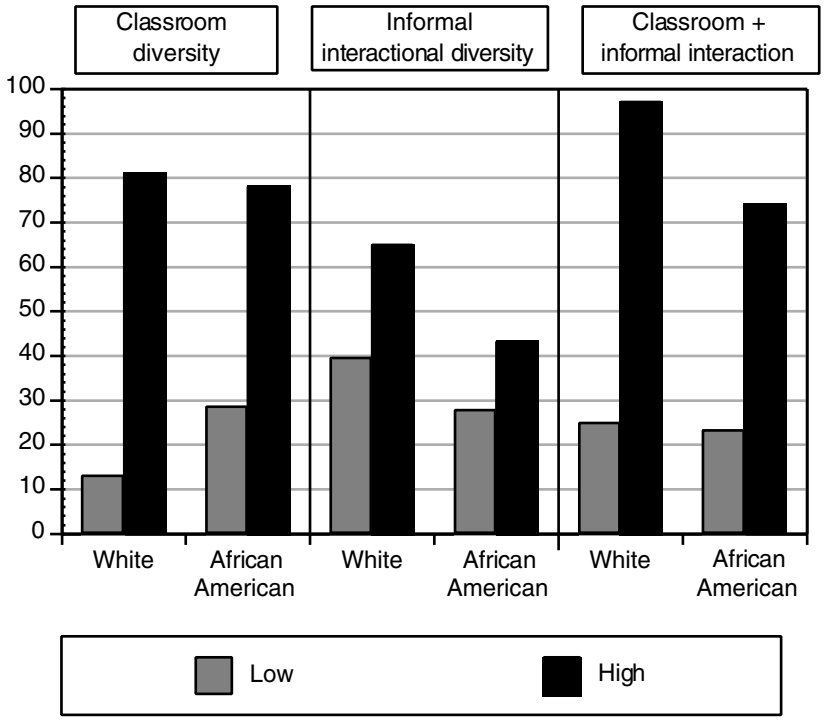


FIGURE 2.4 Effects of diversity on active thinking skills.

Each shows some aspect of our analyses: the effect of classroom diversity, students' reports of informal interactions, and comparing students who had experience with the diversity in the classroom and outside of class in specific types of programs at Michigan. This could be intergroup dialogue, where students take a course and engage in facilitated interaction with diverse peers in discussing issues of diversity, or campus events that compliment the course material.

The results show, again, that students with the most frequent exposure to all forms of diversity also tend to report active thinking behaviors. What we find is that the effects appear to be stronger when students are provided with both the knowledge base about diverse groups in society and the opportunity to practice what they have learned with diverse peers. The results of our more sophisticated statistical analyses was reported in a recent issue of the *Harvard Educational Review* (Gurin et al., 2002).

What do we conclude from the national data so far? Students with frequent interaction with diverse peers demonstrated greater intellectual engagement and active thinking four and nine years after college entry. They also showed a greater capacity to engage in a diverse workplace after college, which is important for the issues we are concerned about at this workshop.

Finally, there was more civic involvement among students exposed to diversity. We had measures of the kinds of activities in which students participated in communities and the variety of their civic commitments. We found greater civic engagement when students had opportunities to interact with diverse peers during their college years.

All of the analyses are on the University of Michigan website. The study was used as part of the affirmative action case to show the educational value of diversity in higher education. All testimony and response to criticism are on the website, and we are currently in the process of completing publications based on the findings.

My colleagues and I were surprised with the consistency of results across a number of outcomes and the number of groups in our findings. Having learned as much as we could from existing data, we decided to follow a new cohort of students entering college in the class of 2000 on ten public university campuses across the country. The first-year data in Figure 2.5 show that about 79 percent of the students rate themselves above average on their ability to cooperate with diverse people. They are very confident

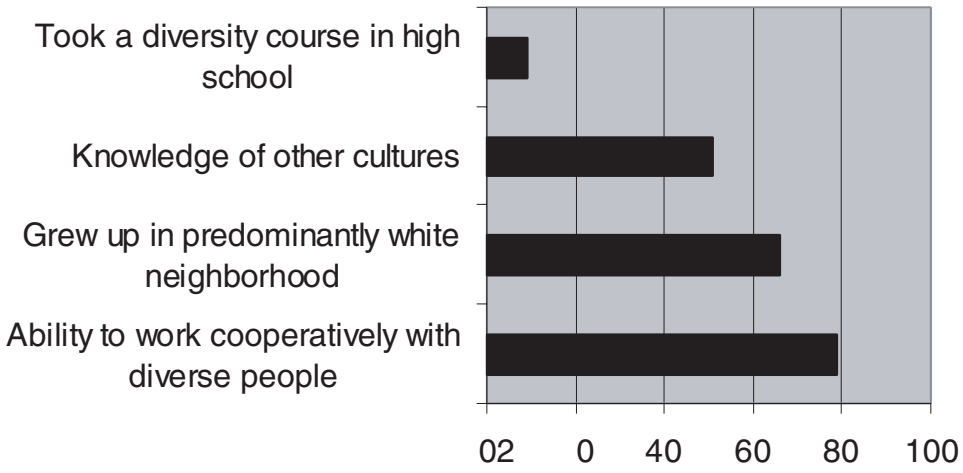


FIGURE 2.5 Diversity experiences and skills: percentage of entering class of 2000.

about their skills when they first enter college; however, 66 percent of these students grew up in predominantly white neighborhoods. In effect, they have little direct experience with diversity, or not as much experience as is necessary to deal effectively with new people, perspectives, and social problems.

Only about half of the students rated themselves above average in having actual knowledge of other cultures and backgrounds, and only 9 percent of entering students have had a course on diversity in high school. This indicates that there is a huge gap in their experience, even though the students might be fairly sure about their abilities to get along with others. Because the data are based on self-reports, and because we see some reporting of higher self-assessments than experience would allow, we decided to use more standard measures to assess students' thinking abilities. It is well known that for standardized pretests and posttests, it is difficult to get undergraduates to take them, unless the exercise has something to do with their major or it is a requirement of the college. We had to get permission to gain access to samples of students in selected introductory courses to administer some of these tests.

We administered a critical thinking skills test, the critical thinking dispositions test, the test of reflective judgment, and in later studies, we added a test of moral judgment. These were administered along with some of the measures from our survey so that we could see the relationship between our own measures and some of the standard tests that have been used on many populations.

We found an interesting link between students' desire to improve society: A civic commitment or value was strongly associated with their perspective-taking skills, their complex thinking ability, and their standard measure of the disposition to think critically. Now we have made the empirical connection, not only between diversity and learning, but between civic engagement or civic commitment and cognitive development. In addition, we found that students reporting negative interaction with diverse peers had lower scores on the disposition to think critically, which suggests that the nature of students' relations with diverse peers is linked with their capacity to handle more complexity and or is indicative of "open-mindedness." Presumably, these are the skills employers are seeking in a diverse workplace.

We are replicating this classroom-based study again and are seeking money to extend the longitudinal assessment of students. We hope to include a focus on science, engineering, and mathematics majors in the hopes of learning more about the experiences of students in their departmental units and peers in similar fields. We need more information about the extent to which the same level of engagement with diverse peers occurring for students in the sciences will produce complex thinking skills and civic commitment. When it comes to scientific training there has been a lot of emphasis on academic achievement, and rightly so. However, we do need to know more about the range of skills students acquire and whether they are prepared for participation in a diverse workplace.

One of the key implications of this empirical research is that diversity is an asset to learning and important for development of the new thinking skills that are needed in the workplace. We need to focus on making the most of the enduring educational benefits of diversity experiences.

We have found that engagement with others and the nature of that engagement are key to producing educational benefits. Diversifying a college, unit, or workplace is the first step in providing opportunities for people to interact, but we also must be attentive to the nature of intergroup relations. In a sense, we have to move beyond the focus on the numbers to think about the climate of the organization for interactions and the extent to which individuals are engaged with each other to obtain the greatest benefits from a diverse workplace, college, or university. We have to consciously create diverse learning environments. In the future, it will be important to identify successful practices to engage individuals' active thinking behaviors and assist them in dealing with the ambiguity that is part of the real social world—engagement in the differences that are part of our pluralistic democracy.

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## DISCUSSION

**Kristen M. Kulinowski, Optical Society of America/The International Society for Optical Engineering (OSA/SPIE) Congressional Science Fellow:** The graduate student population in chemistry is very diverse, not necessarily from American-born students, but from foreign-born students. I worked with Chinese, Russians, Croatians, Indians, etc. Can you comment on the outcomes or results of having graduate students working in a naturally diverse community?

**Sylvia Hurtado:** We have not studied students in traditional doctoral programs. However, there has been some research on professional schools. For example, there are actually two good studies on medical students who have studied in a diverse environment and are now working in a more diverse environment because of that educational experience.

Similarly, in law schools, the diverse interactions that occur are important because legal issues touch a large number of the population and particularly the underrepresented populations. We are finding that students are reporting that exposure to diverse students and cultures is an important part of their education that enables them to understand and be prepared in their professional roles. We have not yet tackled what happens in postgraduate school for the more traditional programs, but research in the other areas is highly suggestive.

**William M. Jackson, University of California**, **Davis:** It is a very interesting study. I have two questions. One is, how much self-selection went on? The second is, based on some of your findings, would it imply that African Americans who go to traditional historically black colleges and universities (HBCU) would not be as effective in a diverse environment?

In fact, I think the data show that these students are twice as effective, if you look at their overall professional achievement, as students who go to undergraduate schools in diverse environments.

**Sylvia Hurtado:** It is not an either/or situation. I think I want to begin with that. I will say that the focus has been on the variety of students, but we have not looked at the HBCU context. The study I am engaged in now with the ten public university campuses includes an HBCU and an Hispanic-serving

institution. We want to find out if the outcomes are the same or different. One of the things that we know is that some of the students enter higher on all the measures that we are monitoring, and we are measuring them all longitudinally.

We do not have all the research in place yet. I would not conclude that the HBCUs are harmful to students. I do not believe that is the case, having visited and been engaged there as part of our collaborating public universities that are involved in this project. We have not explored all of that. We have found that minority students within particular racial student organizations on campus have strong tendencies toward civic engagement. This type of activity is usually reinforced in minority communities. We have not come to any big conclusions about HBCUs yet, but what is suggested is that some same-race involvements are important to key outcomes, including comfort level at the institution, and civic engagement.

The question of selection bias, that is the question that we are constantly working on. I would have to say that the drafts of what I have shown, with the exception of the freshmen data, were all longitudinal.

That is, we had the pretests. When they first came into college, we gave everybody a survey, and some of them took some of these tests that I just discussed. Then we followed them up at the fourth year, asked the same questions, and then repeated this in the ninth year. That is basically what happened in the longitudinal results. We controlled for the selection bias as much as we could. What college you choose to attend is part of the selection bias. We had controls for selectivity of institution, location in the country, public or private, the kind of institution that these students attended.

There were close to 10,000 students in that sample. I have 16,000 students now in a sample of ten campuses; we know a lot about those environments, the selection bias that is operating in those institutions, and how students select those colleges. At best, with nonexperimental field work for this kind of research, you have to introduce all the specific controls you can, and we have done that—family background, income, ability. We had measures of students' performance on the Scholastic Achievement Test (SAT) and the GPA to make sure that ability was not the determining factor. Our goal is to try to understand the true educational impact of this kind of intervention. So, we have tried to introduce controls to test those assumptions.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** I found your notion of disequilibrium intriguing. There was a book published in 1997 called *The Innovator's Dilemma*, by Harvard business school professor Clayton M. Christensen (Harvard Business School Press), which offers similar ideas in the context of technical innovation. He discusses the concept of disruptive technologies, the notion that real change is made when new concepts actually challenge existing views of what is useful and important. I can see connections there with your points.

I have two additional suggestions. One, it might be helpful for people here to understand that thousands of students have taken part in the studies. Indeed, in your recent paper alone you are talking about 1,500, so these are not small numbers of data points. Perhaps you might want to comment on that.

Second, you said at the very end that you want to look at the physical and lab sciences.

One of the points that often comes up when you get a bunch of scientists together is that science deals with an objective reality, which is not influenced by who the people are.

That is, if you mix A and B together, you are going to get C, regardless of who does the mixing.

Now, I know how I would respond to that: The questions that are asked, and which lead to observations of that objective reality, are indeed influenced by who the people are. That is, what are the A and B that are mixed?

What would you identify as some of the other issues specific to science when you try to address the larger topics of your studies?

**Sylvia Hurtado:** I just tried to submit a proposal for a National Science Foundation grant focusing on this issue. We are currently collecting data on 16,000 students at the ten public universities so we will have second-year data.

We did this at the student orientations, so we have initial information. We are collecting data again currently including identification of students' major areas. If you start from the major area identified in the freshman year, about 80 percent of them change their major. Teachers and engineers are two groups that do not change their minds, but most undergraduates change their minds at a some point in time.

So, by the end of this term we will have data about their majors. What I am proposing to do is collect data in two more years, which will actually be the fourth year. It is not simply a retention study. We want to understand when this growth and development occur during the undergraduate years. We suspect it is largely in the early part of their careers.

Because scientists or budding scientists or those who are declared at the second year focus so much of their time on the sciences, they do less social interaction. Therefore, we want to know how they acquire these different skills—complex thinking, values, and the capacity to understand real-world problems. Some of this might happen within their major in science courses. We hypothesize that the process is very similar.

One of the basic assumptions underlying all of this is that students learn a great deal from their peers. They learn content. They learn vocabulary. They learn how to learn. They learn how to study. As an instructor standing in the front of the room, I also have to know that students are acquiring a great deal, not only from the subject matter that I am teaching, but also from their peers. They are learning altruism, political awareness, and identity development in addition to other things at the same time as they are learning the content. So, peers are very important.

I am very interested in understanding that kind of development for the science student. It might be similar to the development of nonscience students occurring within the peer environment of the major. That has yet to be determined.

**Ron Estler, Fort Lewis College:** The segment of the underrepresented population that I am interested in is the Native American students. Fort Lewis College, located in southern Colorado, has a 15 percent enrollment of Native Americans of the 4,500 student population. This is due to a tuition-free status for any tribal member.

This idea of disequilibrium also hit home with me. From the Native American student's perspective, that disequilibrium can be so great that, within the first week of school, there is a high probability that an entering freshman will just turn around and leave.

To engage these students, we have had to place many safety nets around them. Before we are even able to get these students to enter into a dialogue, to share any kind of a cultural difference, these programs have to be in place. We have to help them maintain a cultural connection before we can get to the dialogue stage.

In your study, do you have any Native American representation of students?

**Sylvia Hurtado:** Yes, we do. The numbers are small in most of the public universities. The University of New Mexico has the largest number of Native American students in our study. We have not included a couple of other institutions that potentially would have a very high population of Native American students. So, our numbers are going to be small overall, but we are trying to protect that number.

The University of New Mexico, for example, has a particular problem. At a certain time in the school year, students will leave because they have to move the sheep from one part of the mountain to the other and help the family continue to do that kind of work. So, we really have to be cognizant

institutionally, which I am pleased that you are doing, of the family traditions that are inherent in these different populations. I would say that the world-view difference is so distinct for Native Americans from that of most students in mainstream society that the disjuncture can be large for them.

I am pleased that you are cognizant of that distinctiveness and the importance of that.

**Krishna L. Foster, California State University, Los Angeles:** I think that I am seeing a trend here. I am addressing the question, What does it take for someone to be successful? I find in your study, and also in my experience with HCBUs—I am a Spelman graduate—that there is a sense of belonging that can be developed in both models. When you pit people against each other, when you have an African American working with an Asian scholar and they find they can converse, that lifts the African American scholar to the level where they say, whew, I belong here. I am wondering if anybody else sees that trend?

**Sylvia Hurtado:** I do have a piece in Sociology of Education that talks specifically about the sense of belonging among Latino students, understanding what the environment is like for those students, and creating that larger sense of belonging.

There are a lot of things that can contribute to a more general sense of belonging, which translates into attachment to the institution and, therefore, retains students. There is a body of research on sense of belonging and how that is created in the transitional experience. We have empirical data that show that link you have observed. The strongest, probably most replicated, finding of all the retention literature has dealt with how the extent to which individuals are socially and academically integrated into the institution results in eventual retention.

There may be many different ways. Certainly a lot of the programs we are talking about in this workshop are ways to increase that sense of belonging, engage with the subject matter, and achieve students' long-term goals.

**Joseph S. Francisco, Purdue University:** Thank you so much for your presentation. I just have a comment directed from personal experience. One of my reasons for going to a place like Purdue University is that a place like that needs African Americans and the visibility of African Americans.

One of the things that I made clear to Purdue when I went there was that I wanted to teach the freshmen because that was a critical point where I felt I could have the most impact. In my thinking, I was originally anticipating influencing the African Americans and being visible for these kids.

I had a comment from a student who came up to me in my class of 550 students toward the end of the semester. He said, "Professor Francisco, I never thought that I could learn from a black person. My only experience with blacks has been in regard to my parents' housekeepers and maids." I did not know how to respond to that. In thinking it through, it made me realize the importance of me standing before that classroom for all students.

You are right. There was a disequilibrium there. The disequilibrium was great for him, but as that semester transpired, I challenged that whole classroom to learn, and he learned and realized that he could learn from me. That student later approached me toward his senior year to do undergraduate research in my laboratory. I understand why it is important for universities to have a diverse faculty.

**Sylvia Hurtado:** Thank you for that story.

**Steven F. Watkins, Louisiana State University:** Your data certainly hit home with me. I spent the last ten years or so as director of graduate studies. We have a pretty diverse group, which I will talk about this afternoon.

Counseling incoming and ongoing graduate students has been an interesting occupation. Disequilibrium is an understatement in many cases. I did observe one thing that perhaps we can discuss.

Students who have been at undergraduate institutions in which they are perhaps exclusive or very much in the majority are all disequilibrated when they come. Students who come from HBCUs have a special burden and it is this: They are highly nurtured at these schools. Those HBCUs do a wonderful job of nurturing the students, bringing them along, giving them support. When they come to, for example, a majority white institution, there is a culture clash. Then, their expectation for nurturing and support is not met. In most graduate programs—and we have all been through them—it's sink or swim. When they meet both the cultural and the sink or swim attitude, it is a double whammy for them.

I spend a lot of time shoring up some bruised egos and depressed people who are otherwise wonderful students and do, in fact, go on, but that is a serious problem. I do not know what the answer is.

**Sylvia Hurtado:** I have seen that in graduate students. Clifton Poodry remembers when I did graduate student support at the University of California, Santa Cruz. We had a fairly new graduate enterprise, so to speak, so that was unusual for that institution. Creating that community was important for those graduate students. Also, those who were most successful were intellectually engaged in the research with their primary faculty advisor. I will just say that, not only did they get all the advantages of going to foreign countries to do research and presenting national conference papers, etc., but they felt the identity in their education of becoming a scientist.

That is so important to them at that stage, and it gets back to the sense of belonging. It is having both intellectual engagement and the mentorship of a graduate advisor or supervisor in the research process that makes all the difference in the world of graduate students. They do not need to deal with the rest of the institution, although some of them are concerned with that. It is the issues that are part of that research relationship that are absolutely critical and need to be sustained. That is why these programs incorporating students within the larger research enterprise are important to sustain nationally.

**Iona Black, Yale University:** I agree that you cannot force people to get into diverse groups. So, at Yale, when we put them into discussion groups, we do not know who is who. Within those groups, I find that you have to let them know that it is okay to think outside the box.

There are certain basic concepts that have to be done in the box, but outside that box diversity brings that broadening of ideas. Additionally, you also have to let the students know that you believe they are going to be successful within the sciences.

Finally, it is necessary to give them an outlet to express their views. Do you have any statistics or have you looked at that effect, of thinking outside the box, because that will keep them, I believe, within the discipline.

**Sylvia Hurtado:** I do not have the research, but I cited Taylor Cox, who has looked at small-group dynamics. Actually, some of Morgan's work talks about innovative organizations. All of them have talked about the importance of diverse perspectives and managing that. I would get a copy of Taylor Cox's book. He probably has several, but one book reviews all the research that has been done on thinking outside the box and how that relates to creativity in groups.

**Derrick C. Tabor, National Institutes of Health:** I want to follow up on something Joseph Francisco said, and it has to do with the issue of role models for students and also for faculty. It also has to do with the issue of being an important role model or developing or exposing not only the student to a new kind of diversity in terms of faculty, but also for other faculty.

People like Isiah Warner and Joseph Francisco, and other minority scientists are also good models for our other faculty and our white colleagues, because many of them have never worked with an African American or Hispanic or never served on faculty with them.

I think it is important that we recognize that diverse faculty serve and meet the needs not only of students, but also of the entire discipline.

I also want to comment on the importance of relationships with students being special, following up on what Iona Black was saying. It is important that students believe that they can be successful no matter the race, ethnicity, or who the teacher is.

**William M. Jackson:** I would like to make a comment on working together in groups and students learning from each other. This is something we have known in science and engineering a long time: Those students who are the most effective students, who get through the program and get the highest grades and get the degrees, who learn early in the game to work together in groups and on projects, do much better than the students who do not do all this. One of the problems with minority students in general in majority institutions is that they often do not feel that they can work together in groups. One of the successes was described by Uri Triesman who was at the University California, Berkeley, where he showed this effect some time ago.

Most engineering schools are adopting that model, and most scientists, when they talk to students in general chemistry and in physics, tell them they are supposed to work together. Whether they listen to us or not, that is another issue, but that is the way they will become the most successful.

**Sylvia Hurtado:** Absolutely, and it is becoming a skill that employers want. I have seen different departments introduce the cooperative learning model, not simply because it improves achievement, which has been proven in elementary schools, but also because it is important for the workplace.

**Stanley C. Israel, Southwest Texas State University:** I find the number one factor in the success of our students is peer-to-peer mentoring. If we can get them involved in peer-to-peer mentoring and get them involved in the learning community, they will almost universally be successful.

**Sylvia Hurtado:** I have a bit of research on that. I did research on the transition to college and who helped the students most. This was among Latino students, who were the highest achieving, top scorers in three or four cohorts. They were longitudinally followed up. When I found out about their transition to college, I looked at personal, emotional, social, and academic adjustment and attachment to the institution—four levels of adjustment. I found that when they worked with upper-class peers, all the adjustment outcomes were positive. When they said they relied on other freshman peers, outcomes were as negative, particularly with regard to academic adjustment. It was like the blind leading the blind. They are both trying to figure it out and they do not know how to get there.

So, it is important how you structure that peer relationship, so that you have a somewhat knowledgeable, not a novice peer, working with another peer.

**Stanley C. Israel:** The other question I had is, in your data, have you looked at the difference between first-generation students and students whose parents have been to college? In our experience, we find a tremendous difference in those two groups, including even the Anglo students who are first-generation students. Success, fitting in, and the dislocations of the experience make a difference. We find it much more so for first-generation students in all classes.

**Sylvia Hurtado:** We are finding confirmation of that. I have done that kind of work with Latino students. Now with the national study of 16,000 students we will be able to look at first generation among all the racial and ethnic groups to see that effect.

**Clifton A. Poodry, National Institutes of Health:** What comes first, desire to change the world or the skills? When I interviewed students at theme houses at Stanford years ago, one thing that impressed me about the minority students was that everybody wanted to change the world, and that is why they were there. Were they there because Stanford, in its selection process, is selecting for those skills, so they had a group that wants to change the world or, in fact, is wanting to change the world a motivator that helps them acquire those skills? Which comes first?

**Sylvia Hurtado:** Students do select colleges because they can do certain things socially and also academically.

There is that huge selection bias. That is why we always have multiple institutions in our studies because we want to look at the variation, particularly colleges that admit the variety of students in terms of SAT scores, but also income levels—we try to control for that. We found, primarily, that the lower-income students are more dedicated to going back to the community because that is where they came from.

We have now organized a new study in which we will be able to look at that more longitudinally. So, we will be able to separate the chicken and the egg issue in terms of the desire to influence society.

With this cohort we will have information when they first come in about those desires—that is, how committed were they from day one—we will control for that, and then look at what happens in the second year. If we get funding, we will look at the fourth year, and we will be able to control for their initial dispositions on that measure.

Predispositions are a huge issue for our students who select to go into particular educational interventions, such as service learning. The important question is, when you have it as an intervention requirement where not everybody wants to do this, what is the result? We are separating that as we move along, but we have not gotten there yet.

**Yvonne D. Curry, American Chemical Society:** At ACS we have the Scholars Program, which has given scholarships to over 1,100 students. I want to go back to something that was raised earlier. Many of the students that we have given scholarships to are at majority institutions. Some of the discussion that comes back to us is often, "I am the only." We are 30 years down the road on "the only." I was "the only" for many years and still am "the only" for many situations.

We have to find a way to address this. We have suggestions that we give to our students in our mentoring component, but we have to move beyond this feeling of "I am the only" and the world is on me to succeed. This is happening to too many students, and too many of them choose to opt out because of that concept. I would like for us, at some point, perhaps in your study, to address that.

**Sylvia Hurtado:** Thank you for raising that issue. We just completed focus group interviews with students on the ten public university campuses, and that came up quite a bit in their interactions with other students and in classrooms.

We had particularly compelling stories about how they had the burden to educate others, when they are "the only," which becomes huge. That is an addition to all the other stresses and strains to suddenly be put on the spot and be asked to speak for a whole population that you are just learning about, in terms

of your own identity and history. It is too common an occurrence, and we continue to hear the stories. I was educated in the 1970s and I am still hearing the same stories too.

**Myra Gordon, Virginia Polytechnic Institute and State University:** I am an associate dean in the College of Arts and Sciences at Virginia Tech. I would like to address a couple of points that I think I have heard from various people in their comments, points that all seem to sum to one very difficult and intractable problem. This problem is that of climate in many of our science departments.

When I think about the situations that our diverse students often face in science departments, they are numerous. One situation has to do with whether they are really wanted in these departments. Many of these students report feeling, in fact, that they are not wanted. As you know, many of them are admitted as a result of various grant-funded initiatives aimed at minorities. This way of coming into a department actually sets them apart. Something that should be an enabling mechanism is something that sometimes stigmatizes them.

These students often report feeling that they are not in a department because they are really wanted, but only because a researcher was able to get money to bring them there. White students in the same department often mirror the same sentiments. They think of minority students, "You have a free ride, that is how you got here." So, when it comes to fostering some of those important peer interactions that should promote more critical thinking, more engaged scholarship, better citizenship, and all the kinds of things that we say we want as diversity outcomes, significant barriers exist that prevent these outcomes from occurring.

Also, with regard to peer mentoring programs, this can be a difficult thing for many of our students from HBCUs to engage in with students who are different from themselves. One reason is that they are often fearful of being perceived as not functioning at the same academic level and as not having the same proficiencies with state-of-the-art instrumentation and equipment. They come to prestigious research institutions as proud representatives of their institutions, but very quickly they begin to experience second-class citizenship. As a consequence, it is hard for them to be honest, open, and authentic individuals in cross-cultural, cross-race interactions.

Then we have the problem of black students who have been mentored by very humane, relational faculty members, who are also very smart scholars and researchers. Then they are confronted with the more unidimensional type of white faculty researchers. The students say these faculty members are cold and indifferent. Often, when I talk to faculty about these issues, they say, "No, we are not cold; we are scientific." Trying to help them understand this dimension of climate is very difficult.

Then there is the problem within departments of inflexible progress-to-degree benchmarks and timetables. If any of our young folks deviate from these timetables and benchmarks, they are in serious jeopardy of being dismissed from the program. I submit that we cannot be so cavalier and insensitive. Sometimes, just minor flexibility means the difference between attrition and successful degree completion. Departments often feel one size fits all. But we cannot afford to kick these students out or force them out. That is what often happens to them, especially when they have no empowered advocates at a level higher than the department to intervene on their behalves. When that is the case, whatever happens at the departmental level is the last word.

What I wanted to say to you, Dr. Hurtado, is that I am very familiar with your work and I am delighted that you are going to examine the science areas. The science areas will be very fertile grounds for your research. Then I would like to ask you to make another presentation. This presentation would be, "Preparing Existing Science Faculty for a Diverse Student Body."

**Sylvia Hurtado:** Let that stand for the record.

**Tyrone D. Mitchell, National Science Foundation:** I want to mention something that involves diversity. Most of my career was spent in industry with General Electric and the past ten years at Corning Incorporated. When I joined Corning, there were a number of problems for African Americans with recruitment and retention in the research and development (R&D) area. The African American employees in R&D formed a group called the Awareness Quality Improvement Team (AQIT), because at that time Corning had a large quality initiative. We took advantage of that. The AQIT was made up of all of the African American scientists and technicians in R&D with representatives from upper management also sitting on this committee. This group was able to make a lot of changes within the corporation that affected everybody, and I will mention a couple of them and some of the outcomes.

One of the people we had sitting on the committee was Dr. Eve Menger, who some of you may know. She sat on the committee as one of the senior managers. She had the idea to bring in diversity discussion groups. We benchmarked DuPont Engineering, who had trained many of its employees using diversity discussion groups, and then we formed a steering committee. I was one of the members of the committee along with Dr. Menger. From this initiative, we put together what was called Empowered Learning Groups (ELGs). The steering committee populated the ELGs with diversity of all kinds.

For example, the diverse group included African Americans, Asians, women, scientists, technicians, managers, and a vice president, such that race, gender, and hierarchy were included. For one year, the group met once a month for a half-day, off site. The group also set ground rules, such as everyone being equal in the group and that discussions within the group were proprietary and remained in the group. Two outside consultants, an African American female and a white male, facilitated the group discussions. The AQIT was started because we saw what was happening to summer interns. African American interns were hired and given tasks like Xeroxing and doing things that were not very productive.

The initial reason for starting the AQIT was to have an impact on the summer intern program. However, a major impact was seen from the results of the ELGs. After a number of employees in R&D had undergone diversity training in the ELG, the graduates of the ELG process volunteered to become mentors for summer interns; many of the interns, but not all, were African Americans. Because of this, the summer intern program for all interns improved tremendously such that the interns became a diverse community of students with a diverse group of mentors, coworkers, and advisors. All of the interns were given meaningful and critical (to the company) projects. The improvement of the summer intern program was one of the positive outcomes.

The other positive outcome was the feedback to the larger R&D community about the positive outcomes from the first ELGs meetings. This led to many employees volunteering for future ELG discussion groups with as many as three ELGs of 30 employees each, running concurrently for the yearlong discussions. The question is, would this process work for other organizations?

**Sylvia Hurtado:** Thank you for that question, because it gives me an opportunity to talk about my second book, *Intergroup Dialogue: Deliberate Democracy in College, Workplace, and Community*. (University of Michigan Press, 2001). It includes some examples from the business community on how the dialogues occur. You talked about the very principles that are important in the dialogue, that it cannot be a one-shot race awareness workshop kind of deal, because the stereotypes, the embedded thinking, are still there.

We need to have a sustained dialogue. That is one of the key principles that is part of this diversity learning—you need to develop a working relationship with others, get the stereotypes out on the table

and then dispense with them. Now, that takes longer than a one-afternoon workshop. So, the sustained dialogue is very important.

The other part of diversity learning that is important is a superordinate goal. All intergroup relations show that this is the case. You had a goal to improve the work environment. There were multiple goals embedded in this. The group, all together, began to see a common vision, and that is important when you have such a diverse group.

Those are the key principles. This type of diversity training is probably one of the most innovative programs around. My book is the first one that gives case studies of each of the training programs, but your story sounds incredibly useful. The organizations that are running these programs in cities and in the workplace are often nonprofit businesses. These are not the old-fashioned work relation workshops, where people feel nothing gets accomplished. Those do not work. We have to build sustained relationships to get beyond that and change the thinking. I highly recommend it. As I said, I would not have coedited this book if I did not think that kind of innovation was important.

**Monica C. Regalbuto, Argonne National Laboratory:** I am on the other side of the table. I work with students, but I am not a faculty member. I work in a research institution.

One of our main frustrations is young people in general. I work in an organization where the average population in key positions is usually older, and over 55, where some people in industry are already being terminated. They have been in those positions for many years and they are comfortable with doing things the way they do it. We bring students in for cooperative, graduate, and undergraduate research appointments, and they experience the diverse part of the population at the lower levels. The frustration comes when they are trying to move up. As they attempt to rise in their careers, all those underrepresented people at their current level are not reflected in what is on the top. Has anybody been looking at that?

Second, engineering and science have lost a lot of respect in society, and these are not glamorous careers any more. When I was working at Amoco, which is now British Petroleum, I cannot tell you how many talented Ph.D.s came in and lasted only three years. That is how long it took for them to get a part-time M.B.A. and completely quit doing R&D. The M.B.A. was respected and commanded a higher salary, so it was difficult to keep and retain them at that kind of level. At Argonne, it is slightly different because we are scientifically dominated, so there is respect for being a scientist. I have this feeling that there are many issues addressed at the university level, but that nobody is telling these kids that when they graduate, it is not that simple to be recognized if they are an engineer, a scientist, or a chemist. The university has to do more. I challenge the professional societies in general to do more to raise the level of respect.

It was not good to be a fireman a year ago. Now it is. Now it is good to be a policeman! Well, we have not hit that level of acceptance for our professionals. Chemistry, physics, and even medical doctors are not cool any more because of all these negative things that kids read in the newspaper and on the Internet.

As an example, we lost a scientific segment to the perceived exciting dot coms two years ago, and they did not come back. They spent four years in college, four years in graduate school, and a few of them pursued a postdoc in research institutions—it is a ten-year investment: There was a lot of effort from a lot of people, and then they did not come back. I would like to ask you, is there anybody addressing these issues? All these underrepresented youngsters need to be represented by the people in the upper levels.

**Sylvia Hurtado:** I think I am going to have to defer to members of the audience on that, in terms of the workplace.

For academia, that has been studied in terms of the faculty demography and how it has an impact on the organization overall. Jim Hearn, a sociologist, has studied this. His recent studies are about the faculty demography, the difficulties that occur as a result of an aging faculty, and how an aging faculty has organizational implications.

In terms of the workforce, you have hit on a principle that actually permeates both the workforce and academia. Once people are comfortable in their roles, they fall into that familiar mind-set, and it becomes difficult to create change in the organizations. This is true for all organizations. So, thinking about how to create change in organizations is probably the key to the answer for these individuals to help young people move through the system. I think that my only strategy as a department chair is bringing people at a senior level who can enter the discussion on an equal peer status basis and have a very different way of thinking. This could be a person of color, or it could be a woman. Sometimes it is a man who has a different way of thinking and who is coming from a very different work life, who comes and introduces those ideas, but has the respect of everyone in the group.

There have been many studies from different organizations and individuals, but I think discussion is the way to begin to strategize. This is the beginning of thinking about how to change the organization so that it is more creative and more inclusive so that young people have a way to move up and move through.

Otherwise, those organizations will no longer be dynamic. They will not be on the cutting edge. That is basically what Morgan and other people in business are saying now, that they will lack innovation.

If you cannot break the groupthink in those different arenas, you will lose ground.

# 3

# An HBCU Perspective

Cornelia D. Gillyard and Sylvia T. Bozeman
*Spelman College*

During the past 20 years, Spelman College, a historically black, liberal arts college for women, has become one of the nation's leading institutions in preparing African American women who are successful in completing graduate and professional degrees in science, engineering, mathematics (SEM), medicine, and related fields. Approximately one-third of the undergraduates at Spelman major in SEM fields. Spelman's success is due to the decided growth of the institution both longitudinally and latitudinally over the past 20 years. During the early 1970s, the college aggressively initiated efforts to improve the status of its science programs by garnering support for programs that focused on student and faculty research, curricular reform, academic enhancement, and student retention. This presentation highlights some of the activities and programs that led to that growth and success throughout the sciences and specifically in chemistry. The growth of the chemistry department since its establishment in 1977 and its productivity relative to students and faculty are discussed, and some success stories are included.

## BACKGROUND INFORMATION

Spelman College, a historically black liberal arts college for women, was founded in Atlanta, Georgia, in 1881. One of the goals of the college is to provide an educational experience characterized by excellence for women who seek to be responsible citizens of the world. Spelman College is a member of the Atlanta University Center (AUC), a consortium of six schools: Clark Atlanta University, the Interdenominational Theological Center, Morehouse College, Morehouse School of Medicine, Morris Brown College, and Spelman College. Membership in the AUC allows Spelman students to enjoy the benefits of a small college while having access to the resources of the other five participating institutions.

The college offers the Bachelor of Arts and Bachelor of Science degrees in 25 fields complemented by several academic programs including the dual degree in engineering, domestic exchange, study abroad, and the honors programs.

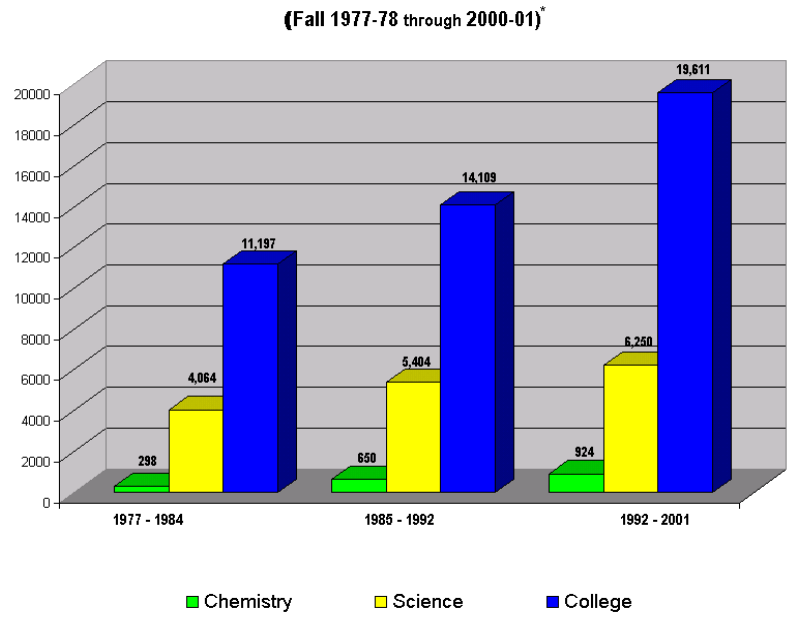


FIGURE 3.1 Student enrollment trends at Spelman College from 1977 to 2001. The chart compares total enrollments at the college, science majors, and chemistry majors.

The current enrollment (2001-2002) consists of 2,100 students from 41 states and 15 foreign countries. These students are served by 145 full-time faculty with a student-to-faculty ratio of 14:1. The average graduation rate for Spelman students is 78 percent in six years or less.[1]

In May 2001, 103 of the 434 graduates received the Bachelor of Science degree in an area of science or mathematics. Thirty-five percent of the 2001 class planned to attend graduate school immediately.

In 1971 only 10 percent of the student enrollment pursued majors in the sciences.[2] This percentage increased by 1977 to approximately 36 percent and has remained relatively stable through 2001 (see Figure 3.1).

The average enrollment percentage in the sciences by discipline from 1977 to 2001 is shown in Figure 3.2. Relative to all science disciplines collectively, the average percent enrollment of biochemistry and chemistry majors from 1977 to 2001 was 12 percent. The average percent of science graduates by major is shown in Figure 3.3. The average percent of graduates for all science disciplines collectively from 1977 to 2001 was 25 percent; the average percent of biochemistry and chemistry graduates during the same period was 14 percent. Comparison of the data in Figure 3.3 with the data in Figure 3.2 reflects a positive trend for graduates in the sciences.

[1]Office of Institutional Research and Assessment Planning, Spelman College.

[2]Falconer, E.Z. 1989. A Story of Success: The Sciences at the Science Department at Spelman College. *Sage*, *6*(2):36–39.

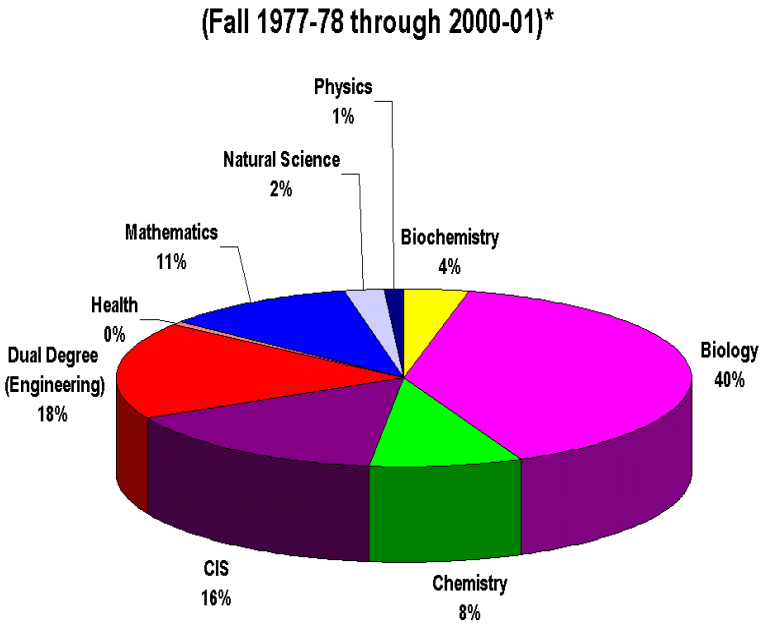


FIGURE 3.2 Average enrollment percentages in the sciences from 1977 to 2001.

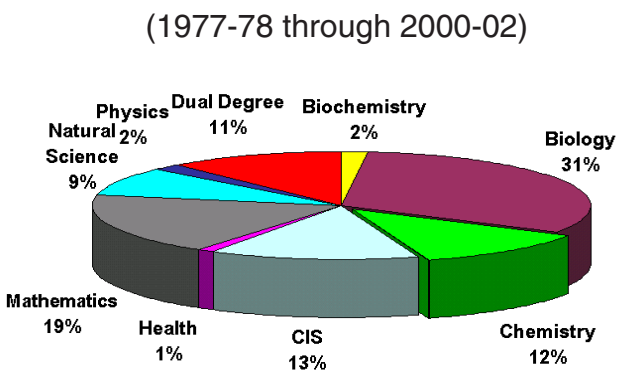


FIGURE 3.3 Average percentages of science graduates by major from 1977 to 2001.

Comparison data on the status of the sciences at Spelman College in 1977 with the current status (2001-2002) show both a longitudinal and a latitudinal growth (Table 3.1).

Prior to 1977, the year that the Department of Chemistry was formed, there were only two departments in the sciences, biology and mathematics, complemented by programs such as nutrition and health services. However, students were able to complete the major sequence in chemistry and physics through formal arrangements with other nearby institutions in the AUC, particularly at Morehouse College and Clark Atlanta University (then Clark College). A Central Dual Degree Engineering Office coordinated the transition of students from all AUC schools to the partner engineering schools in order to receive the additional engineering degree in a five-year program.

TABLE 3.1 Overview of the Sciences, Engineering, and Mathematics at Spelman College

| 1977-1978 | | 2001-2002 | |
|---|---|---|---|
| College enrollment | 1,285 | College enrollment | 2,139 |
| SEM enrollment (biology, chemistry, mathematics) | 375 | SEM enrollment (biology, biochemistry, chemistry, computer science, dual degree engineering and environmental science) | 707 |
| SEM faculty | 21 | SEM faculty | 50 |
| Total college faculty | 100 | Total college faculty | 145 |

The picture is quite different now. The student enrollment in the sciences is approximately 700. The number of departments has increased to include chemistry, computer science, and physics. Biochemistry is actually housed within the chemistry department as a second major option. A concentration in environmental science has been added. With approximately 200 students interested in pursuing an engineering degree, there is now a dual-degree coordinator on campus. The number of faculty in the sciences has more than doubled since 1977 to 50.

## DEVELOPMENT OF THE CHEMISTRY PROGRAM

When the chemistry department was established in 1977, there were 24 majors from the first year to senior level. The course offerings on campus at that time were limited to the general chemistry, organic chemistry, and biochemistry courses. That year, in 1977, three students graduated with a degree in chemistry. The department had a three-person chemistry faculty.

Currently, 92 students have declared themselves as chemistry majors, in either biochemistry, chemistry, or chemistry and dual-degree engineering tracks. The department is composed of 13 full-time faculty and a staff of 3 (2 laboratory technician and coordinators and an administrative assistant).

As indicated in Table 3.1, the growth and development of the chemistry department paralleled a growth in the sciences and the college. An increase in enrollment resulted in an increased demand from students for science course offerings on campus at Spelman College. Prior to 1977, chemistry courses, with the exception of the nonmajors course (for home economics and physical education majors), were offered through collaborative agreement with Morehouse College or other institutions in the AUC. Each of the partner institutions in the AUC experienced similar growth; classes filled early, and fewer students from Spelman could be accommodated. It became essential that Spelman take measures to increase resources on campus with additional faculty and additional courses. This was the impetus for the growth and development in the sciences that ensued in the years following.

The growth and success of the chemistry department in preparing African American women for the workforce, graduate school, and professional school were phenomenal during the next 20 years. A summary of this productivity in the department is evident most notably during the five-year growth period between 1993 and 1997 as summarized in Table 3.2.[3]

[3]Davis, S., and S. McBay. 1997. *A Closer Look at the Role of Historically Black Colleges and Universities in the Production of African American Students Accepted into Medical School and Science-related Graduate Programs.* Washington, DC Quality Education for Minorities Network, p. 16.

TABLE 3.2 Percentage of Biochemistry and Chemistry Baccalaureates Accepted to and Enrolled in Professional or Graduate School, 1993-1997

| Class | Number of Baccalaureates in Biochemistry/ Chemistry | Number Accepted to Professional School | Number Enrolled in Graduate School | Percent Accepted and Enrolled in Professional or Graduate School |
|---|---|---|---|---|
| 1993 | 20 | 5 | 3 | 40 |
| 1994 | 14 | 6 | 7 | 93 |
| 1995 | 24 | 12 | 5 | 71 |
| 1996 | 24 | — | 2 | 8 |
| 1997 | 30 | 4 | 3 | 23 |
| Total | 112 | 19 | 20 | |

Note: This table does not include the dual-degree students.
SOURCE: Department of Chemistry, Health Careers Office, Spelman College, 1997.

It is a productivity characterized by an increasing number of graduates and a large percentage of students accepted into and enrolling in graduate and professional schools. During this same five-year interval the number of chemistry majors peaked at 155 in 1996, and the number of graduates peaked at 35 (including dual-degree engineering students) in 1997. Twenty students were accepted into Ph.D. programs. Prior to 1977, only one Spelman chemistry graduate had earned a Ph.D. degree. The total number of Ph.D. degrees earned by chemistry graduates from Spelman College since 1977 is 28; there are 25 Spelman chemistry graduates currently enrolled in Ph.D. programs.[4]

This averages approximately one Ph.D. degree per year over the 24-year history of the department. Given the current graduate enrollment and past success rate, the number of Ph.D. degrees earned by Spelman chemistry graduates should double within the next five years.

Spelman College chemistry graduates are characteristically well prepared and competitive in their postbaccalaureate pursuits. They are accepted into graduate programs at some of the nation's leading institutions. Table 3.3[5] complements Table 3.2 in listing institutions where graduates have matriculated.

Spelman College's reputation for preparing successful graduates became eminent during this period. This success can be attributed to several factors and initiatives, many beginning in the 1970s. The initiatives and strategies implemented at Spelman formulated a model for success. Components of the models can be duplicated and can be found at other successful institutions.

## SUCCESS FACTORS

Factors that contributed to the growth and development of the chemistry department and other disciplines in SEM include the following: visionary leadership, committed faculty, divisional structure

[4]A.N. Thompson, immediate past Chair, Department of Chemistry, Spelman College.

[5]Davis, S., and B. McBay. 1997. *A Closer Look at the Role of Historically Black Colleges and Universities in the Production of African American Students Accepted into Medical School and Science-related Graduate Programs*. Washington, DC Quality Education for Minorities Network, p. 16.

TABLE 3.3 Graduate Schools Attended by Spelman College Chemistry Graduates, 1993-1997

| Institution | Number of Students | Institution | Number of Students |
|---|---|---|---|
| Alabama A&M | 1 | Tennessee Technological University | 1 |
| Auburn University | 1 | University of Alabama | 1 |
| Baylor University | 1 | University of California, Berkeley | 1 |
| California Institute of Technology | 1 | University of California, Davis | 1 |
| Clark Atlanta University | 1 | University of California, San Diego | 1 |
| Cornell University | 1 | University of California, Santa Barbara | 1 |
| Emory University | 4 | University of Colorado | 1 |
| Georgia Institute of Technology | 2 | University of Florida, Gainsville | 1 |
| Hampton University | 1 | University of Maryland, Baltimore County | 1 |
| Howard University | 3 | University of Michigan | 2 |
| Johns Hopkins University | 3 | University of Missouri | 2 |
| Mississippi State University | 1 | University of Nebraska | 1 |
| Morehouse School of Medicine | 1 | University of North Carolina, Chapel Hill | 1 |
| North Carolina A&T | 2 | University of Rochester | 1 |
| North Carolina State University | 2 | University of Texas, Southwestern Medical Center at Dallas | 1 |
| Ohio State University | 1 | University of Wisconsin at Madison | 1 |
| Purdue University | 2 | Vanderbilt University | 1 |
| Temple University | 1 | | |

SOURCE: Department of Chemistry, Spelman College, 1997.

in the sciences, implementation of specific retention strategies and programs, talented student pool, mentoring, research experiences, role models, recognition, and service.

Visionary leadership at Spelman is all-inclusive, emanating from both the faculty and the administration. The initiatives of the 1970s were faculty driven. Actions were taken to change the low status of science by concerned faculty who voiced their concerns to the administration. The administration was visionary in responding to the concerns of the faculty, planning for the future in science education, and partnering with faculty to support a comprehensive program to increase the emphasis on science and health careers.[6]

The commitment and dedication of the faculty are recognized as potent determiners in preparing successful graduates. Many of the returning chemistry graduates attribute their postbaccalaureate success to the devotion, interest, and commitment of the faculty in their undergraduate preparation. These faculty are receptive and responsive to the academic needs of their students, fully engage students in the learning process, encourage students to assume responsibility for their education, and take the necessary measures to ensure that the learning environment is not compromised. The faculty made a commitment to extended hours in assisting, counseling, and academic advising; holding special review sessions; coordinating and planning weekly seminars, mentoring activities, and special programs, including summer programs. Clearly, the impact of hard-working, committed faculty on students cannot be minimized.

[6]Falconer, E.Z. 1989. A Story of Success: The Sciences at the Science Department at Spelman College. *Sage*, *6*(2):36-39.

One of the measures that was initiated early in the 1970s was the division organizational structure in which all the sciences were collectively housed under the leadership of one administrator. The implementation of this strategy was significant in that it produced cross collaboration among the faculty who became well acquainted with each other and set common goals. Faculty collaborated on not only curricular issues, but also on grant proposal writing, resulting in a number of funded grants in the science division that supported the development of faculty and students across departmental lines.

One of the most significant externally funded programs established was the Pre-Freshman Summer Science Program by the current president of Spelman College, Dr. Audrey Forbes Manley. This program began in the early 1970s and continues to the present. Summer science programs for incoming students have been important to the retention of students in science majors as they provide a bridge from high school to college. There are three bridge programs at Spelman including the Pre-Freshman Summer Science Program for incoming first-year students interested in health professional careers, the Summer Science and Engineering Program for incoming first-year students interested in careers in SEM (with an emphasis on graduate school), and the Post-Freshman Summer Science Program for rising sophomores. The Post-Freshman Summer Bridge Program was the last to be added in 1995. All of the bridge programs provide academic enhancement and academic career navigational skills. Students can earn academic credit in courses and progress to the next level.

The implementation of other divisional retention strategies in the sciences included the development of counseling and career guidance offices such as the Health Careers Office, the Office of Science, Engineering, and Technical Careers, the Office of Graduate Relations, and the Academic Success Office (formerly the Freshmen Success Office) for early intervention.

Within the divisional structure, infrastructure grants provided support to strengthen the curriculum, support to strengthen faculty through faculty development activities, and provided support for research activities for students. Research training grants were used as a retention strategy. With 85 percent of Spelman College students receiving financial aid, students were recruited to faculty laboratories to eliminate outside employment that adversely affected their academic success.

In its infancy the chemistry department had limited resources. Creative planning was key in providing the majors with a quality undergraduate experience. Research courses were developed in the chemistry department so that institutional supplies could be used to support student research; students could also earn academic credit in the research courses. As a result some students received training grants, others earned academic credit, and still others volunteered to join a research team without receiving either.

Students on the college work study program were also put in close contact with faculty as they were recruited to work in the chemistry department. Those who were highly successful were recruited to tutor in the department's tutorial program. Others were recruited to work as laboratory assistants.[7] Both jobs gave them contact with faculty and helped them to feel a membership in the chemistry department. Students decided that service to the department should be one criterion for the receipt of departmental honors at graduation.

A talented student pool is an important component of the model for success. External scholarship funding has enabled the college to target talented students interested in doing science. Approximately 90 students receive scholarships through the Women in Science and Engineering Program, many of whom have a major in the chemistry department. Several other special programs have been established, funded by corporations and federal agencies, which support from 2 to 20 students with scholarship funds.

[7]G. Bayse, former Chair, Department of Chemistry, Spelman College.

Almost all such scholarship support is accompanied by assignment of a faculty mentor, a requirement to participate in research with faculty and to attend seminars, and opportunities to attend scientific conferences, often to give presentations on their research. Nearly all programs are available to chemistry department majors. These scholarship-based programs have proven to be extremely important in directing students toward graduate school and increasing the probability for success in graduate and health professional programs. Success predictors are based on standardized test scores, high school GPAs, high school activities, and rigor in high school courses taken.

The external scholarship program is a significant factor in recruiting and retaining science students. This strategy coupled with other factors, such as mentoring and research, are strong indicators for student success.

Mentoring of students by the faculty has proven to be a win–win situation for both groups. Faculty mentors benefit from interacting and bonding with students on a personal level. They learn about the students' goals, share ideas, and play a crucial role in the students' academic and professional development. Students benefit by developing a long-term relationship with faculty who can serve as their advocate, counselor, guide, and friend. Faculty mentors continue to encourage and support students after they leave Spelman to attend graduate or professional school, or to work. Students share their successes with mentors and serve as a valuable link to other students at the college and to other graduate students.

A significant amount of mentoring occurs between students and faculty in the research lab. Student research is considered a vital part of the science education program at Spelman College. Faculty actively engage students in research on the faculty's projects in most cases. In the case of very inexperienced students, specialized projects are designed for them. Students are mentored closely, encouraged to become independent thinkers, and to report their research findings to a larger audience. In recent years, more than 95 percent of the graduating chemistry majors participated in a research experience with faculty on campus in addition to external research experiences.

Role models are powerful catalysts in motivating students to higher achievement and career aspirations. Interacting with faculty who have shared cultural similarities encourages students to expand their knowledge and experience base. Scientists, engineers, and related professionals, including women and graduates of the department, are frequently invited to campus to share their experiences with current students. These activities motivate students to continue in chemistry and build their confidence. Students are encouraged to apply for summer internships; attend special research programs at other institutions, research facilities, and in industry; and pursue graduate and professional degrees.

Recognizing achievement gives students a sense of accomplishment. It builds self-esteem through positive reinforcement. The achievements of students in chemistry and SEM disciplines are recognized at various levels including the department, division, and collegewide. Recognition, certificates, and awards for service or leadership are given to chemistry majors appropriately at departmental events. A Science, Engineering, and Mathematics Day initiated in 1988 is an annual event (divisional) celebrating the accomplishments of students and faculty in the area of research. Students give oral and poster presentations on their research findings. Prizes are given for the best presentation in each category and discipline at a culminating awards ceremony. Since 1988 Spelman has witnessed a 57 percent increase in the number of science majors pursuing doctoral degrees in the SEM areas.[8]

Chemistry majors also receive recognition for their academic achievements at the collegewide honors weekend activities. Finally, most students engaged in research with faculty are provided opportunities to give technical presentations at regional and national meetings. These meetings give students

[8]Office of Sponsored Programs, Spelman College.

visibility and provide an avenue for students networking with others in the profession. Students meet potential employers and faculty from various graduate schools.

Service is an integral part of the academic experience at Spelman College. It teaches students the value of their education and allows them to apply what they have learned in the classroom to practical, real-life situations. Chemistry students complete service experience by volunteering as laboratory assistants and as tutors and mentors on campus and in the local school systems. Service is a component of departmental honors.

The aforementioned factors collectively constitute a model with proven measures of success in preparing outstanding, high-achieving Spelman graduates in chemistry and SEM disciplines. These graduates are strong, positive role models who continue to bring honor to Spelman College. Given the successes, current status of the science education program, and available resources, Spelman College is poised to increase its leadership role in producing minorities in the chemical workforce.

## ACKNOWLEDGMENTS

We are grateful to the many individuals and offices at Spelman College who provided information, data, and reports for this presentation including Dr. Etta Z. Falconer, Senior Advisor to the President of Spelman College; Mrs. Gwedolyn Johnson, Office of Institutional Research and Assessment Planning; Dr. Fred Buddy, Registrar; and Drs. Gladys S. Bayse and Albert N. Thompson, former Chairs, Department of Chemistry and Office of Academic Affairs, respectively. Special thanks are extended to Mrs. Shrinda Faye Jackson and Mrs. Tracey L. Parrish, administrative assistants, Department of Chemistry, and Ms. Kennita Carter who helped in preparing the report.

## DISCUSSION

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** What Spelman has accomplished is absolutely remarkable. I wanted to ask for some elaboration on a couple of detailed points.

Your list of ten success factors was not in order of priority, right?

**Cornelia D. Gillyard:** No, it was not in order of priority. It did not even follow the order in which we tried it. Let me say, we have tried a little bit of everything at Spelman.

**Robert L. Lichter:** It certainly helps to have a talented student pool. Not everyone has that luxury. I wonder whether you would also agree that having committed faculty is, if nothing else, essential—or, without having committed faculty, nothing else would matter. Would you agree with that rather extreme statement?

**Cornelia D. Gillyard:** Based on our history, I would certainly agree to a large extent. You have to have committed faculty, and it is not easy to find faculty who are energized and believe in the student and her potential. Like one of my colleagues said, during those times of adversity, we rose to the occasion of the challenges and found strength in the potential that we saw in the students. So, you have to have committed faculty that is open and receptive to the fact that, just because a student does not have a 4.0 or even a 3.0 GPA, they may have other strengths that the graduate school admission committees will see in them. A key factor would be one-on-one research they had done in addition to their academic studies.

**Robert L. Lichter:** That is the point I was trying to get at, and it conforms to the point that was made by Marvin Makinen at an earlier session.

The other question I had was if you could elaborate a little on what you mean by the expression "research experiences."

**Cornelia D. Gillyard:** Let me start off from a very basic initiative. Our first original research experience or research training experience with students was actually from the National Institutes of Health under the heading of the Minority Biomedical Research Support program, the undergraduate Minority Access Research Careers program, for example.

We have those types of programs that provide faculty with release time to do research and that also provide time to purchase supplies and equipment and that pay students a stipend to come into their laboratory and spend a minimum of 12 hours in the laboratory per week and be full time during the summer.

We now have faculty with pure research grants who take on students in their laboratory working on their research initiatives. They copublish. They present the findings at conferences. That number is much smaller than the broad-based research training programs. We also have a number of scholarship programs that have research as a component.

The programs vary in terms of the length of time that research experience lasts. For the most part, as long as a student has a scholarship, they must do research during the semester. It may not be as extensive as the research training program with specific guidelines, but those students work with a faculty member.

Sometimes the scholarships provide supplies for the faculty and that is it. Other scholarships do not provide supplies.

Then we have the more recent initiative to bring the students aboard in terms of research that provides, at the end of their freshman year, research courses to acquaint the students with methodology and the idea of research, in preparation for entering a faculty lab. The faculty is supported in terms of supplies and travel, and students get a stipend. So, it covers the gamut.

We do have a few programs in which research is a requirement, but there is no specified time length in terms of years or semesters or hours that must be spent in the lab. Most of those programs have a minimum of five hours. Students cannot earn credit for academic research in a lot of these programs if they are not upper-level students. Our juniors and seniors are the students who can earn credit for research.

Let me conclude by saying that the research projects that students engage in range from ones that faculty devise for them at their level just to get them involved and acquainted with research to pure research on a faculty project.

**Isai T. Urasa, Hampton University:** I am from the other HBCU represented at this meeting. I am going to make a comment that I wanted to make earlier and to add a couple of statements to what you have presented here. A comment was made about the nurturing environment that HBCUs provide. It is obvious from this presentation that a nurturing environment is critical in preparing students for Ph.D.s. Without that environment, the students who leave to go to Louisiana State University (LSU), Virginia Tech, and other Ph.D. institutions would probably find it difficult to succeed. I think what is needed is more of such transitioning experiences.

There are working models out there. Some of them have been terminated. Most of these have been funded by federal agencies. There used to be a program that was supported by the National Science Foundation called Research Careers for Minority Scholars. That was a very effective program. Unfortunately, it is no longer operational. We would like such programs to be brought back. At one time we

had over 70 students majoring in chemistry, which was a large number at Hampton University, thanks to that program. I think we need more interaction between the HBCUs and other minority institutions and the research institutions. The familiarity among faculty members would do a lot in helping students' transition from undergraduate institutions to Ph.D. institutions. I would also like to mention a program that we started several years ago with Virginia Tech, through which we sent five students who completed a master's degree program at Hampton to Virginia Tech for their Ph.D.s. These kinds of interventions, I think, are very effective.

**Cornelia D. Gillyard:** Spelman students who go away to graduate schools or other majority institutions with a different culture have experienced a similar culture shock. If you would allow me, I would like to relate the experiences our students initially had with the dual-degree program.

Most of our students in the dual-degree program matriculate at Georgia Tech. They would leave Spelman with very high GPAs—3.8, 3.9, 4.0. They would go to Georgia Tech and suffer tremendously. It was a different culture. Initially, I do not think—this is not to offend anybody—that the faculty there took the students seriously, because it was an arranged program. They did not initially consider them to be as talented as the students at Georgia Tech. What have we found, as more and more students went to Georgia Tech and were successful, through those early years, is that now our students leave Spelman and go to Georgia Tech and earn higher GPAs. We now have students that go to Georgia Tech and matriculate and earn 4.0 GPAs in the engineering field; and I do not know if Georgia Tech would admit it, but our students are certainly performing as well as, if not better than, some of their students who were not in dual-degree programs, but had matriculated there during all of their undergraduate career.

One success story is one of my research students, who was very talented. She worked in the laboratory like a graduate student and was intuitively inquisitive. She went to Georgia Tech and earned a 4.0. They recruited her as a presidential scholar. She is in their graduate program, passed her exams the first quarter she was in the graduate program, and is well into the experimentation.

We have to do something. We found that we will get a call or an email from students who go to graduate school and experience that shock. Of course, we talk through it, work through it, and I tell them give it another month.

Usually the first month is the critical month. We get the calls. Once we work through that and they get through that first semester or quarter, then they hang on and continue in the program. Nevertheless, the transition to a graduate school or majority institution is difficult.

# 4

# Reports from the Breakout Sessions

Following the presentation described in Chapters 1-3, breakout sessions were organized to enable more extensive discussions among the workshop participants. The following questions and statements were suggested to the breakout groups as possible topics for discussion:

- Consider the previous talks regarding successful diversity models and discuss which models can likely be replicated.
- Discuss potential problems that may be encountered in trying to replicate a given model.

Rapporteurs from the breakout groups then reported in plenary session what they believed to be important ideas and topics that had emerged during the discussions.

**Rigoberto Hernandez, Georgia Institute of Technology:** All of us thought that we were just attending a typical workshop in which all the usual problems leading to a lack of diversity in the chemical workforce would once again be aired out. This morning, we quickly realized that this workshop is different. The first three lectures were truly outstanding, and we were surprised at the success stories that they described. This cognitive dissonance probably led us to say a lot more than what we expected to say during our one-hour discussion. Consequently, although I may not give a direct statement about any one of the lectures, the common consensus among the group is that we felt it was very useful to listen to all three of the speakers describing diversity models that work. In what follows, I summarize several of the questions we formed during our discussion as well as our attempts to answer them.

*How and where do you find diversity?* Of course, we need diversity of students, but that alone is not enough. We need diversity among our faculty, because that allows us to obtain or prepare a more diverse student body. We need diversity in the agencies. By that, I mean the funding agency that recognizes the importance of diversity by having that diversity among them. Of course, this is just a microcosm. There should be diversity everywhere, including the general workforce. Perhaps diversity that is anchored at the front end of the pipeline will allow diversity to filter throughout our country.

*What is diversity?* Within this workshop, we have been primarily defining diversity in terms of race and ethnicity. There is also diversity in gender as well as diversity in career paths. Diversity in the chemical workforce should not be framed solely within a discussion of academic achievement as the one and only possible route for a success story. Success stories are also to be found in industry. We should therefore think about the need for diversity in many different directions. We should think about it in a holistic kind of way, if you will pardon a new-age term. It is all related. So, do not try to solve just one diversity problem within a particular setting. Instead think about how solving that problem might fit in within the context of all the other problems.

A most important action item in this sense is the delivery of the diversity message. Do not just come to a diversity meeting or workshop and say, "this is my contribution to diversity for the year because I attended this workshop." Go back and talk to members of your institution and let them know what facts you discussed, for example, diversity models that work and how diversity should be viewed within the context of your institution.

A common theme in our group discussion came under the refrain, "programs, programs, programs." In today's lectures, we heard about several new and successful diversity programs. However, there is a sentiment that at many workshops one often hears about new programs or initiatives and that in general there is an increasing proliferation of such programs every year. Unfortunately, the fact is that the success stories have not seemingly proliferated. That is, the success stories do not seem to be increasing at the same rapid rate at which the programs have increased. So, the question is, *What do we need to do with these programs, and how can the increase in the proliferation of these programs increase the success stories?* The group consensus is that we need to buy in. But from whom do we need buy-in?

- We need the buy-in from the students. We will get this kind of buy-in if we advise them properly. How do we advise them properly? Let us start by advising their teachers. A lot of capable teachers have an idea of what they need to do to prepare the kids to apply successfully to college, but maybe they do not have a good enough idea of what those kids' needs are in order to be successful in college. For those of us who are faculty members, the burden is therefore on us to educate these teachers, particularly high school (9th-12th grade) teachers and counselors, on what they need to teach the students before they go to college. Perhaps with this better preparation, we can have a higher yield of success stories at the college level.
- We need to persuade the importance of buy-in to the entire faculty and administrators. That is, we need buy-in from ourselves. It is an excellent advance to exclaim that diversity is important. However, at the end of the day, or better yet, at the end of the year, when you are expecting a promotion, nothing that you do to enhance diversity affects your promotion or your salary increase. Clearly, diversity has not been an issue in measuring most of our academic careers. Perhaps this could be factored into the equation.
- We need buy-in from funding agencies. For example, when a funding agency is asked whether or not they will renew your grant, perhaps the agency could base their consideration on how well you have handled diversity at your place of business. This is a double-edged sword because we want such grants to be based solely on the scientific merit. The challenge is to achieve this quality and yet reward investigators who enhance diversity.

*How do we define a success story?* By success, I do not just mean absolute success, as in whether the science is good, which of course is part of the question. Instead, we are also asking whether the social context of the success story is also one that has promoted diversity. There are at least two parts to this question:

• The first involves the preselection process. How do you identify which students are going to be successful, and what is the right criteria for this selection process? One relevant example given today by Sylvia Hurtado is the University of Michigan case involving the question of how to include diversity in acceptance standards for incoming students. The case has just recently percolated through the legal system up to the Supreme Court. I do not know the details, but maybe someone who does will tell us more on that later. Nonetheless the take-home message is that one has to be careful in applying a standard that may give rise to diversity at the risk of creating a bias against other members of the society. In any event, the sad truth is that a mere 1 to 1.5 percent of the incoming class of undergraduate students at the University of Michigan is African American despite the fact that a diversity criterion is in place. Given that this percentage is significantly lower than in the American population, it can be argued that in practice it is not adversely affecting other groups. And, moreover, it is helping to enhance the diversity at the University of Michigan. In our group's experience, we have found—as Sylvia Hurtado more quantitatively shows—that the effect of taking students of ethnically or racially diverse backgrounds does have positive nonadditive effects on the education of the entire student class. That may or may not be something you would agree with.

• The second involves the postevaluation of success as well as how it is rewarded. As remarked earlier, your success in promoting diversity does not play a role when it comes to grant renewal time or promotion. That is, at least in the experience of the academic members of our group, the promotion of diversity initiatives is not a reason why you are or are not awarded a grant. And yet, many funding agencies include mission statements for their grants that seek to promote diversity. In the final analysis, therefore, we need to ensure that the rhetoric matches the action. If you believe that diversity is important, then put your money on it. If you are not going to put your money on it, then do not say that you will, so that other people do not spend time on it—particularly African Americans, Latino Americans, or other members of diverse groups. For example, I spend time on diversity issues because I want to help people and I am happy doing it. If I were rewarded for it, that would be good too because that is what the rhetoric says I am going to be rewarded for. However, there is clearly a time-management problem. If I spend time on diversity issues that I could have spent directly to promote my science, then I am sacrificing some erstwhile success.

*What is the role of nurturing and support groups in promoting diversity?* Both in industry and among our faculties, there should be an attempt to develop support groups in which a mentor is assigned to different individuals starting within the system. Such mentoring may involve guidance in how to deal with office politics that may be inhibiting the successful initiation of a project or in how to write a grant proposal to a particular funding agency. Through mentoring, you can have a substantial impact on the success of their careers. In summary, mentoring and nurturing is important for both industrial and academic members—at this relatively upstream stage of a scientist's career—in order to obtain the success stories we have been talking about.

Nurturing also plays a significant role in the development of diverse students. You may argue that you have to impose a sink-or-swim standard in your graduate program, but that does not mean that you cannot nurture. Nurturing does not mean coddling. Nurturing means challenging and paying attention to someone. If you pay attention to your students as well as challenge them to be successful, they may very well be.

Finally, there is the issue of transition. It can be found both at the undergraduate and at the graduate levels. Specifically, the issue is that we need to have a better understanding of how we take students from college to graduate school. Do we prepare them appropriately for those graduate schools? Do we keep track of them? Among the tools used by some funding agencies and smaller colleges is a tracking

system that varies in its sophistication. The National Science Foundation (NSF), for example, keeps careful track of the human capital that it supports because they recognize that tracking is a significant positive that they can point to in justifying their budget allocation. Small colleges often keep track of how their students perform in graduate school by maintaining lines of direct communication. If a graduate student does not succeed in your program, then you will likely see a drop-off in applications from that student's undergraduate college. In this way, they indirectly ensure that there is some quality control in your nurturing process. But too often graduate faculties are oblivious to this feedback.

**Isai T. Urasa, Hampton University:** Our breakout group discussed the need for effective programs to help students transition from undergraduate programs to graduate school. This assistance must begin long before the students leave college. Undergraduate research should be a large part of preparation for a graduate program and could occur in a number of different venues: the student's own university, other academic institutions, or industrial or national laboratories. Undergraduate research can be accomplished as summer programs or through the academic year. For example, Hampton University has developed several courses for academic credit that allow students to engage in research activity starting in their freshman year. Partnerships can also be established between baccalaureate institutions and Ph.D.-granting institutions. This allows the students to see the working culture and diversity at that institution and to decide if the atmosphere in that graduate program is right for them.

There is also transition from university to industry. One of the breakout group's concerns was ensuring that earning a Ph.D. is a worthwhile investment for a future career. Professional societies can aid in this transition process. The American Chemical Society (ACS), for example, has held workshops and short programs for students about job search, industrial research, and other topics.

The attraction of students into science, mathematics, engineering, and technology continues to be a critical issue in addressing the underrepresentation of minorities in these fields. The loss of students from the leaky science pipeline transcends all levels of education from K-12, to undergraduate and graduate programs. Interest in and attraction to science must be cultivated at an early stage, and this requires programs that address not only science and math skills but also communication skills.

NSF is now involved in K-12 science programs, which is a step in the right direction. There are model programs that allow high school students to spend time at an undergraduate institution to determine their field of study. Undergraduate students who are not ready to advance to graduate school could also be helped to stay in the pipeline. Such students may benefit from an intermediate master's degree program that would give them a two-year period to firm their knowledge and reorient them into graduate school. Hampton University has done some things similar to that.

Recruitment is an issue closely related to the leaky pipeline. There are several factors that impact on our abilities to recruit students for baccalaureate and graduate programs in science. There are a number of programs that have proven to be quite effective in this regard, for instance, the National Institutes of Health (NIH)-supported Minority Access to Research Careers program. NSF had the Research Careers for Minority Scholars program several years ago that has since been discontinued, but which successfully recruited and supported science students.

Similarly, there is a continuing minuscule number of minority faculty members at majority institutions. Although external support and resources are essential, institutional commitment, support, and the overall climate are also important to the issue of diversity.

Although we do not have the solutions to these problems today, I think there is a desire to put forth effective programs to help resolve these issues.

**Billy M. Williams, Dow Chemical Company:** Our group spent a lot of time following up on what was reported in the success models by the first three speakers this morning, and concentrating on the issue of transition, which the previous rapporteur talked about, and disequilibrium. Therefore, most of our discussion focused on that.

The disequilibrium occurs in the undergraduate-to-graduate transition for majority populations. It also occurs in academic-to-industry transition, but because of the cultural adjustment, it creates a double burden for the nonmajority population. We recognized that this is a universal phenomenon. One of our participants pointed out that this is also an acute issue for first-generation college students.

Increase accountability among the faculty. One of the barriers that we discussed was the lack of incentives for faculty members to assist with this transition any more than they do already. There are a lot of faculty members who do this very aggressively, but it is done more out of their own will and desire to help society's need for future scientists. There are limited, external faculty incentives to help with the transition. Also, there was an acknowledgment in our group discussion that professors were unlikely to change their practiced beliefs. We spent time focusing on what actions we could suggest or what actions could be taken to help influence their belief.

There was some discussion on models that work for assisting transitions. One such effective model gaining use in industry (and on campus) is "affinity groups." We heard this morning that they have a similar group at Corning. These groups were managed by employees (and/or students), but supported by the employer or educational institution. The question was whether or not these student support groups can be extended to the graduate level. Reportedly, there is an NSF program that encourages and supports the undergraduate affinity group on campus and that this could be extended to the graduate level. We also thought that academic institutions could be more proactive in helping students during the transition by making incentives available to faculty for their commitment to this effort. One of our group participants reported that in Texas there is a requirement for all students to obtain some type of diversity education and training. There was discussion on whether a university could ask untenured faculty to attend such training as a means to help raise awareness of transition-related issues. Training grants are available from NSF and NIH.

There is a question as to whether some of the professional organizations could bring more attention to the issue that we are losing a lot of students during these transition stages. This could be an area for further attention by organizations such as ACS, American Institute of Chemical Engineers, Hispanic professional societies, and African American professional societies.

Currently the tracking system is poor. There are a number of minority students who successfully complete even the most challenging programs across the nation, many without the type of support that should be in place. But the success factors cannot be understood or correlations developed because of the poor tracking system. What were the factors that allowed students to get through the Massachusetts Institute of Technology with good GPAs? Discover what was critical to that success, and publicize those findings.

Promote technical careers. One person in our group discussed a study that they have under way to not only take a snapshot of capacity (what is feeding the pipeline), but also to be proactive in promoting technical careers to help increase the pool entering the chemical-related professions.

Last, have a better attempt to educate institutions on the inherent value of a diverse faculty population. We heard in this workshop that when students are exposed to a more diverse group of educators, it really has a positive impact on their careers.

# 5

# The Meyerhoff Undergraduate Scholars Program

Michael F. Summers
*University of Maryland, Baltimore County*

This evening you are going to get an enthusiastic presentation from University of Maryland, Baltimore County's (UMBC's), president and founder of the Meyerhoff Scholars Program, Dr. Freeman Hrabowski. Dr. Hrabowski is one of only a very small number of African American presidents of predominantly white universities in our country. When he came to our campus in 1988, we had no coordinated minority training efforts on campus. He has really transformed UMBC. He is an example of how one person with a vision and a lot of energy can have a large catalytic effect and can change the way departments view education and treat their students.

The first part of my presentation focuses on UMBC's Meyerhoff undergraduate program. In the latter part, I will tell you about our more recent efforts to develop a biomedical graduate training program that is modeled after the undergraduate program.

The Meyerhoff Scholars Program began with a $500,000 donation from the Meyerhoff Foundation. Today at UMBC, there are nine different undergraduate programs and three graduate programs run by faculty in different departments across campus, based on the highly successful Meyerhoff model. The first graduate-level training grant we received was the Initiative for Minority Student Development (IMSD) grant from the National Institutes of Health (NIH). We now have funding for nine new positions dedicated to minority graduate students in UMBC's Joint Center for Earth Systems Technology, a center that partners with NASA to study such issues as global warming and remote sensing. You can see that the Meyerhoff program is not being run by just one person, even though one person started this. Dr. Hrabowski has affected a lot of people in different departments across our campus.

The Undergraduate Scholars Program is named after the Meyerhoff family. They donated $500,000 to fund African American males from Baltimore City who were interested in studying science, engineering, or mathematics (SEM). That is how Dr. Hrabowski started this program in 1988. Today the program is entering its 14th year. After the first year, it was modified to include African American females. Today, our program is open to all high-achieving students.

Although the Meyerhoff undergraduate program was opened to all students in 1996, we still have 71 percent participation by African Americans, 14 percent by Asian students, and only 12 percent by Caucasians. UMBC has worked hard to make certain that the original focus would be maintained, in part

by including activities that will be of interest mainly to students that care about underrepresentation in SEM fields.

There is a misconception when it comes to the issue of students entering the SEM pipeline. People say that there are very small numbers of undergraduate students who are interested in SEM when they enter in their freshman year. At UMBC, that is not what we see. For the fall of 2002 incoming class we have over 1,600 nominations for our Meyerhoff program. Ninety percent of these applicants are from Maryland. Of the 1,600 nominations, nearly 500 students have completed applications for only 50 available positions. Again, the majority of those 500 applications are from Maryland.

As can be seen by the numbers at UMBC, there is a large population of high school seniors who seek out college with an interest in SEM. These are talented, high-achieving minority students who are doing well in high school and who qualify for our program.

A study conducted by the University of California, Berkeley, has shown that a large majority of students start college interested in SEM degrees. We believe that among those students there is a large pool of underrepresented minority students. The study found that many of the students lost interest or decided that the SEM areas were too hard very early on in their freshman year. *Thus, the data clearly reveal that, although very large numbers of highly talented and motivated minority students with interests in SEM fields now exist in the United States, few are retained in the sciences.*

The program that Dr. Hrabowski set up was designed to ensure that we recruit students that are likely to succeed and then make sure that we retain them in SEM. Once they get past their freshman year, large numbers of these talented underrepresented minority students want to begin working in research labs. At UMBC we have found that faculty welcome these students into their labs.

The Meyerhoff Scholars Program contains several major components: the Summer Bridge program, mentoring, summer research experience, monetary support (including room and board, tuition and fees, and a book allowance), cultural arts activities, academic advising, travel to present research at national scientific conferences, assistance with graduate and professional school placement, and staff support.

We have two different mentoring programs: research and professional mentors. Both on- and off-campus research experiences are required for all students. We also provide monetary support. It costs about $12,000 per student for the Summer Bridge program, $14,000 for every in-state student per academic year, and $20,000 for out-of-state students. We do not receive any tuition breaks for these students. That is one reason most of them are Maryland residents.

We actively recruit high school students who look promising in science. These are students that have high SAT scores and high GPAs. People criticize UMBC on this point because they believe that these students will make it anyway. What I will show you is, yes, we are taking the cream of the crop, but what we are doing differently is, keeping them in science.

So, these students represent the cream of the crop. We have two selection weekends in which applicants come to campus with their families and participate in numerous activities, including interviews with students, faculty, and administrators in the program and the university. After the selection weekends are over, the interviews and placement tests are tabulated. Then we decide who will be offered a scholarship. The students have to have a B average in their preparatory classes. The SAT scores have to be at least 1200 with a 600 math score.

Students also have to have a strong interest in pursuing *doctoral* professional degrees. We are emphasizing the Ph.D. above the M.D.[1] degree, and Dr. Hrabowski will tell you that we think we have let our students down if they go to medical school, because we are trying to encourage them to think about creative research as a career.

[1]The College Board, 2001 National Report, Princeton, NJ.

In 2001, the national average of SAT scores for all students was 1020, for African American high school students it was 859, and for the Meyerhoff students it was 1310. That is a difference of over 450 points. As I stated earlier, we are taking the best and the brightest.

To determine if what we are doing works, we have a strong evaluation component to the program. Professor Ken Maton of the psychology department at UMBC is responsible for conducting these evaluations. He has determined that the Summer Bridge is perhaps the most critical piece of the program. The students enter the program and have to take 21 hours of classroom contact time during their six-week program. Let me reiterate, they are in class 21 hours a week.

Then students must participate in workshops on business etiquette, study skills, and time management, and they visit numerous science and technology workplaces in the Baltimore and Washington, D.C. area. Beyond that, they have to study. They receive seven credits for their participation in the Summer Bridge. These kids learn quickly how to study in groups, how to study independently, and how to support each other when they are studying and preparing for classes. Building that sense of camaraderie is absolutely essential.

Many of the students have had calculus before, but nevertheless, they have to retake it at the college level. This teaches them what it is going to take to succeed, not at their high school level, but to succeed at high levels in college. Dr. Hrabowski tells these kids that he does not expect them to make an A. He says that he expects them to make a high A. Also, he expects them to be running the tutorial center and helping other students. We have seen that this is indeed what happens.

This program has had a huge effect on the white faculty at our campus. That is something that I think is often overlooked when we think about minority training. In general, I think it is the white faculty that have to be educated as much as the minority students. None of us—now I am speaking for many of my white colleagues—want to think of ourselves as having prejudices. Nevertheless, we have been raised in white neighborhoods and generally live in white neighborhoods, so we do not understand many of the issues that the underrepresented minority students are facing. For example, some of the senior faculty in my department said that, prior to Dr. Hrabowski, they might occasionally see one or two underrepresented minority students in their upper-level undergraduate classes. When they were in the classes, they never spoke up, they often sat in the back of the class, and they generally—although not always—did not perform as well as most of the white students. Now we see large numbers of underrepresented minority students sitting in the front of the class, asking questions, and pushing the teachers. That has a huge affect on the perceptions of the white faculty. Educating the faculty needs to be a big part of what goes on, especially at majority research institutions.

As a part of the Meyerhoff Program, there is counseling and advising for students. In their freshman year, they are monitored on a weekly basis. If they do poorly on a test, the academic advisor is aware and addresses the situation. The students are paired with a tutor or study group, depending on their need. There are tutors available for students that need help; many times these are upper-level Meyerhoff students. The staff makes sure that the students do not get into academic trouble in their freshman year.

We have a great professional mentoring program that Dr. Hrabowski started, in which students are paired with underrepresented minority mentors in the Baltimore and Washington, D.C. area. These might be business leaders or faculty. Also, we have a research mentoring program for students, with faculty from all over the country. Isiah Warner from Louisiana State University (LSU) is a mentor for the Meyerhoff Program. People come from around the country to participate in what we are doing at UMBC because they want to help these students.

We have an interesting, high level of family involvement. The Parents Association contributes significant money, but even more than that, they contribute their time. Whenever there are big events, the parents will come and help do whatever it takes to make sure the event is successful. They are very

active in the program, even after their child graduates. For example, three generations—grandparents, parents, and child—of one family have actively participated in the program.

All students are required to participate in a summer research internship off campus for at least one summer during their career. However, many students participate in more than one. Students work with people like Tom Cech, a Nobel laureate and the president of Howard Hughes Medical Institute. He has taken at least two Meyerhoff students in his lab for the past six years. There are international internships as well, in places such as England, France, and Rio de Janeiro. These students work in top research laboratories where they participate actively in a research project, many times resulting in publications.

As the students need more than just that limited exposure to research, we try to get as many as we can involved in an extended research experience on our campus. I can talk about my laboratory as an example. Last year I had 28 undergraduates working in my lab. In one year, a total of ten seniors graduated from my lab that collectively had 15 publications. Chelsea Stalling had a paper in *Science*, as did another undergraduate Meyerhoff student, Jill Walker, a couple of years earlier. Several of these students had first authorships on the covers of peer-reviewed journals, and they have all gone on to good places. Ryan and Brian Turner are from the Eastern Shore in Maryland and are currently conducting biomedical research in the M.D. program at Harvard. Chelsea Stalling is in the M.D./Ph.D. program at the University of Pennsylvania. Rebecca Meier is in the M.D./Ph.D. program at Yale. Daniel Klein is working on his Ph.D. at Yale. And Chika Madu is at Washington University. These are just a few of the undergraduates who have worked in my laboratory.

One of the big questions people ask is, "Does this program really do what we say it does?" We have been accused of taking the cream of the crop and that these students would be likely to succeed at most other institutions as well. We have one study that has been completed and published. Admittedly, it is a couple of years old now, and we are working on another study that is not yet completed, but should be out next year. The populations that were compared were a sample from the first three educational cohorts of the (Meyerhoff) program, and a sample of students who qualified for our program, were accepted, and declined the offer to go elsewhere. These students generally were offered scholarships to top-level or Ivy League universities. They agreed that if they attended selection weekend and were made an offer—even if they declined—they would allow us to track them through college. The final populations compared were a sample of students who were at UMBC prior to the Meyerhoff Program and would have qualified for the program and students who entered UMBC in 1990-1992 who met Meyerhoff criteria. Note that all African Americans during this time were Meyerhoff students.

Figure 5.1 shows the graduation rates for students majoring in SEM fields at UMBC from 1990 to 1992. N = 31 for all groups. What you can see at UMBC is that 9 out of the 31 Caucasian students who have the same scores as the Meyerhoff students graduated with an SEM degree, and 14 of those students are not likely to graduate in the SEM field. This is typical of a standard white student. Forty-two percent of our Asian students graduate in the SEM fields. That is typical as well.

What you will notice with the Meyerhoff program is that of the 31 students in the sample, 91 percent graduated with an SEM degree. Today, more than 95 percent of the students that come into the program graduate with a science, engineering, or math degree.

If you look at this same Meyerhoff group in Figure 5.2, and look at those that go on to graduate education, you can see that the pre-Meyerhoff—minority students who meet the qualifications of the Meyerhoffs—only had 1 out of 31 who actually went on to a graduate program. Five went on to medical school. Now, for post-Meyerhoff, 12 students went on to graduate school and 8 did not. So, there is a substantial boost in the number that go to graduate school. Again, this is our first group of students. The latest data indicate that 85 percent of all the graduates go on to graduate or professional school.

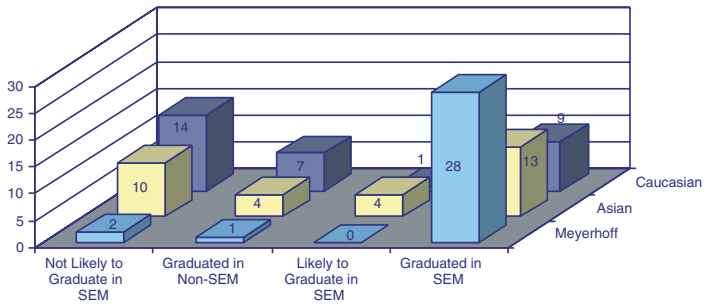


FIGURE 5.1 Graduation rates for students majoring in SEM fields from 1990 to 1992.

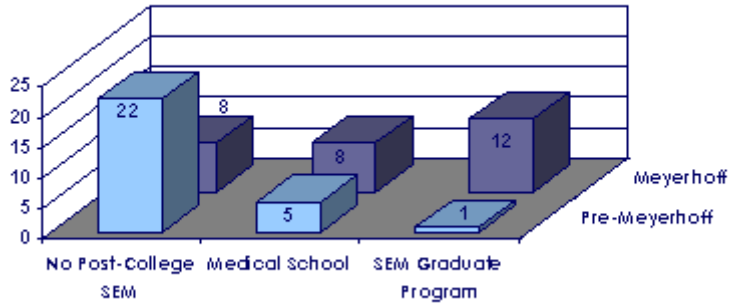


FIGURE 5.2 Postgraduate education patterns before and after introduction of the Meyerhoff Program.

What about the students who were offered a Meyerhoff scholarship and went elsewhere? The GPAs are similar, 3.16 for the Meyerhoff students and 2.90 for those who declined.

The students that turn us down do succeed in college and they do well, but what you can see is that, of those that go elsewhere, a much smaller fraction graduate in SEM.

How many go on? In Figure 5.3, comparing Meyerhoff students with those that went elsewhere, only 3 out of the 34 that went elsewhere, or 8 percent, went to graduate school. Twenty-six percent (N = 9) went to medical school. Of the Meyerhoff scholars, 46 percent went on to graduate school and 24 percent continued on to medical school.

There are many other quantitative indicators of success. The 12-year overall retention rate—this is retention in SEM, not retention in college—is greater than 95 percent. The average GPA is about 3.5 for all the current students.

In 1999 an American Society of Biochemistry and Molecular Biology graduation survey was conducted in which universities and colleges were polled to find out how many biochemistry graduates they were turning out and what percentage of them were minority students. Their results showed that UMBC graduated 21 African American biochemistry bachelor's degrees in 1999. It turns out that the next closest place was the State University of New York at Stony Brook with six, and then the rest of the universities only had a few. This number may not be 100 percent accurate because some institutions did

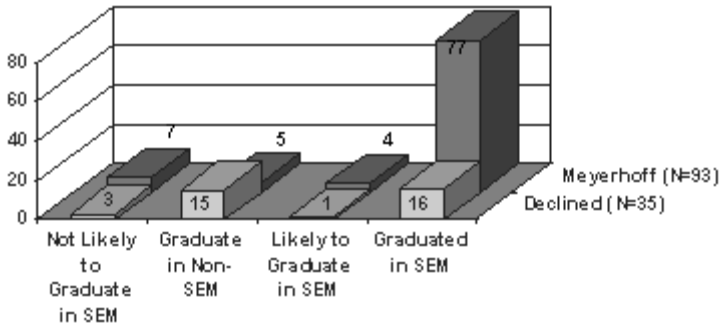


FIGURE 5.3 Comparison of Meyerhoff students with Meyerhoff-qualified students who attended other institutions.

not respond to the survey. I assure you the UMBC number is correct, and it is very unlikely that any place else turned out this many.

Let me point out something else. Of these 21 African American graduates, only half, 11 of them, were Meyerhoff or Minority Access to Research Careers (MARC) students, a program to aid minorities into graduate, Ph.D, and eventually biomedical fields. Due to the presence of the MARC, Meyerhoff, and other programs, we are seeing a trickle-up effect. We have high-achieving underrepresented minority students that are setting a high standard. They are changing the perceptions of white students and faculty. They are also changing the perceptions of their minority peers who are not in the program. That is one of the reasons why we are now seeing much larger numbers now, of minority students that are not part of this program graduating with degrees, in this case, in biochemistry.

Since 1993, we have graduated 234 students. We have over 200 students currently enrolled. Ninety-one students out of the total graduates are enrolled in Ph.D. programs, and 22 are in M.D./Ph.D. programs. So almost 60 percent of students out of this undergraduate program are now in Ph.D. programs.

As part of the undergraduate program, my involvement has been limited. I take large numbers of these students into my lab and they get involved in research. The students begin full-time research in the summer. They have to commit to one year so that their research experience is extensive. That is how most of them can end up publishing papers. That is why graduate students and postdocs are willing to work with these students; they know that the students are going to be there for more than just a few weeks in the summer, and they know that the students are going to make a substantial contribution.

We started a graduate program in 1996 with a Minority Biomedical Research Support and IMSD grant through the NIH. A faculty member who is no longer at UMBC, Catherine Fenselau, began this program. In 1998 she moved to the University of Maryland at College Park and I took over the program. The graduate program is modeled after the Meyerhoff undergraduate program in order to boost our minority graduate output. These are the key elements. We have an extensive outreach program. Not only do we give the usual talks at universities, but we also have an undergraduate summer training program. We bring in up to 15 undergraduates for the summer from all over the country. This year we have had more than 70 applications for 15 slots. Last year, we had not quite 60 applications. Of those that came, the average GPA of the students that came over the summer was 3.8.

We are getting very talented students who are interested in summer undergraduate research at UMBC. I would like to point out that 10-20 percent of the students that come as part of our summer

program end up coming to us for graduate school. As an outreach tool and a potential recruiting tool, this summer program has been very effective.

We also have a Graduate Summer Bridge program. The graduate students who are accepted to the program come the summer before the academic year and participate in a research rotation and take a course in technical writing. The content of the technical writing course, in and of itself, is not the most important thing. These students, who span five different disciplines—engineering, psychology, chemistry, biochemistry, and biology—work together in this class on group projects and presentations and form a tight bond with each other. This is very helpful for providing peer support throughout the year when they are back in their own academic departments and generally are more isolated from their minority peers.

During the academic year, monthly meetings are held where the students give seminars about their research and learn how to give a good seminar. Their peers are responsible for critiquing them on both the science and their presentation skills. This is important to build their confidence for research presentations at national meetings for which we provide support.

Of significance for this program is that all of these things happen because the students want them to happen. When Dr. Hrabowski asked me to take over because Catherine Fenselau left, I was a bit nervous. In fact, I met with the students. There was a small number of students, only six at the time. I said, "Look, I am a white guy who was raised in the south. I haven't really been doing this kind of thing. You need to tell me what it is going to take to develop a good graduate program."

Collectively we came up with these items. Each year we reevaluate and modify the program to make it more effective. It has had a very positive effect. One of the things that the students wanted to do, and it has worked out great, was provide support to bring research faculty to UMBC from other universities to give scientific presentations. The student will pick out a faculty member from somewhere around the country that will be important for their career, possibly to complete a postdoc with them. We try to bring underrepresented minority faculty, but this is not mandatory. The faculty member will come to campus and give the department seminar. Now we have got a prominent minority faculty member going around to meet UMBC faculty in half-hour intervals. Remember, we are a white institution. This has had a big positive effect.

Isiah Warner came once and gave the talk. I was surprised because, even at UMBC with a black president and all the changes that have been taking place, after his talk I heard a white student say, "Wow, I didn't realize that African American scientists were doing those sorts of things." It was surprising. It also brought home the point that, in addition to educating the students in the program, you need to educate the nonminority faculty and students.

For the first three years of our graduate program, we struggled having only two, three, and three applications for 1996, 1997, and 1998, respectively. During those years we gave back several hundred thousand dollars to the NIH that was unspent. In 1999, after the development of a website and a full-time program coordinator, the applications went up to 27 for four available positions. As of right now we have 42 applications to our program for ten available slots. These are qualified applicants. We now have to look for ways to support more of these interested students, if not all of them.

For the Summer Biomedical Training Program, we have over 70 applications for our summer program. In addition to filtering through our graduate applications, we are also filtering through the undergraduate applications just for the summer. We have had 38 participants from 12 universities so far in the program, just over the past four years.

Seventy-nine percent of the undergraduates that have come through our summer training program have gone on to graduate or enroll in professional schools. Of the participants, 20 percent have applied to UMBC with 14 percent attending UMBC for graduate school. As an outreach program, it is working very well.

The total enrollment by department over the years has grown tremendously. We have 42 applications for this fall. We are expecting to have more than 30 minority graduate students in our program this fall.

For retention, pre-IMSD and post-IMSD, we had five total minority students in our four graduate programs before the IMSD program. Of those five, two minority students graduated with Ph.D.s from UMBC in the biomedical sciences.

To date, the graduate program has had 27 students enrolled and 21 retained. That is a retention rate of just under 80 percent. That retention rate is the same as the average retention rate in general for the participating departments. We would be happier if we were retaining all of our students, but it is just not going to happen. Some of the students do struggle. I should point out, however, that of these students who left, two of them left in good standing. One of them had a 4.0 GPA and a 2000 GRE score, but he left for family and personal reasons. Another student had just passed her qualifying exams and also had high grades. The numbers that are dropping for lack of performance are actually much less than 20 percent.

Figure 5.4 compares the number of underrepresented minority graduate students that were in the department before the IMSD graduate program and after the graduate program.

In biology there were zero underrepresented minority students. Now we have five, with four of our new applicants interested in biology. In chemistry, we had one. We now have ten minority graduate students. Psychology has always done better. They had eight. We now have 15. Engineering had zero minority graduate students. We now have three.

We have a retreat every summer where we get together as a group after all the incoming students have had a chance to take their class and commiserate and do their research rotation. We all get together. We go out to a place in Pennsylvania and we have seminars and we go rafting.

To summarize, it is now clear that large numbers of talented, high-achieving, and motivated underrepresented minority students are now available in high schools who have interests in the SEM fields. Although large numbers enter college with SEM interests, few are retained in the sciences. The Meyerhoff undergraduate program is a replicable program that could have a substantial national effect if reproduced and implemented more broadly. Minority participation at the graduate level can also be

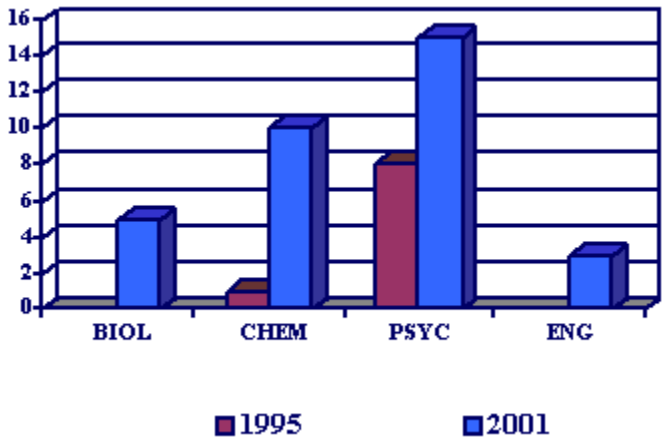


FIGURE 5.4 Growth in numbers of underrepresented minority graduate students from 1995 to 2001.

increased by increasing outreach efforts, mainly with minority-serving colleges, and by modernizing application and evaluation practices that generally lead to the disqualification of talented minority applicants.

## DISCUSSION

**John M. Schwab, National Institutes of Health:** What is your response to those who would rather cynically claim that the only reason this program works is because of Dr. Hrabowski?

**Michael F. Summers:** I would say that the only reason it started is because of Dr. Hrabowski. In my opinion, federal agencies should find people who are going to make a difference and support them, and support them big if they can. I think supporting programs where there can be a catalytic effect by a dynamic and energetic leader has the potential to produce a substantially larger effect compared with simply supporting a program with three students a year. I strongly believe that supporting people like Dr. Hrabowski will have, and is having, a much bigger bang for the buck.

**Isiah M. Warner, Louisiana State University:** Ten years from now, we will know whether it is strictly because of Dr. Hrabowski. We are seeking funding right now to start a Meyerhoff-like program at LSU. If we are successful, it will show that it can be replicated and it is not just Dr. Hrabowski. I am confident that it is not just him. Dr. Hrabowski, however, has set into place some factors, such as a change in attitude, that will go on whether he is there or not.

I just heard something recently, and it is astounding to me if it is true. UMBC is 60 percent white, 15 percent African American, 15 percent Asian, and 10 percent others. I heard that in the entering freshman class, the students with the highest SATs and the highest GPAs were the African Americans.

**Michael F. Summers:** That is right.

**Isiah M. Warner:** That is incredible for this to occur at a majority campus. You have transformed a majority school into an environment where all students can learn. That is incredible.

**Michael F. Summers:** I should also point out that we are using your graduate program as our model as well. So, it works both ways. We are using the best programs in the nation as models.

**C. Reynold Verret, Clark Atlanta University:** Are your students preselected to receive the tuition and scholarships available, or is that done after the fact?

In some programs it seems like the financial inducements tend to cause students to select to become science majors and it seems that others have already selected themselves as science or engineering-oriented students. How do you make that distinction in your program?

**Michael F. Summers:** We do say up front that we are specifically supporting science, people who are interested in SEM and people who are interested in pursuing a Ph.D. They may be interested in the M.D./Ph.D. or they may be interested in medicine, but they are willing to give serious thought to a Ph.D.

**C. Reynold Verrett:** How do you select them? Are they nominated?

**Michael F. Summers:** We have partnerships with all the high schools that have a good record. We send nomination forms to the teachers that we have good relationships with. These teachers write down students' names and send them to us. Then we have a staff that goes after those kids and their families to say, "Hey, apply to our program." We also pay money to testing programs to find out who is doing well on exams. We do anything you can imagine to find these smart kids and expose them to our program.

In two weeks, I am going to be giving a talk to juniors in high school and their parents. These are the kids that Dr. Hrabowski and the staff have identified already at the high school sophomore year, and we invite them to campus to expose them to our program. We tell the students and their parents that they do not have to wait until they have their postdoc and start at a faculty postion before they make a serious contribution in science. They can do it as an undergraduate. I give them examples of students that have done that.

We start early going after these students. A lot of them are interested in medicine, and a lot of them get converted along the way.

**Michael P. Doyle, Research Corporation:** You have got a wonderful program. I think it is a model for the nation.

The question that needs to be addressed in part, I think, is the cost. It is not just financial cost. You have already stated that it takes $12,000 for the Bridge Program, $14,000 in tuition alone during the academic year. What are the added costs that have been put into place that were not there before the Meyerhoff Program existed, and what costs in terms of faculty time and administrative efforts are put in? How much of an incremental cost is this to make something really work right?

**Michael F. Summers:** I do not have those figures. There probably are extra costs, but I doubt they amount to a whole lot more on a per student basis.

In terms of the commitment of the faculty, I am finding myself spending more and more time at these kinds of meetings. If a faculty member does not know it up front, he or she learns quickly that if you take one of these undergraduates over the summer and spend some time with them, there is a good chance that they are going to come back and work in your lab. The faculty buy in very quickly.

I will tell you another interesting fact. Every year I have to go to Howard Hughes Medical Institute for a meeting. We have science meetings in Chevy Chase and I have to present my work. At the end of every talk, I show pictures of these students to the group, and these Hughes scientists ask me: "How can I get those kids in my lab?" They would love to have the pipeline that I have.

I am in a phenomenal situation. I can sit at my desk and have 4.0 GPA minority students walking into my office, stating, "I want to do research." The recruiting efforts and the Summer Bridge program are set up and run by the administration. These programs ensure that the students are successful during their freshman year. Then I get them and help develop their interest in research.

I am convinced that if any college or university administration does a good job of outreach, getting these kids to campus, supporting them, and making sure that they stay in science in their first semester, the faculty will respond positively and they will have a modeled UMBC. There is no reason we would be any different from most other places.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** I want to get back to Dr. Hrabowski for a second and take a slightly different tack on this, suggest something slightly different.

The program did require Dr. Hrabowski and it continues to require the characteristic that he brought, which you clearly evidence here: a passion and a commitment. But sustaining this program, the direct

and indirect costs of which are expensive, has to reflect the priority that an institution sets. That means that, if you are going to make that investment there, you will not invest in something else, like big-time athletics, although you do pretty good at big-time athletics.

**Michael F. Summers:** Not us. No, we are the other campus.

**Robert L. Lichter:** Small-time athletics then. The point is that this program is an institutional priority. Individuals set priorities and, hence, Dr. Hrabowski had to come in and set them. He had to convey to the faculty and students the importance of this program. That is the personal engagement that is required, embracing of the importance of this issue.

I have the privilege of serving on the advisory committee to the Meyerhoff Program. And if anyone is ever in doubt about the value and the accomplishments of this program, just go and talk to those students. They will blow you away. If they are the future, the future is in really good hands.

**Michael F. Summers:** This program is working in Maryland, and there must be a large population of really bright kids all over this country that start out interested in science and math. There are places that are doing similar things. In fact, we have learned from other places. If more places were doing what Dr. Hrabowski has done, it would make a big difference. To answer your point about Dr. Hrabowski, there was only one Hank Aaron. When Hank Aaron retires, somebody else is there that can not wait to step up in the cleanup position, and there are a lot of people at UMBC who want to do that.

Now, nobody is going to replace Dr. Hrabowski when he decides to leave, but there are a lot of people that have already bought into what we are doing. Whether they stay at UMBC or whether they go someplace else, it is now in their blood.

**Iona Black, Yale University:** We have a program at Yale called the Stars Program that we have been operating for six years. We operate on a much smaller scale, but we are now tracking students just as you have. I think that our results are going to be just as grand as yours. We have smaller numbers, which is approximately 20 selected during the academic year and an additional number (20-25) selected during the summer. Our cost is $10,000 for the whole academic year. So, it can proceed on a different type of scale.

Our first graduates are now third-year graduate students and medical students. Most are M.D./Ph.D. or M.D. joint degree, and there is an increasing number of Ph.D.s in science programs. I think it is nice to know that I am following in the right path, and I am now using your program as the example for the graduate program. Hopefully, that will work. So, I just want to say thank you.

**Michael F. Summers:** Thank you. I should tell you that Tom Steitz at Yale told me two years ago that Yale made more offers for their biophysics graduate programs to students from UMBC than from any other place. These were all Meyerhoff students. Yale is clearly interested.

**Isai T. Urasa, Hampton University:** What happens to those students who are not accepted into the Meyerhoff Program? Do they still matriculate at UMBC or do they seek opportunities elsewhere?

**Michael F. Summers:** I do not have any data on that.

**Isai T. Urasa:** I see an opportunity here for networking for programs similar to the one at UMBC.

Hampton University has had a program for the past 15 years that has been funded by the Office of

Naval Research. It has the same characteristics as your program, and I think the point here is that there are possibilities of networking to maximize our efforts in recruiting for these programs.

**Michael F. Summers:** I agree.

**Billy Joe Evans, University of Michigan:** I am a bit concerned about some of what I have been able to digest, and maybe I am not digesting it.

I understand some of the Meyerhoff undergraduate program. It is quite clear that well-prepared, high-achieving, African American students go to college and something happens. The expectation that they will succeed is frequently not borne out. I think for the Meyerhoff Program to have that kind of success is certainly unique. However, I do not quite understand the graduate program. I am not aware that the attrition rate for African Americans, for example, at graduate schools is exceptionally high or different from what we would have projected.

My question is, what particular issue were you addressing with the graduate program?

The other question I have concerns the situation in our public school system—where the great majority, I believe, of African Americans are found. How many 3.9ers or 3.8ers are there yet to be identified, if one is going to replicate this program elsewhere? I would argue that we may have already reached saturation.

**Michael F. Summers:** Maybe in Maryland, but I doubt in Detroit.

**Clifton A. Poodry, National Institutes of Health:** The attrition rate among minorities is twice the rate as among nonminorities in graduate school.

**Michael F. Summers:** Right, in graduate school. We do not have that problem.

**Billy Joe Evans:** We need to think specifically about the chemical side of graduate schools. I am concerned about chemistry, and a high attrition rate for minorities is not my experience. My 31 years experience at Michigan is that the attrition rate for minority students is about the same as for majority students.

**Michael F. Summers:** My concern was that we had no minority students in three of our departments. That was five years ago. Now we have faculty that are mentoring students.

The problems, I think, at the graduate level are much, much different, in my opinion, than at the undergraduate level. At the graduate level, you do have a smaller pool. The small pool of minority students who are interested in graduate school and who are well prepared tend to get offers to go to graduate schools at Johns Hopkins, Harvard, Duke, and all the top places. We have a difficult time recruiting top minority graduate students. So, we have to try to build an environment that makes it more attractive to them.

The other big hurdle that we had to overcome is that we had to get faculty to stop being lazy, to sit down at one committee meeting and just look at GRE scores and say, well, we are going to populate our department with students from India, China, or other places. This is one of the big things we have taken from your program, to take care of business at home. We find that there are lots of diamonds in the rough.

I actually was educated in a junior college and small places. I am one of these slow growers. So, there are people that will be ready for college later and ready for graduate school later that will be overlooked by the Ivy League. Those are the ones that we are trying to find. So, we have different issues

at the graduate level. Dr. Hrabowski does not like to hear this, because he wants all the students to have high scores.

We have to get faculty to look at other criteria, and to support the students in every way possible. If we support students to the best of our ability and they still do not qualify, then we will have to let them go.

**William M. Jackson, University of California, Davis:** I think the Meyerhoff program is outstanding. I agree with you; Dr. Hrabowski started it. I also agree, from my own experience of being there, that very enthusiastic faculty populate it. I think one of the key issues here is having a good staff, and that is one of the expensive items in having such a program.

I have managed an undergraduate program with NSF help. We pay for a lot of the staff out of the university's money. In fact, the program is continuing with the assistance of the university's money. The amount of money that is spent on the student, not counting tuition but just to pay the students for the summer, is about $6,000 per year. You do need a lot of money.

You need to do all these things in addition to other things that are sometimes ingrained in the university setting like student services. What you have to do, and what I think Dr. Hrabowski did, was to integrate the faculty with those student services. We have very separated faculty and student services in our universities. The faculty are often interested in working with the students, but they do not get to talk to the people in the student services. So, they go off on their own. The kind of program in which you integrate student services and faculty is the kind that can make a difference.

I am not sure that there are many African American students that you could pull from a pool like you have talked about. I know in California there are not many African Americans in the pool of graduating seniors. I think we did a count, and there are roughly only about 2,000 African American students who graduate from high schools every year in California. You are much better off in Maryland because of the population distribution.

Certainly, the kind of thing that is done to keep African American students in science at UMBC is the kind of thing that we should be doing for all students in science. We need students in science. That is why we have to get exceptions to the immigration policy. I am not against bringing foreign students over here. My career would not have been what it was if I had not had foreign postdocs and graduate students. But we should not have to go to that extreme. We are only going to that extreme because we are not doing the kind of thing that we are talking about here.

That is an indictment on chemistry. I am talking about chemistry now. Chemistry gets more students in that first general chemistry course than any other discipline. We get them before the biologists do. We should be converting a lot of those students into chemistry. That is the issue, if you really want to look at it, not just minority students, but white students, women students, all kinds of students.

**Michael F. Summers:** I agree with every point you said.

**E. Kent Barefield, Georgia Institute of Technology:** There are a lot of African American students who graduate from Georgia Tech. Most are engineers; I am sorry to say there are not as many in the sciences. The program is much like the one that you described, except that the students do not have scholarships. They are paying their own way. There is a group of people that are very dedicated to seeing that these students have an environment that is nurturing when they are starting out, and they maintain that.

It has all the elements that you suggest, and maybe you got some of those from us. The students do have the option to come in the summer, and they track those that do and those that do not. However, the students that come in the summer and take advantage of what we call the Challenge Program will do

better academically. This propagates through the institution. Although we do not have as many minority undergraduate chemistry majors, we are doing quite well at the Ph.D. level.

This year we graduated five minority students, which is not a large number, but it is 20 percent of our output. I think all of them, or all but one, are African American. There is a culture that gets built within the institution. I have to say one more thing, because Dr. Gillyard speared us a little bit this morning (Chapter 3). The numbers of students that we put out at the end are much greater than what we take in as freshman—actually, because of transfer students and those in 3/2 programs—and they contribute enormously to the success of the institution in training African American students in particular. So, that is very important. We do a lot to bring them in as first-time students as well.

**James D. Burke, Rohm and Haas:** I will be brief. Excellent talk. I think the Meyerhoff Program is something that should be exported to every major metropolitan area, because your program *works*. I think it is not just because you have a charismatic leader like Freeman Hrabowski. More important, your faculty seems to have taken it on as a mission. I think that is more important than having a very public leader—not that you do not want both. It is the faculty who see the students day after day and who influence them day by day. If the faculty wants the Meyerhoff Program to succeed, it will; and if the faculty do not want it to succeed, it will not.

Another point: Obviously there are costs associated with a Meyerhoff Program or any other kind of program. However, when you compare the differential unit cost between providing academic excellence for the students and merely supporting academic mediocrity or failure, it is only an incremental difference. Further, when you compare the unit costs of supporting a Meyerhoff student with the social costs of supporting a failed human being, fully integrated over a lifetime, there is no comparison.

Education is the great equalizer in this country. We need to make this quality of education more widely available: first, where it is most needed, and then use that model to upgrade all education, just as Professor Jackson said. We should not by default have to go outside the current educational model to ensure educational excellence for minorities. It is good to be able to go outside if we choose to do so, but not because we have to.

**Michael F. Summers:** I do not think that the Meyerhoff model is the model that would necessarily fit everywhere. There are other innovative models that would work better in other locations. However, I certainly think the Meyerhoff model could be put in many places, and it could have a big effect.

**James D. Burke:** I agree with you. I was not referring to cloning the Meyerhoff Program. It is an exemplar that people can tailor to suit their needs. It is a wonderful program, and I am glad you shared this with us.

# 6

# The Imperative for Leaders and Organizations[1]

Steven F. Watkins
*Louisiana State University*

Despite the title, I do not intend to offer any imperatives; what I will do is describe the development of our chemistry graduate program at Louisiana State University at Baton Rouge (LSUBR) over the past 10 or 12 years and offer it as an example for other graduate programs. I hope this will lead to some discussion afterwards.

In December 2001 an article appeared in *Chemical & Engineering News* (Figure 6.1) that described our program in detail; that article was based on a talk I gave a little over a year ago to the Chemical Sciences Roundtable. I would like to acknowledge my colleagues in the effort to improve minority participation in the chemistry department. Dr. Sibrina Collins was instrumental in getting the article published and for filling in some historical research. She is now at the American Association for the Advancement of Science and a strong advocate for the Minority Scientists Network. Dr. George Stanley is chairman of the LSUBR chemistry department recruiting committee. Dr. Isiah Warner is of course a key factor in the growth of minority participation in our graduate program. I was privileged to be director of graduate studies during the 1990s, when the program grew and developed into the nation's leading producer of African American Ph.D. chemists.

First, I would like to put the program in a historical context; I will then mention events that happened exclusively at LSUBR and in the LSUBR chemistry department. Finally, I will discuss a few of the success factors, some of which are unique, but some of which may be portable to other programs.

My story starts with the famous case of *Plessy v. Ferguson*. At the close of the 19th century, Homer Plessy sued the East Louisiana Railroad for requiring separate, but purportedly equal, facilities for blacks and whites. Plessy argued that this requirement violated the 14th Amendment by abridging "the privileges or immunities of citizens of the United States." John Ferguson, a Louisiana district judge, ruled against Plessy, and the U.S. Supreme Court eventually upheld Ferguson. Justice Harlan, in his lone dissenting opinion, said that "separate but equal" did indeed undermine the 14th Amendment and would

[1]This contribution is based on an earlier publication: S.N. Collins, G.G. Stanley, I.M. Warner, and S.F. Watkins, *Chemical & Engineering News,* 79(50):2001.


Chemical & Engineering News
December 10, 2001, Volume 79, Number 50, pp. 39-42

FIGURE 6.1 What is Louisiana State doing right?
SOURCE: *Chemical & Engineering News,* December 10, 2001, *79*(50):39-42.

actually delay full implementation of it. How right he was! The entire 20th century saw the struggle to overcome separate, but by no means equal, accommodations in education, housing, and the workplace, a struggle that continues to this day

A consequence of this doctrine, at least in the deep South, was the growth and development of historically black colleges and universities (HBCUs), many located near LSUBR in Louisiana, Texas, and Mississippi (see Figure 6.2). In Louisiana during the 20th century, most of the resources have gone to majority institutions such as LSUBR. More funds are now being allocated to HBCUs, but an equitable distribution of state and federal funds still has a long way to go. Nevertheless, these schools have done an incredible job of educating young black students with minimal resources.

Even after Thurgood Marshall argued successfully for integration in *Brown v. Board of Education*, blacks still were not welcomed, nor did they feel comfortable in majority white institutions. Certainly very few blacks came to LSU during the 1960s, 1970s, and 1980s.

Even now the black population at LSUBR is very much out of proportion to the general population. The United States is approximately one-eighth African American. In Louisiana, that proportion is one-third. In East Baton Rouge Parish, where LSU resides, African Americans comprise nearly one-half of the population. With minority students representing only 26 percent of the student population at LSU as in Figure 6.3, the term "underrepresented" certainly applies.

Figure 6.4 shows the small number of African American chemistry Ph.D.s produced in the United States since 1991. We at LSUBR believe we have contributed to the spikes in minority graduates at the end of the decade; in any case, the trend is definitely upward. The x axis in this figure represents the

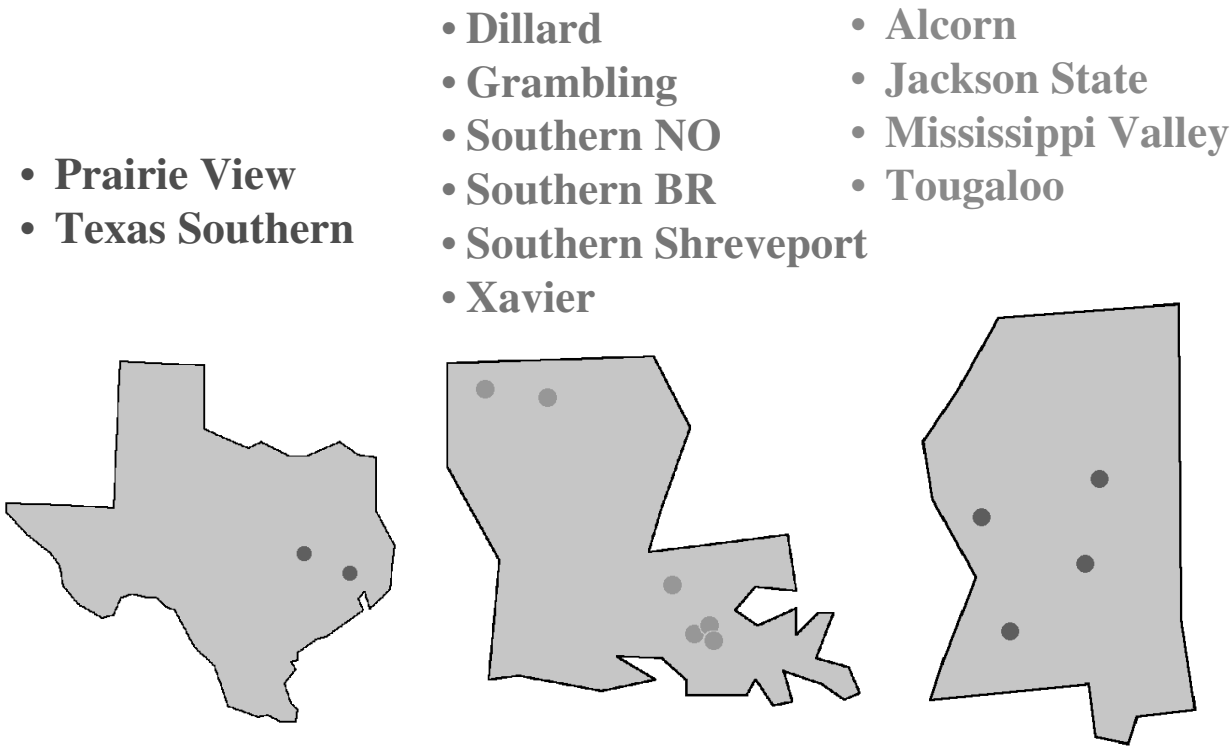


FIGURE 6.2 Historically black colleges and universities.

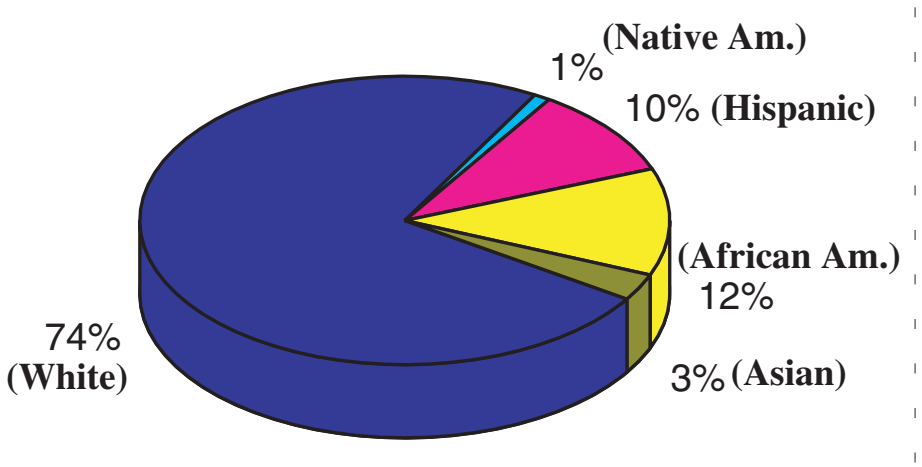


FIGURE 6.3 U.S. population.

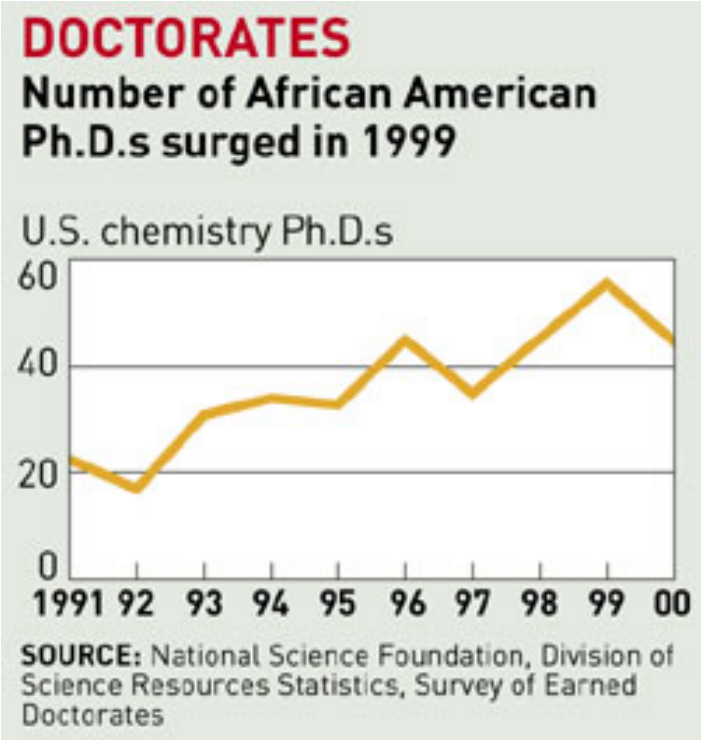


FIGURE 6.4 African American chemists in the United States.

number of African American Ph.D.s graduating each year. This number is far better than it was 100 years ago. In fact, up to 30 years ago, it was traveling along in the binary mode, shown in ones and zeros. The number of graduates has certainly improved, but I think the message here is that we need to do more.

LSUBR is deep in the South and is an unlikely venue for our program as it has developed. For example, one of the first presidents of LSU was William Tecumseh Sherman, who resigned his post to join the Union Army and eventually wreck havoc on the South. To this day, Sherman's name is not much in evidence on campus; William Tecumseh Sherman Memorial Hall is still far down on the list of buildings to be built. It is also ironic that both Isiah Warner, Vice Chancellor for Strategic Initiatives, and Greg Vincent, Vice Chancellor for Diversity, occupy offices in buildings named after Confederate generals.

It is not that LSUBR has been dragged kicking and screaming into affirmative action, because there have been a number of voluntary initiatives, but there have also been some definite actions taken by the courts. Some of these integration lawsuits are still in place and are monitored to date. Thus, many campuswide programs have developed in response to these actions.

Figure 6.5 shows some of the developments on the LSU campus that began to occur in the 1990s. One of the first was a joint program with Southern University, an HBCU, called the Cooperative Assistantship Program (CAP). This was strongly championed by Dan Fogel, then assistant dean of the

- CAP 1991
  - Cooperative Assistantships for HBCU students
- Huel Perkins 1994
  - Fellowships for African American Doctoral Students
- External (McNair, GEM, NSF, NIH)
- Minority Infrastructure in the 90's -
  - OMA, AACC, BFSC, many student organizations
  - Intercampus initiatives
  - Vice Chancellor for Diversity

FIGURE 6.5 Louisiana State University milestones.

graduate school and now provost. CAP was an assistantship program for black graduate students, primarily from Southern University, but it was expanded through the years to include students from a number of other HBCUs. The Huel Perkins Fellowship program was also the result of a desegregation lawsuit. Additional external funding is in place: McNair Scholars Program; National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.; National Science Foundation; and National Institutes of Health, which have helped all graduate programs on campus significantly.

One of the great things that has happened at LSU in the past 10 or 12 years is the empowerment of minority students, faculty, and staff. The vice chancellor for diversity reports directly to the chancellor and the provost, the Office of Minority Affairs is an active and ongoing operation, the African American Culture Center is an active part of campus life, and the Black Faculty and Staff Caucus interfaces with and supports all of the student organizations.

Empowerment means that the students are able to network. One of the problems discussed earlier today in our breakout session was that black students, coming into some chemistry departments, did not know where to get old exams to study from. At LSUBR, both undergraduate and graduate organizations such as the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers and the Black Graduate Students Council provide a focus for information and activities.

There are also many intercampus initiatives with Southern University. There is cross registration between campuses, and a number of LSU students register for classes at Southern in addition to Southern students taking classes at LSU.

The overall program at LSUBR is a fairly massive educational enterprise. In 2000, approximately

3,000 bachelor's degrees and 1,000 master's degrees were awarded, along with several hundred Ph.D. degrees in more than 50 fields as shown in Figure 6.6. In contrast, Figure 6.7 shows the degrees awarded to African Americans: In 2000, approximately 250 bachelor's degrees and 50 master's degrees were earned. During most of the 1990s, the yearly Ph.D. degrees earned by African Americans could be counted on one hand. Clearly these numbers do not reflect the population of the United States, much less Louisiana. In fact, these numbers show that only 7 percent of each kind of degree awarded by LSU was earned by African Americans (see Figure 6.8). Note that LSUBR is the flagship university in a state that is 30 percent African American!

The chemistry department at LSUBR has changed during the 1990s, and to set the stage, I would like to put the program in perspective. First, notice that the total student population has been steadily climbing, shown in Figure 6.9 by the uppermost line. In 2000, the genders reached parity. Chemistry is no longer a male-dominated profession at LSU.

Figure 6.10 presents the yearly enrollment by nationality. In 1990 when I became director of graduate studies, the majority of our chemistry student body was composed of international students, and the largest international group was Asian. There is a huge pool of excellent Asian (predominantly Chinese) students that send hundreds of unsolicited applications to our program each year. However, at LSU, since 1990, we have made a concerted effort to recruit domestic students more actively to the program. We recognized that there were excellent students in HBCUs; they were not being recruited, and we needed a way to bring them into our graduate program.

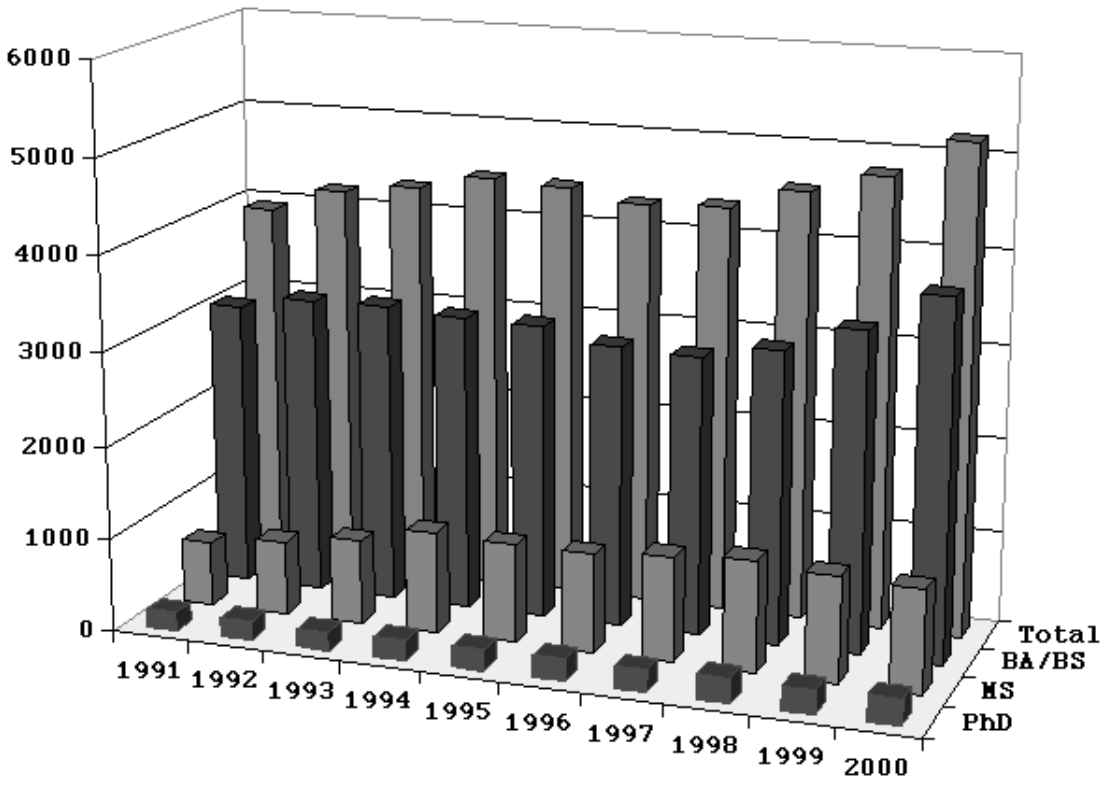


FIGURE 6.6 Total Louisiana State University degrees.

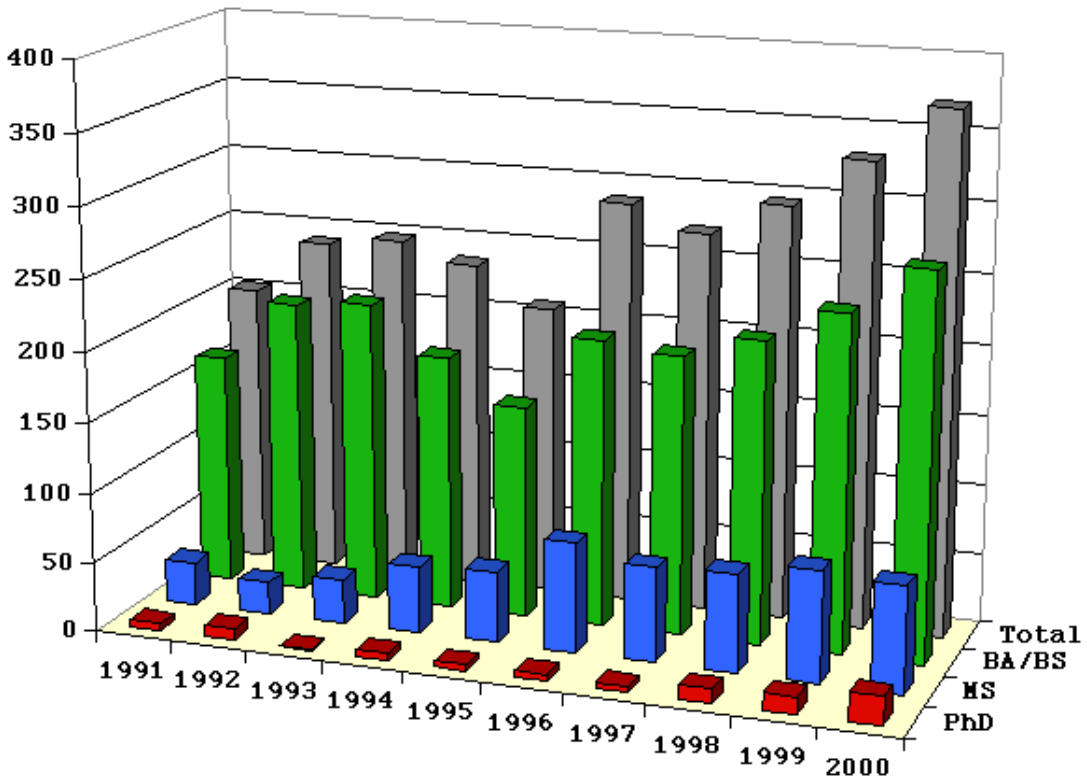


FIGURE 6.7 Louisiana State University African American degrees.

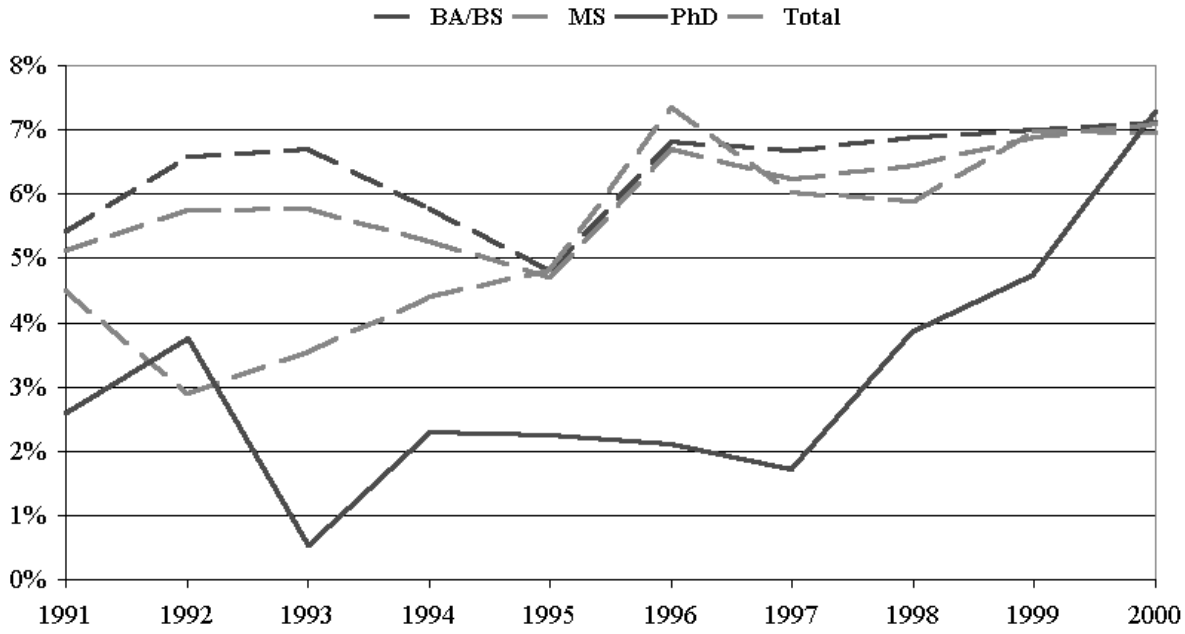


FIGURE 6.8 Louisiana State University African American degrees (as a percentage of total LSU degrees).

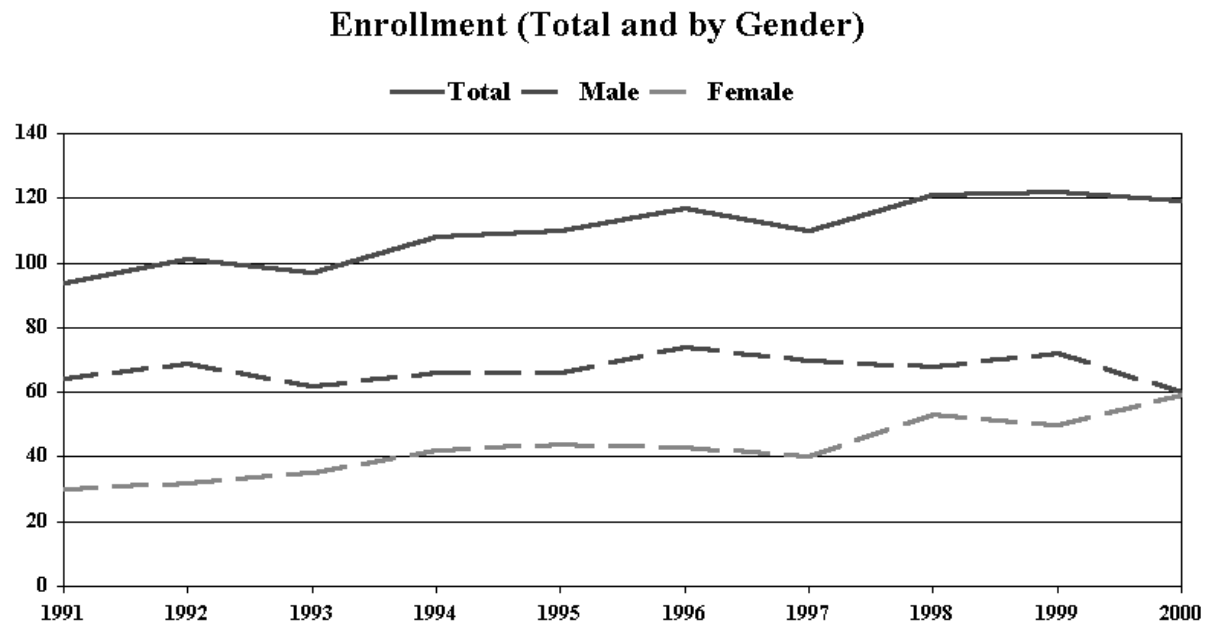


FIGURE 6.9 Student enrollment in chemistry (total and by gender).

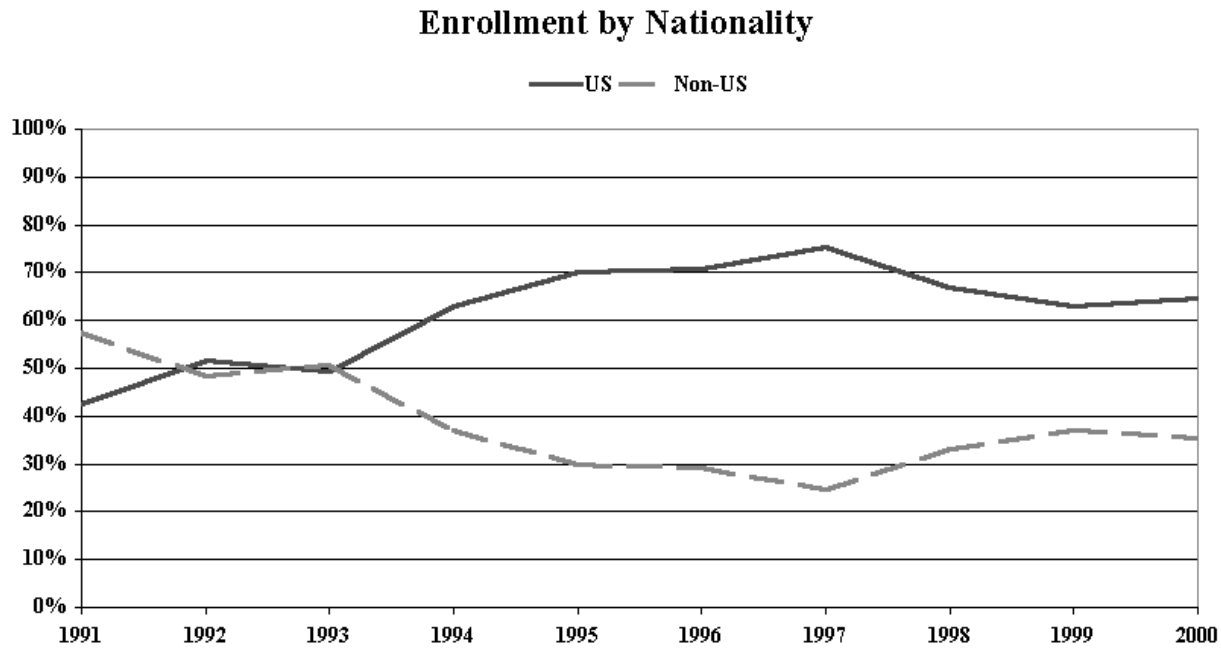


FIGURE 6.10 Student enrollment in chemistry by nationality.

Before 1991, only four African American students had been awarded Ph.D. degrees in chemistry at LSUBR. Richard Evans was the first African American Ph.D. (1971) in the history of the LSUBR chemistry department. He is now retired from Alabama A&M University where he was the chairman of the chemistry department for a number of years. Mildred Smalley (1972) is now vice chancellor for research and strategic initiatives at Southern University. Don Prier and Aris Gallon both joined the local Dow Chemical facility. The excellence of African American Ph.D.s had been proven; LSU simply needed to actually recruit these students for the graduate program.

Figure 6.11 shows the change in the domestic student body during 1990s, starting in 1990 with 90 percent Caucasian Americans, mostly male. Through the years, we have successfully recruited African Americans (see Figure 6.12). At present, the number of African American students in our department has reached between 30 and 40 percent of our domestic student body in the chemistry department.

Although we decreased the number of international students proportionately, we still have a very diverse population. International students now represent only 30 to 40 percent of our student body, but they come from more than 20 countries, making the chemistry department the most culturally diverse department on campus.

Isiah Warner joined the LSUBR chemistry department in 1992 and brought a number of his students with him from Emory. His presence and stature catalyzed a cascade of applications from African American students that has continued to this day. With his influence, one might think that all African American students come to LSU only to work for him, but in fact only four to five African American students are members of his group. All faculty members actively recruit these minority students; they have proven to be of excellent caliber, and they are productive researchers.

By 1995, the population of African Americans in the department had reached its steady state of about 30 students. Many of the students have indicated to me that, when they saw all of the black

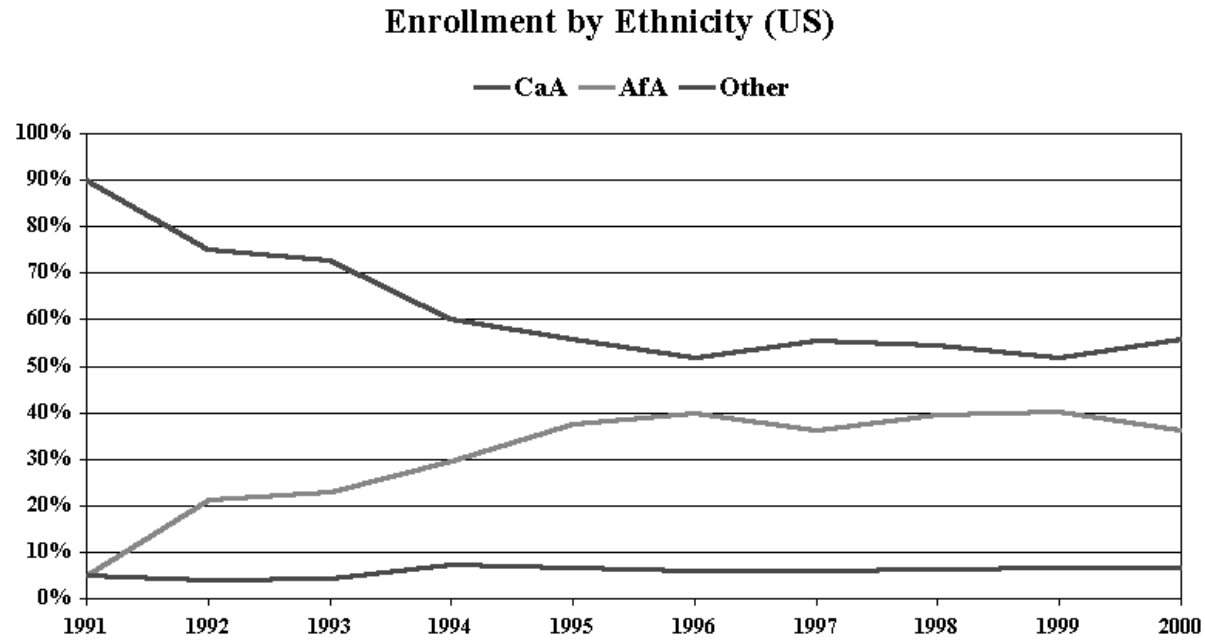


FIGURE 6.11 Domestic student enrollment in chemistry by ethnicity.

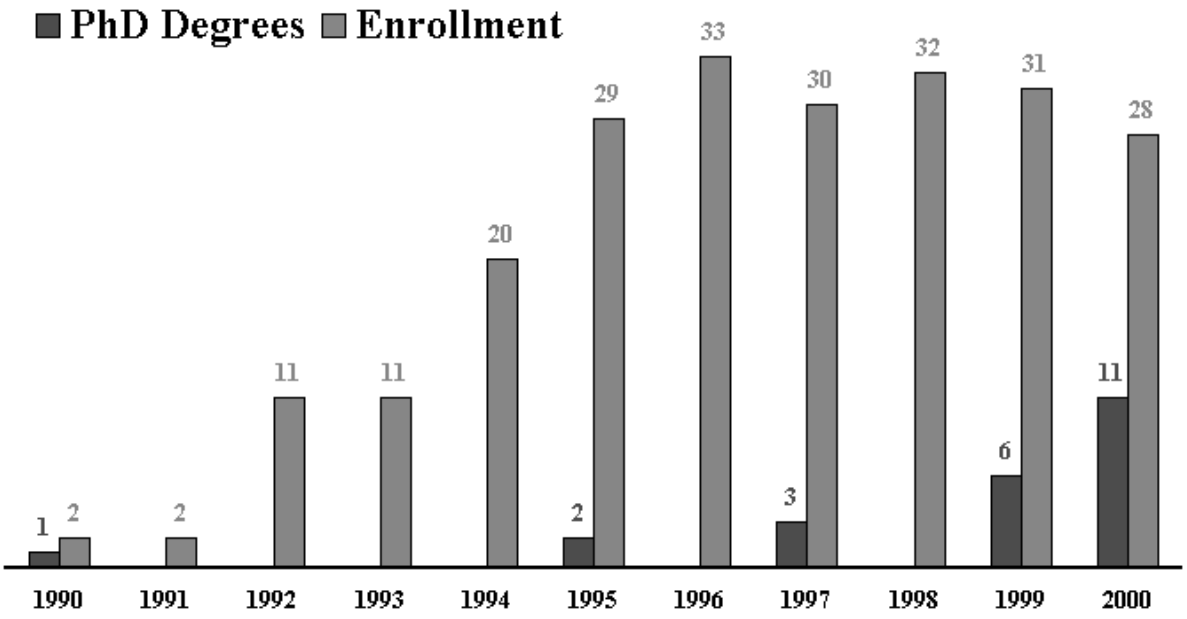


FIGURE 6.12 African American student enrollment in chemistry.

students during their initial visit to the department, they felt very comfortable. Nearly every research group has African Americans in it, and this is an important factor in the success of our program.

From 1992 to 1994, the campus went through an induction to the minority recruiting program. Then, toward the end of the decade the Ph.D. degrees began to be awarded. Now, production of African American Ph.D. degrees continues at about ten per year, and we expect this to continue as long as we can maintain a high enrollment of African Americans in the department.

Figure 6.13 shows a list of the current graduate students and their undergraduate institutions. Schools like Grambling, Xavier, and Southern are well represented and are certainly regional, but in fact HBCUs and majority white institutions from all over the country are represented here. Thus, in terms of wide-area recruiting, the program is certainly successful. There are often measurable successes for the program as well.

One measure of success is retention and degree attainment. African American students may actually perform slightly better than the overall student body, but the statistical universe is still too small to draw definite conclusions: About 60 percent of all students achieve the Ph.D., about 20 percent leave with a master's degree, and the remainder leave the program with no advanced degree for a variety of reasons (see Figure 6.14).

If African American students do achieve at a higher rate than the total student body, there may be an "Avis effect": we are number two, so we try harder. In any event, these students are producing some excellent work across the department in all research groups. In that sense alone, this program is a success.

Certainly the proximity of HBCUs has helped us to build this program. We are in the deep South. There are lots of excellent small schools nearby and the word is out. LSU is a comfortable place for

| | |
|---|---|
| Adams, Andre | Grambling |
| Brown, Courtney | Xavier |
| Burton, Sylvester | Southern |
| Doomes, Edward | Morehouse College |
| Douglas, Angela | Grambling |
| Edwin, Nadia | U. of Virgin Islands |
| Etienne, Marcus | Southern |
| Freeman, Chayla | Southern |
| Galloway, Michelle | Delaware State |
| Hamilton, Kimberly | Southern |
| Holmes, Veronica | U. of Nebraska |
| Johnson, Latisha | Southern |
| Johnson, Rolanda | Southern |
| Kennedy, Tameeka | LSU |
| Erick Lawson | Southern |
| Llopis, Shawn | Xavier |
| Lyman, Lorraine | Texas A&M |
| Narcisse, Damien | Xavier |
| Robinson, Teri | Jackson State |
| Sinville, Rondedrick | Grambling |
| Sparrow, Christopher | Xavier |
| St. Luce, Nadia | U. of Virigin Islands |
| Thomas, Gloria | Southern |
| Verdree, Vera | Columbus State |
| Washington, Sam | U. of Nebraska |
| Williams-Rule Willa | Jackson State |
| Wilson, Zakiya | Mississippi State |

FIGURE 6.13 The African American student body in chemistry (2002).

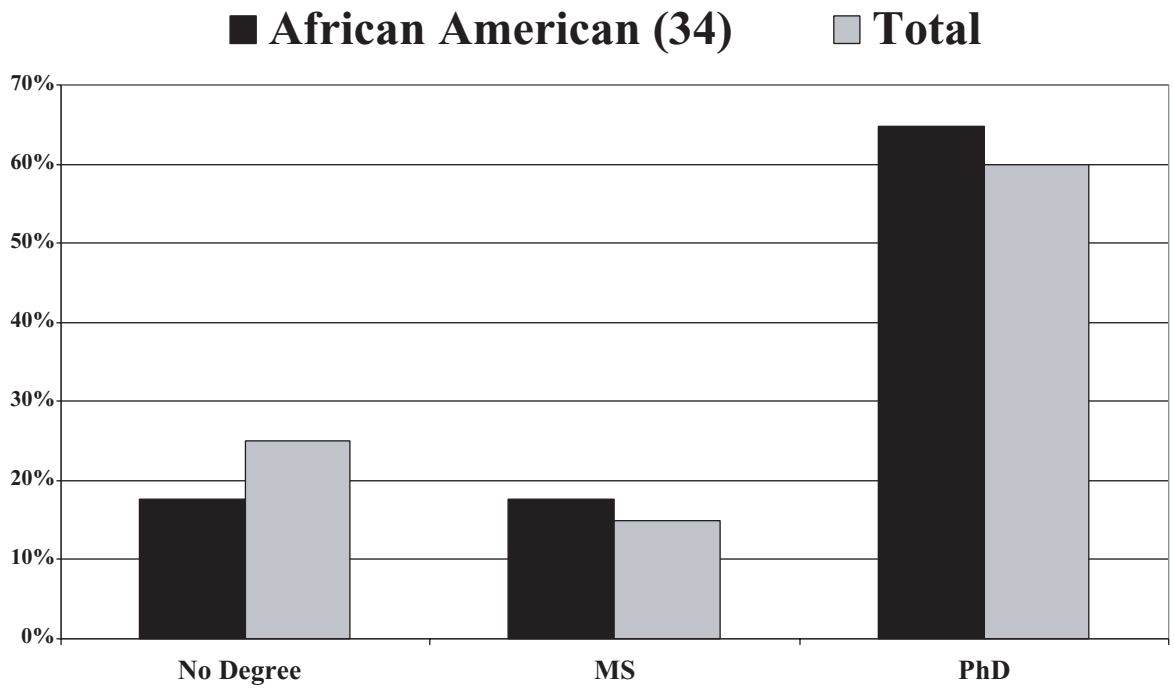


FIGURE 6.14 Success rates for chemistry students.

African Americans to study chemistry. It is easy for us to go out and talk to these schools, and we always invite students to our campus because we think that is an important part of recruitment.

Perhaps the most important factor in our program is the achievement of a critical mass of students who share a common ethnic and cultural heritage. An African American undergraduate who is visiting

a graduate department has to be comfortable; if he or she sees only white faces, then they probably will feel uncomfortable simply because there is nobody around to talk to, who speaks and understands their language, and who shares their background.

In addition, LSU does not put much value in general GRE scores. We have found over the years that the GRE is not a good predictor of success in graduate school, and we have been able to convince the dean of the graduate school that it is not a good indicator, particularly for minority students. As a consequence, the graduate school has given us some flexibility in accepting students with lower GRE scores. A good GPA and good letters of recommendation are better indicators of a student's ability to excel. This is very important to us because we want to know how the student has done, how they have interacted with others academically, and what research experiences they have had.

The LSU chemistry department has lots of built-in support for African American students. We certainly have achieved a critical mass. And the recruiting is almost self-sustaining; the students almost recruit themselves: In fact, we often ask graduate students to accompany faculty on recruiting trips to their alma maters.

Mentoring and support are extremely important (see Figure 6.15). The faculty have to be willing to help those students who may have a little trouble with some of the courses at the start of their careers. If a student wants to do chemistry and if he or she has had some experience and has been nurtured at a good school, the faculty have to be willing to help them along. In short, the sink or swim attitude has proven to be very counterproductive.

We also think it is extremely important to have in place black faculty who will be role models and who will simply make the students feel at ease. Minority students often feel more comfortable, at least


FIGURE 6.15 Factors in recruiting and retention.

initially, talking to a minority faculty member. Later, he or she becomes comfortable talking to all the faculty.

Unfortunately, there are not enough minority faculty members available for all the graduate programs in research universities. That is a serious problem for our country; a faculty that has no African American presence is going to have trouble recruiting and retaining African American graduate students.

For a program like this to be successful, the faculty has to believe in it. This was not the case in the beginning at LSU. There was some resistance to diversification from the faculty and from the majority white students. This resulted in a departmental workshop. Isiah Warner was chairman at the time, and he brought together the faculty and graduate students for a two-day meeting. We are a better department from the workshop process, but nevertheless, it was a painful step to take.

After that workshop, most people believed that diversification was going to lead to success—their success. Indeed, what we found was that the African American graduate students who came in with McNairs, Graduate Education for Minorities, Huel Perkins Minority Fellowships, and Career and Placement Service Fellowships had larger salaries than the majority students. The majority students started to agitate about this, and pretty soon their salaries went up. All of the students were cognizant of this chain of events; the interrelationship between the minority and majority students in our department has been very healthy and has led to higher salaries for all.

Employability almost goes without mention. Other schools, industrial labs, and government agencies are thirsting after minority students. When new students interview for positions in our graduate program, they know there will be a job waiting for them at the end of their long hard struggle. This benefit extends beyond the minority students. Companies like Dow and Proctor & Gamble come looking for minority graduate students; but with the overall pool of available graduate students who interview, majority students are offered jobs too. It is a win–win situation. We now have much more on-campus recruiting, and increased employability is definitely a success factor.

Approximately half of our minority Ph.D. students go into industry. The remainder are evenly divided between academics and government labs. What concerns me is the one-quarter that enter academia. How are we going to change the low number of minority academic positions if we are sending a majority of our students to industry? I am not suggesting that they avoid industry because they do earn better salaries. However, I am suggesting that the professoriate is not being served, and although I offer no solution, it might be worth discussing.

Figure 6.16 shows workplace demographics in 1996, but there probably has been some change in five years. Clearly, the workplace is still majority white, but over time, the small wedges are going to get bigger—we at LSU are working on it, and I know all of you are too.

LSU is doing some things right. We do not have all the answers, but we have, partly by chance but mostly by hard work, developed a diverse and productive chemistry graduate program. We have had many excellent minority students who are productive researchers, but are also active in departmental committees and on the Graduate Student Council. Some are also active in the Baton Rouge community, in such things as K–12 outreach and National Chemistry Week activities. In short, these students have enriched both the department and the university with their presence and will no doubt continue to be highly valued professionals and citizens.

## DISCUSSION

**David Bergbreiter, Texas A&M University**: In your discussion, you mentioned an interview for

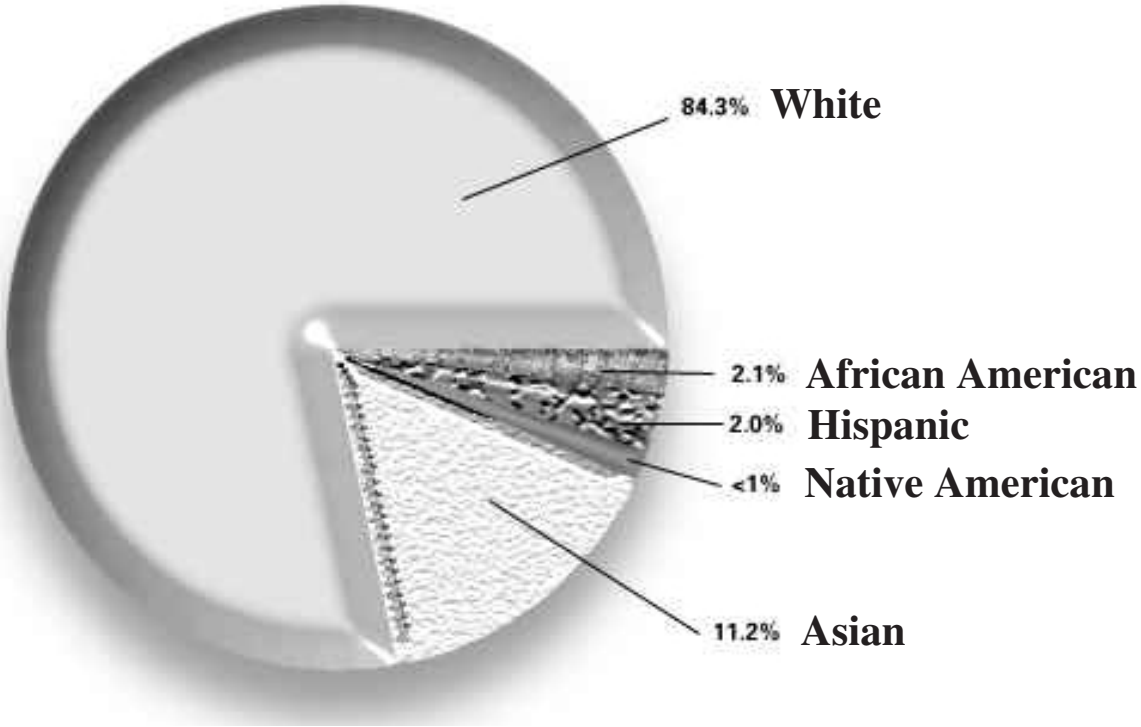


FIGURE 6.16 Workforce demographics in 1996.
SOURCE: *Women, Minorities, and Persons with Disabilities in Science and Engineering*, 1996, NSF 96-311.

graduate students. Where, in the recruitment process, does the interview take place? Is it before or after they have an offer, on campus or off campus? Can you explain that in the context of graduate recruiting?

**Steven F. Watkins:** After the application has been made, we generally ask the students to come in before we give any offer. We do not generally make offers until we see and talk to the students and look at their credentials. We then invite the student to visit for a day, sometimes two, and to meet with each faculty member individually and personally. We do not have group interviews because nobody likes them. Occasionally, if a student's credentials are good and he or she looks great in the interviews, we will produce an offer letter and give it to them in person.

**David Bergbreiter:** This interview process is something that you do only for the African Americans or is it something you do for everybody?

**Steven F. Watkins:** We do this for all domestic students, but it is particularly important for the African American students.

**David Bergbreiter:** You are actually the only place I know of other than Scripps that does this.

**Derrick C. Tabor, National Institutes of Health:** Could you comment on the presence of LSU faculty members at HBCUs, in terms of their seminar presentations, the nature of the interaction with their faculty colleagues, and especially their visits to the HBCUs as opposed to the HBCUs' visits to LSU.

**Steven F. Watkins:** Good question. I am sorry to say that we do not do as well with that as we should. Isiah Warner is a great traveler and promoter.

**Derrick C. Tabor:** The white faculty.

**Steven F. Watkins:** The white faculty do not do as well with that as we should. Back before Isiah Warner showed up, I was traveling around and going to the HBCUs. You would be surprised—maybe you would not—by how much credibility a white man has in an HBCU. It was a good experience, and we did get some students that way. Locally, recruiting is easy. We have good relations and research collaborations with Southern University, Xavier, and with the other HBCUs that are close by, but the white faculty do not project the proper image.

**Kristen M. Kulinowski, OSA/SPIE Congressional Science Fellow:** I have to applaud you on the remarkable success of your program. It speaks to the importance of creating a comfortable environment for minority students.

I know that the subject of women was the topic of last year's chemical roundtable. I was given an article (by another person in the audience) describing last year's Chemical Sciences Roundtable workshop on women in the chemical workforce. It stated that the presence of faculty wives helped to create a comfortable environment for prospective women students.

I believe that just as Isiah Warner's presence catalyzed a comfort level for African Americans, women faculty role models, rather than spouses, should be doing the same for women students.

One of the barriers [to retaining underrepresented groups in academia] may be that the academic environment is not seen as friendly on the faculty level to certain types of people.

Again, referencing the chemical sciences roundtable workshop in 2000, Debra Rolison made that point that the academic community, at the faculty level, is not creating a hospitable environment for certain types of people who may be excellent scientists but who do not fit well within a certain type of academic structure.

Can you comment? Is LSU doing anything at the faculty level to help promote these role models?

**Steven F. Watkins:** Specifically with reference to gender issues, we have been fortunate, just within the past couple of years, in fact, to bring on four women faculty.

**Kristen M. Kulinowski:** Out of how many?

**Steven F. Watkins:** Out of about 30. Before they arrived we did not have any tenure-track women faculty. In fact, one of these women, who was a postdoc at National Institute of Standards and Technology and who, I am sure, worked day and night as a postdoc, mentioned to me one day that her work load had gone way up at LSU because all of the women graduate students wanted to talk to her about their problems. The central idea is that every group has to be comfortable in the academic environment. I do not know how you do it for every group. You identify and try to make provisions for women, for international students, for minority students. The white males can fend for themselves, I suppose.

**Kristen M. Kulinowski:** The question was more about the faculty and how you make the women faculty members feel comfortable and successful so that they can help the students.

**Steven F. Watkins:** Again, I think it is a question of critical mass. If you have one woman in the department, she is going to be very lonely. Two women is good, three is better, and so on. We are fortunate enough to have two African Americans in the department. We have an adjunct, Saundra McGuire, who is also a part of this process. Isiah Warner is the one male faculty member right now, but we need more.

**Clifton A. Poodry, National Institutes of Health:** Your results are very encouraging. You are to be applauded for this effort. Do not take my next question, though, as too much of a criticism, but I would like to probe deeper. Are you, in the greater scheme of things, doing well? We have all sorts of birds in our backyard because my wife puts out suet and bird seed, but this does not make a difference to the birds. They are there for our enjoyment because we have attracted them to our lawn, but if we did not put food out, the birds would be doing just as well. So, you have created an environment, a hospitable place that welcomes the students. Your numbers have gone up. Do you have a sense, do you have a way of knowing, in the greater scheme of things, whether you are doing well?

**Steven F. Watkins:** I do not know how to answer that. I think in a graduate program we are dealing with small numbers of students. We are not dealing with thousands. We are dealing with dozens.

My sense is one success at a time is okay. One productive Ph.D. who goes out and makes a contribution to society is a success. Are we doing well overall? The numbers are impressive, but would these students have gone someplace else to get Ph.D.s? There is no control.

**Isiah M. Warner, Louisiana State University:** I think we have some data. For example, let me tell you about the Victor Vandell story. He is a young man whom I happened to find at Chicago State University. He worked while he was an undergraduate, had about a 2.6 grade point average, went on to do graduate work at RIT—I think he had a 3.1 average in graduate school. I found him at Chicago State as a lecturer. I was sitting there talking to this young man, thinking to myself, this is an incredibly bright young man. So, I talked to the chairman, "Yes, he is very bright," said the chair. He had a poor undergraduate record, but he was working full time while in school full time.

I came back to the LSU faculty and told them about this young man and about his record. They said, "We don't want to see this young man. We have completed all of our recruiting for the year." I told them to just interview him. So, we brought him in and interviewed him. The faculty were so wowed that they made him an offer on the spot. Five years later, he graduated with a Ph.D. He went on to start his own company. He was the greatest ambassador for our department and he was all over the campus. Everyone on campus knew him. He did phenomenally well in our program. There are a lot of schools that would not have taken a chance on him. He is an extreme example; however, there are a number of other examples like that, of students that we took a chance on, and some of them are extraordinary students.

We now have companies beating on our doors. For example, Dow Chemical interviewed a few of our students. Previously, corporate headquarters told Dow Plaquemine, across the river from LSU, not to recruit at LSU because they wanted to recruit at a top ten university. Later, headquarters called and asked, "What is going on at LSU? Why aren't you guys recruiting there?" Dow Plaquemine said, "Because you told us not to recruit there." They said, Well, get on down to LSU and see what is going on there. We just interviewed these phenomenal students.

I will give you another example. I had two students who graduated from my group, both African Americans. A Dupont recruiter said that, regardless of what criteria he would have used—academic skills, gender, race, any criteria—those two students would have finished in the top 5 percent of his recruits. So not only are we taking students that some schools might consider marginal, we are producing a phenomenal product. That is why these companies are beating on our door. It is simply because they see a product that is incredible and suits their needs. They do not know the background. They do not know what we started out with. I think we are doing more than just pushing students through who would not have survived at other places. Although I am certain these are students who would not have made it at MIT or Berkeley, our close interactions with the students make an outstanding final product.

**Iraj B. Nejad, National Science Foundation:** I would like to applaud your effort as well and then ask a short question. If I understood it correctly, you showed a slide that said that about 7 percent of all degrees offered are to African Americans.

**Steven F. Watkins:** That is correct for the overall LSU population.

**Iraj B. Nejad:** That is not representative of the Louisiana population, which is 30 percent African American. My question is, with all the efforts that you have in place—mentors, a committed faculty, a committed department, self-sustained recruiting—what else would it take to bring that percentage up?

**Steven F. Watkins:** All the HBCUs would have to close down. HBCUs are still a good venue and value for many undergraduate students. Undergraduates have alternatives, but graduate students do not; that is why we are succeeding in the graduate arena. The trend is upwards at LSU.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** Isiah Warner's last description reminded me of the comment that was made early in this workshop by Dr. Makinen: The focus has to be on the output, not on the input. If we restrict ourselves to the traditional methods of evaluation that focus on the input, we are not going to get the kinds of results that we are seeing.

Obviously you have challenged the traditional model for recruitment of graduate students and have succeeded in it. Are you doing anything more with the larger questions of graduate education taken broadly, challenging or revisiting traditional models, dealing with the kinds of issues that were brought up at an earlier workshop in this venue and that are going on now in other places in the country? It seems to me that you have a great opportunity.

**Steven F. Watkins:** We are probably not doing as well in that area. We have focused on recruitment and retention in this program, which is fairly traditional. We need to think about that; maybe we need your help.

**Joseph S. Thrasher, University of Alabama:** I, too, would like to commend you for your efforts.

I am curious about a question you raised. I am sure we do not have time to get the answers now, but I would like to hear any ideas on how to improve the professoriate to make more of these students want to pursue the academic career path. Perhaps industry has some interesting ideas.

I would like to close with one observation or comment. I am sure everybody in this room is convinced about the need to recruit minorities in science, but I think we need to do more to get the word out. There are a lot of people out there who obviously are not convinced how acute this underrepresentation problem is.

I can give you a personal example. A couple of years ago I was lead author on a Graduate Assistance in Areas of National Need proposal. I quoted some of the same data you did on an early chart, in terms of African American Ph.D.s per year in chemistry. One of the referees wrote back that these data are surely incorrect and the number of students cannot be that small.

**Jessica Arkin, Ventures in Education:** We received permission to provide you with information about the Ventures Scholars Program. The Ventures Scholars Program identifies high-achieving high school and undergraduate students from traditionally underrerpresented groups and provides them with recognition and information that will increase their chances of entering careers in medicine and the allied health professions, science, engineering, and mathematics. This is accomplished by partnering with a consortium of undergraduate and professional institutions nationwide and providing opportunities for these institutions to recruit, enroll, and prepare targeted students for these professions. We work closely with the College Board to target these students based on preliminary scholastic assessment test scores and GPAs.

Recently, we started working with our undergraduate Ventures Scholars who were seeking to go into graduate programs. If you are interested in obtaining a database of these students, please call us at 1-800-94-SMART, extension 103.

**C. Reynold Verret, Clark Atlanta University:** What is being done to replicate these efforts in the other departments in our schools?

**Isiah M. Warner:** That is part of my charge in my new position. The chancellor and I were talking. He said, if we had sat down and talked ten years ago about being the nation's leading producer of Ph.D.s in some area, chemistry for sure would never have been the area we picked. If we can do it in chemistry, we can do it in any area. One of the charges of my new position is to try to create the same kind of environment in other graduate programs.

# 7

# Beating the Odds: Preparing Minorities for Research Careers in the Chemical Sciences

Freeman A. Hrabowski, III
*University of Maryland, Baltimore County*

You have already heard about the best part of the University of Maryland, Baltimore County (UMBC) today during Michael Summers' presentation (Chapter 5). Mike is my hero, and he helps me tremendously as we work to bring about change on our campus. This is why: The only time anything changes at a university is when people really want to have change. You must have people who are true believers, who are respected by others, and who can work to build enthusiasm for an idea.

Michael Summers has done this for a number of people—leading the way and showing not only what the rewards of helping minorities to succeed can be, but making it clear that their success is possible. He has proven that you can be a first-rate scientist and a superb educator, while at the same time making sure that large numbers of women and minorities are succeeding. It can happen!

The Meyerhoff Program has already been described (Chapter 5), and you have heard that the program is successful. Robert Lichter of The Camille and Henry Dreyfus Foundation is on the Meyerhoff Program's board and has been very helpful to us. Clifton Poodry of the National Institutes of Health (NIH) immediately came over to me when he saw me, and, in the spirit of the best defense is an offense, he said, "I don't have any money." He knew that before the night was over, I would ask him for more money. I have no shame. I have to ask. A day without asking is like a day without sunshine. We never get enough money. We need much more money. He knows this. Actually, I told him that I would not be asking for money tonight. Instead, I want to acknowledge and thank the NIH and the National Science Foundation (NSF), and the members of their staffs for what they do to support the Meyerhoff Program.

When we talk about the issues involving participation of women and minorities in chemistry, and in science generally, we need to make sure that we have a lot of white males around. The power in our country, whether we are talking about companies or universities, still rests primarily with white males. Unless we can change the hearts and minds and thinking of those in power, what we do will continue to be at the edge. For example, I have seen Michael Summers stand in front of a group of black parents of very high-achieving students and say, "We have a problem in health care involving minorities. This is what it is for blacks, this is what it is for Latinos, and this is what it is for whites." There is a power imbalance, which is why Michael Summers looks such parents in the eye and says, "If you don't solve it, if you don't get involved in research, who will? If your child does not do it, who will?"

It is a powerful message that takes courage to deliver. When he first did it, I was afraid that the parents were going to get up and say he was racist. But he was telling the truth. If we are going to make a difference, if we are going to change things, we must be willing to tell the truth. Sometimes we must be willing to say things that make others uncomfortable, not because we are trying to push them into a corner or against the wall, but because we have to get them to think about the issues differently. If we do not bring about this change in thinking, 25 years from now we will still be sitting here saying, "We do not have any blacks on most of the chemistry faculties of research campuses in this country."

Although companies may be doing a better job than universities in recruiting, companies are still falling short, and they need to do better. We know the demographics. We know that if we are going to be competitive as a nation, we have to talk about the impact of changing demographics in this country.

I want to share a variety of stories with you this evening. It occurred to me that I actually took my first chemistry course in 1964, the summer before my 11th grade year. My mother sent me from Birmingham—where I could not go to school with white kids—to Springfield, Massachusetts, where I had a godmother, to give me a chance to see what it was like to be in class with whites.

I always thought I was the smartest kid who ever lived. I was taught to believe that. My parents pushed me on that because they wanted to counter the idea that I was a second-class citizen. I had gone to jail with Dr. King. I was in the civil rights movement. I led a group of children to jail. I was empowered to do that. I really did feel that I could do anything.

I wanted to see if it was true that white kids knew more than I knew because I kept hearing that in different ways: I had been given books second hand from white schools as a child, and my parents explained to me why that was. So they went out and bought books so that I would not have to use the books that had been given to us second hand from the white schools. My parents did everything they could to help me feel special, which is important for anybody to do well.

At the school in Massachusetts, I expected people to welcome me with open arms in algebra II, chemistry, and literature courses—but nobody ever spoke to me. A few would smile, but they were very uncomfortable. I was the only black, and the teacher never called on me. The first week, I raised my hand every day. I knew the answer, but I was ignored. Southerners are different from people in New England. Southerners are effusive. We are emotional. The New Englanders were much more stoic, and they said "five," not "fahve." So, the first thing I had to do was learn how to say "nine," not "nahn."

I learned more chemistry in those eight weeks than we covered the entire year in my chemistry course back in Birmingham that next year. It was a powerful lesson for me because I had very dedicated teachers in Birmingham. The chemistry teacher was excellent, and he taught as much as he could, given the background of the students in the class. Do you see my point? There were people who left his chemistry class and went on to places and became physicians, but many others knew very little at the end of the class. He gave us what he could give us, and it was a foundation. That was when I came to understand just how different white schools could be.

When I went to Hampton University, the students who were from northern public schools, private schools, and other countries clearly had a superior educational background compared with mine. But I discovered that nothing takes the place of hard work. That is the difference! I started off in college not having had calculus but having a stronger background in chemistry, due to that one course I had taken during that summer in New England. Clearly, I was behind, but I was accustomed to making As and I was determined to make As.

Now, I tell my students that there is a "low A" and then there is an A they can make when they are able to say, "I know I know this work." This is making the difference. I always tell them what Descartes said: "Dare to know." I tell them that they should want to know as much as the faculty member, not just enough to make an A. We talk about "high As" in the Meyerhoff Program. But we do not talk only about

grades and getting into graduate school and medical school. Michael Summers always said, "Freeman, sometimes the kid who gets the A is potentially not as good a scientist as the one who gets the B," which helped me understand that there is more to life than just the grades. It is the curiosity. It is the passion. It is the determination to stick to it. Those are the things that will make a good scientist. I want all those things from our students, but frankly, I want the As also.

All my life, my parents said, "You need to be twice as good." Some in this room know exactly what I am talking about because we did not think the world would be fair. We knew a lot of times opportunities would be there. But we also knew we would not necessarily get them because we were black. In my generation, growing up in the 1950s and 1960s, the understanding was that blacks had to be twice as good as whites. If you were twice as good, and if you were smart, maybe that opportunity would not be taken from you.

Think about these examples as I tell my next story. This story involves spending a summer in the 1960s at Tuskegee University in an NSF mathematics program.

The summer of 1960 marked the first time I met somebody who had a Ph.D.—a black man. He would come into the room, and on the blackboard he would write a math problem in probability—a problem we could not possibly solve. It was also the first time I realized that, even when you are smart, there are many problems you cannot solve in ten minutes. Sometimes you can go for hours and days and sometimes never solve them. I was amazed by what he was trying to teach us—that sometimes the process you go through in trying to solve a problem is far more helpful to you than getting to the answer. For years after that, I spent time in class trying to figure out, as the teacher was teaching, how I could explain a concept differently or how I could get kids excited about mathematics.

If you ask a group of typical Americans if they like mathematics, a few people will raise their hands. If you ask them if they really love math, they look at you like you are crazy (except for the few science and math teachers in the room). If you ask, "Do you love to read?" most educated people will raise their hands. It seems to me that, as we talk about increasing the number of minorities in science, we have to talk about what we need to do to increase the number of Americans who appreciate math and science. How do we get more students wanting to be smart, wanting to know, wanting to be the best, and having the curiosity?

I always quote the Nobel Prize winner Isidor Rabi, who said that when he was growing up in New York, all the Jewish mothers would ask their children at the end of a school day, "Did you learn anything today?" He said his Jewish mother asked him every day, "Did you ask a good question today?" It was that which made him a scientist. I get goose bumps thinking about that.

I moved to UMBC after a number of years at other institutions following undergraduate study at Hampton University and graduate school at the University of Illinois. It was at Illinois that I became passionate about committing my life to increasing both the number of kids who wanted to go into math and science and the number of students who would excel in math and science. At Illinois I never saw anybody black do well at math, ever, and I never had a black professor.

But at Illinois, there were several white faculty members who could see that I had a curiosity, who fascinated me in abstract algebra, and who were willing to spend time with me. It was there that I learned that you do not have to be black to help somebody black. It became clear to me that if all the faculty members in the math department are white males except for two women, and if we are going to increase the numbers of minorities and women that we have, we will need the help of a lot of white males.

It was that passion from the 1970s that led me to work with other students there, from graduate students who were having problems in statistics courses, to undergraduates who were trying to become engineers but could not get past the first calculus course. I began to shape my ideas about what was needed to increase the numbers of blacks who succeeded and to understand that succeeding at one of the

historically black colleges and universities (HBCUs) is very different from succeeding at a predominantly white university.

There are caring faculty, both black and white at the HBCUs, who understand they must spend time with students to enable them to succeed. Clearly, liberal arts colleges, black or white, tend to be more caring than big research universities. We know this, regardless of color. So, these institutions offer a number of advantages. This is why HBCUs such as Spelman, Morehouse, Hampton, and Xavier have been able increasingly to educate students who sometimes do not have the desired academic background upon entering college, but who build the necessary background while there.

One of the challenges we face is that 70 percent of African American students are at schools other than HBCUs, and people do not realize that. The fact is that many go to college planning to major in science. Why? Usually they want to become physicians because these professionals have been important in their communities, often representing the most prestigious individuals. Few of the students have ever seen a Ph.D. chemist, and if they have, they are unaware of it or do not know what it means.

On my campus, we are trying to produce large numbers of students who will go on to M.D./Ph.D. programs because many already have the bug about being a doctor or physician. Michael Summers goes through this all the time. The students come in wanting to be physicians, but we spend a lot of time trying to hook them to research. Quite frankly, when a senior comes up to me and says, "Doc, I got into medical school" and goes on and on talking about a M.D. degree. I just say "okay," and I never show excitement. But if the students talk about Ph.D. or M.D./Ph.D. programs, I get really excited. I am very biased that way. Why? Clifton Poodry told me that the purpose of the money NIH provided was to produce Ph.D.s. When I talk with representatives of the American Medical Association, they ask, "Why don't you show more excitement for physicians?" I say, "Give me some money to produce some doctors and I will show some excitement, but you get no freebies here." Lunch is never free.

We have to produce the Ph.D.s for a lot of reasons. The point to all of these stories is to help shape your values, your vision, and what you are thinking about doing. For me, the vision for many years has been the following: I imagine a country in which you can go from university to university, from high school to high school, from company to company and see blacks and whites and Asians and Latinos and men and women working in science labs with the understanding that you will find superbly prepared people from all of those groups. You might walk over to somebody and, seeing a black scientist, say, "Oh, that is Dr. Warner, no big deal, just another black scientist. We have them all over the place." This must be the vision. If you think about it, before the midpoint of this century, one in every two Americans will be of color. If you look at what is happening in California, in Texas, and in Florida, you can see the browning of America, where the terms minority and majority will cease to have meaning.

I was born in 1950 and I have my AARP (American Association of Retired Persons) card. I feel very good about that, although it took me a while to adjust to the idea. But the fact is, when I was growing up, there were four people working for every retired person. By the time I retire, there will be only two people of working age for each retiree, and one of those two will be of color. Do you want that person to be a chemist, to be sweeping floors, or to be in prison? The last two options will cost us a lot of money. That person's social security—along with my social security—depends on the kind of money the person is making. That is an argument we have heard many times.

So, the question is, what can we do—given the science and technology infrastructure that supports everything from defense to health care—to make a difference? The vision for us at UMBC was the Meyerhoff Program. The idea was to create a program in which African Americans would not just be getting by in science, but would be the very best that you could find anywhere—in terms of research, excitement about science, grades, and test scores.

From the beginning, the Meyerhoff program has focused heavily on the notion of evaluation. Bob and Jane Meyerhoff are wonderful philanthropists. Bob is a graduate of the MIT with a degree in engineering, and is a developer. Back in the 1980s, Bob had been telling people that he was interested in understanding why everything he saw on TV about black males was so negative. He said this to the head of the Abell Foundation, Bob Embry, with whom I had been talking with about improving the success of African Americans on our campus. Bob Embry introduced me to Bob Meyerhoff, and the program developed from our discussions. He and his wife have now contributed over $5 million to the program.

I am now serving as a visiting scholar with the College Board, which looks at interesting data and trends. Unfortunately, if you tell me you have a program involving students with high test scores, regardless of race, I will respond that most of those kids have a parent who had some college. There is a very high and positive linear correlation between standardized test scores and the income level and education of parents. The higher the education level of the parent, the higher the test scores will be for their kids. If you control for income, you find that test scores of blacks and Latinos are still far below those of whites. This is a consequence of what happens in the home after school, the kinds of schools that the children may attend, and, in some cases, whether the child gets the test preparation sessions that other kids get. All three are factors.

I have spent a lot of time with colleagues documenting what works in the Meyerhoff Program. At the same time, I have tried to answer the question that parents of young black children have been asking me since the late 1980s, "What can I do to make sure that my eight-year-old one day can be a Meyerhoff scholar?" My idea was to produce a program that would be so prestigious and so fabulous that parents would be saying, "I want my kid to be in that program," and that young kids would be saying, "I want to be a Meyerhoff scholar one day." How do you help the child to want to be smart and help the parent to understand that they must take certain steps to ensure their child's success?

I brought two books[1,2] with me this evening that my coauthors and I have produced, and I want to read from one of them. We wanted to write books that reflected and documented the voices of the parents: "You know, we have always heard that in the third grade the little boys get off course." For boys, scores and grades tend to decline from fourth grade on, girl's grades decline during middle school. The essential question to these parents was this: What did you do to help your child to become excited about science and to do well in school and to want to be smart?

In the Meyerhoff Program, about 40 percent of the participants are first-generation college students. This is only because we have worked hard to do two things. First we built up the skills of some of the region's high school students through math and science upward bound programs, so their test scores and grades would improve. Second, we searched in the inner city and surrounding areas to find those few kids who came from poverty but did really well, in spite of the odds. The child who comes out of poverty with SAT scores in the 1100s or 1200s is often as good—or has the potential to be as good—as that very advantaged black or white student who has a score of 1400 because of the difference in available opportunities.

The fact is that the advantaged kids, such as the high-achieving student whose father might be a physician, usually go off to big-name universities planning to become doctors, but they often end up becoming great lawyers. Why? Because that first chemistry course was a killer or that first calculus

[1]F.A. Hrabowski III, K.I. Maton, and G.L. Greif, *Beating the Odds: Raising Academically Successful African American Males,* Oxford University Press, New York, 1998.

[2]F.A. Hrabowski, K.I. Maton, M.L. Greene, and G.L. Greif, *Overcoming the Odds: Raising Academically Successful African American Young Women,* Oxford University Press, New York, 2002.

course, or that first physics course gave them a grade of C or below, while they got As in the English and history courses. The humanities people are a bit warmer than we math and science people. As you know, we in math and science will say, "Either you get it or you don't." As a result, these kids will change their majors. This is an issue.

We talk about making a difference at all these levels. The fact is that if we could just keep the kids, black and Latino, who have done well, and who have As and Bs in chemistry from high school—if we could just keep them and help them get through the first year of college with Bs—we could double the number coming out of bachelor's degree programs. If you look at the numbers from NSF, you will see that they get wiped out in that first year.

I coauthored a book on young black males that was published in 1998 (see reference 1). I say to people that if we had written a book about the parents of murderers, it would have been a best seller because people like the bad stuff. However, I did not know if people would buy a book about parenting smart black boys in science. Yet, amazingly, this book is in its fifth printing. I have been in 30 states, and I have signed books for 30 state school boards from Alaska to New York. People in Alaska have the same kind of issues with minority children that people in D.C. have for black and Latino children.

When I go to the state school boards, arrangements are made to have book signings. From Atlanta to parts of California, people want to know what is working, and it is amazing. Parents will ask, "What can you tell us to do to help our children?" School administrators will ask, "How do we help these parents?"

Part of the issue as we talk about producing young scientists is to learn how you can help families to succeed and identify the factors related to success. These are probably the things that your parents did for you—simple old-fashioned approaches, such as acknowledging that there is a spirituality component. There is an emphasis on no-nonsense. There is an emphasis on discipline. There is an emphasis on creativity, LEGOs, puzzles at an early age, and reading. What is different about these minority parents? They have turned the televisions off, and they spend much more time getting their children to read.

There are wonderful cases, in which the mothers barely finished high school, and they used cooking to do mathematics and teach the children about fractions, decimals, and dollars. Just because you are poor does not mean you are not smart. There are a lot of brilliant people who just did not have the opportunity but can somehow use that brain power to help their children.

It was most important for the boys to give them examples of people who were not nerds, but who were smart. Think about it. What black boy in American society on TV in the 1980s and 1990s was known for his brains? There was only one. His name was Steve Erkel, a quintessential geek little boy who had his pants up to his chin. I remember saying that in a class, and I asked, "Who would want to be like Erkel?" A little boy who looked just like Erkel said, "I do, I do." I had to change my story immediately.

The reality is, we do not have examples of cool kids who are smart. We need a lot of smart Doogie Howsers. Just think about it. We need more smart little girls on TV. Our kids do not see the examples. I just want you to hear this because you never know the background of a child in your class.

I am going to share with you an essay written in a freshman class by a very polished young woman. The professor was so taken by it that she sent it to me, and I was so touched that I made it the beginning of the first chapter of our book, which discussed successful African American women and their families. This is what she wrote:[3]

[3]F.A. Hrabowski, K.I. Maton, M.L. Greene, and G.L. Greif, *Overcoming the Odds: Raising Academically Successful African American Young Women,* Oxford University Press, New York, 2002, p. 240.

> "Your uncle is hooked on crack," says my mother, as we park in front of his house. As I walk toward my house, I look to my right and we see a couple of drug addicts sitting on what used to be my aunt's favorite couch and enjoying the comforts of her once humble abode.
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> On the steps there sits a high-school drop out, no older than the age of 17, counting the money he earned from selling drugs. At the corner, the mother of a local drug kingpin took on his responsibility after he was killed in cold blood. My parents always stressed the importance of a good education and taught me to strive to be the best. What you don't know is that I have witnessed the effects of drugs and alcohol firsthand with them, and it has taught me that drugs are not the way to deal with life's bleak realities. I use society as my motivation to excel in all that I do. As a teenage, black female, I am not expected to do well. There is a sense of satisfaction in knowing that I have achieved more than was expected. Even more important, I achieved more than I expected. My hard work paid off.

This is a young woman who is now a college junior, with a 3.9 GPA in chemical engineering. What made the difference? Even with drug and alcohol problems in her own family, someone kept telling her, "You can do anything if you set your mind to it." That someone in her family was her mother. Even with the problems with the father, the mother pushed the notion, that "with hard work you can succeed."

In the Meyerhoff Program, we write poetry together. I want the students to be broadly educated and not just technicians. I want them to learn social sciences, and we read from a Langston Hughes poem, Hold Fast to Dreams, "…if dreams die, life is a broken-winged bird that cannot fly." I help them to focus, focus, focus. The biggest challenge you face with so many young people is that there are a million ways they can get off track.

The Meyerhoff scholars are bright kids who come in with scores between 1200 and 1500 on the SATs, and they have high grades and they have had advanced placement chemistry in high school. "You have got it made" many people will say. The fact is that, if we did not spend a lot of time supporting them and holding discussion groups about what it means to be smart, black, and love science, and if we did not kick their butts, while loving them, most would change their majors.

What happens if I were a student who wanted to be accepted by my friends, but my friends spent one-third the amount of time studying and still could get Bs in the social sciences? In the meantime, I am working so hard to get an A, or sometimes a B or even below a B. If I am not careful, even though I might like Dr. Summers' lab, I could move toward a much easier life if I majored in political science and became a lawyer. Our students might entertain these thoughts, if we did not get involved.

There is good news on our campus, where 11,000 students are enrolled; 9,000 are undergraduates and 2,000 are graduate students. We are producing between 50 and 60 Ph.D.s per year, and 70 percent are in the sciences. Sixty percent of the undergraduate students major in science and engineering, with the typical student belonging to an honor society. One of the things that makes our university competitive is that we have so many first-generation Americans—whether they are from Russia, one of the Asian countries, Nigeria, or the Islands—and they are all focused. They are hungry. They push my typical American student, black or white, to do more. We have worked to create an environment in the Meyerhoff Program where the most prestigious people are the highest achievers.

That is why I make chess a big deal on our campus. We are the national chess champions. I am very proud of that. We actually give chess scholarships. The chess team has black, white, Asian, and all kinds of students participating in chess tournaments.

The goal is to create a climate in which it is great to be smart and to create a climate in which people talk about the sciences. I stress this. Look at the black kids and the white kids. Many—not all, but many—are talking about the party from the night before. It is part of American society. We have worked to encourage group study for all students. The chemistry involved has a wonderful effect on faculty and everybody, so that the students are involved in group study, with heavy emphasis on tutorials. The

chemistry tutorial center is a place you go, not because you want to pass, but because you want to be the best. There is no stigma attached to it. That makes the difference. Whether we are talking about the chemistry tutorial or the faculty who are involved, what makes the difference is a commitment by the whole place that says, "this is important to us." In contrast to early years at UMBC, Asian students are not the only group studying hard.

UMBC is working with companies to discuss multilevel partnerships. From my perspective, if we are going to make a difference, we must develop the kinds of partnerships that will work with kids from high school through the postdoctoral level—and do so in such a way that we know where those students are the entire time. For instance, I still have an NSF grant that allows me to monitor all the hundreds of students who have gone on to graduate and professional schools. As well prepared as they are, they still need that push from time to time. We want to encourage the students to use email and work with each other, so that when things get tough, there are other people they can talk to—for example, to talk about what it means to be the only black physics Ph.D. student in a place. I encourage you to look at ways of identifying students with the ability and giving them the support. You have to have it at all levels, but I am emphasizing the time through high school.

We enroll students from 45 states and 91 countries, but some of my best students come from right outside of Washington in Montgomery and Prince Georges counties—from Roosevelt High School and Montgomery Blair High School. Why? Those kids often are doing research at NIH labs or in biotech companies while in high school. They know what it means to have good hands. They have gotten the bug already, and they are serious about science. These are both black and white kids that I am talking about.

I spent five years as part of a trilateral study group on competitiveness. There were six Germans, six Americans, and six Japanese. I was representing education, pre-K through postdoc. We were together every six months, so we got to know each other really well.

After about three years, the Japanese really opened up to us. The Germans and Americans had been fairly straightforward, but the Japanese finally asked me the question they really wanted to ask. They said, "Freeman, yours is the greatest civilization that humankind has ever known. Yours is also the most diverse we have ever seen, but don't you think your diversity will be your downfall?" That is the question that the world, places like Japan and Germany, will ask and think, even when they will not say it.

I do not think I have ever been more proud to be an American. I said, "Let me tell you, it has been our diversity that has made us the greatest civilization ever. Everybody in the United States, except for the Native Americans, comes from somewhere else. It has been the pulling from all these different cultures over the years that has gotten us to this point. We have problems, big problems, yes, but any time this country has big problems, it finally pulls together the resources to make a difference and to solve those problems." I said to them with great confidence, "I have no doubt we will do it here, too."

The challenge for us right now is not about producing more chemistry students or science majors. It is getting more kids who want to be smart. It is somehow thinking out of the box about ways of connecting with these kids at earlier ages so that they see themselves as scientists—by becoming involved with science throughout their undergraduate experience. We need to create ways for them to work with companies while universities keep giving them that much-needed support.

We all need direction and support. The new Ph.D.s who are coming out now are calling me on the telephone and asking, "Doc, what do I do? Where do I find a mentor? The advisor I had is okay, but he really isn't interested in me."

If there were one thing I would say it would be, "How can we be inspired by people like Michael Summers and Isiah Warner and the others in this room who are devoting their lives to producing these

students?" How can we get that passion to make it contagious to the point that others will say, "This is a big deal. This is as important as anything else we could possibly do." That is the challenge that we face.

When Tom Cech became president of the Howard Hughes Medical Institute, he had been taking Meyerhoff students into his laboratory at the University of Colorado since the early 1990s. I will never forget the earlier time when Harold Varmus said to Tom Cech, "Freeman started the Meyerhoff Program." Tom responded, "What is the Meyerhoff?" and Harold answered in his inimical way, "You mean you don't know what the Meyerhoff Program is?" The next week, Tom Cech called and said, "Freeman, give me two Meyerhoff students next summer." Every summer he has had two. When he became the president of Howard Hughes, I sent him an email message telling him where his former students were—at Harvard, Yale, Baylor, doing a M.D./Ph.D. degree, and so on. These students had gone to his lab and were fascinated by two things. The science was wonderful, but he was also a decent human being. It is a big deal for a kid to realize that a Nobel Prize winner can be a decent human being who cares about students. It makes all the difference in the world. He emailed me back saying, "Thanks, Freeman, but you forgot three, and this is where they are located now." There is the vision—the idea of connecting—not just for a summer, but for a lifetime.

When I first got to UMBC we had a black student protest in the first week. Angry black students overtook the whole floor where the president's office and my office were then located. There were TV cameras that looked right in my face, as if to ask "What are you going to do about it?" All of a sudden, I remembered the 1960s when we were the ones protesting. It hit me right then that I had become the administration. I remembered my president, years ago, saying, "Keep living, son, just keep on living. It will come around." Now I was on the other side and I had become the man.

When I got to the bottom of the problem at UMBC, I discovered a number of reasons that the black kids were doing so poorly academically. The average GPAs were 1.9 for black males 2.0 for black females. So I decided to find out which of these kids were really smart. When I finally found the one who was considered one of the smartest of all, I asked the student (who was a chemistry major), "What did you earn in organic chemistry?" He said, a C. "What did you get in organic II?" Also a C. I said, "You are the best around here?" He responded, "If you are at UMBC and black and you get a C in organic chemistry, you are very smart." That was the mind-set.

This kid had no problem getting into medical school because people knew that if you had a 2.7 in chemistry at UMBC and were black, you were really good. We would get them into medical schools without a problem. People were not thinking about Ph.D.s, but they knew they were really good.

That was the idea. Amazingly, when I went through the records, I could not find one African American who had earned an A in any upper-level science course in the history of UMBC. I have gone from one university to another challenging them to find the black students who got As. Usually they are from other countries.

I close with a story about Adam Freeman, the young man who was my first black student at UMBC to never earn less than an A in chemistry. Adam was finishing up. He had taken the GRE, scoring in the 99th percentile of the chemistry part—the best. He walked into the room as I was leading a focus group. I told him how well he had done, and all of a sudden, one person got up, then another person got up, and the entire room just started applauding, as if he were the best basketball player ever. Before I knew it, there was not a dry eye in the place. I saw big guys applauding with tears coming down. I looked at them, and I said, "It doesn't get any better than this, when a young man or a young woman wants to be the best."

# 8

# Reports from the Breakout Sessions

Following the presentation described in Chapters 5-7, breakout sessions were organized to enable more extensive discussions among the workshop participants. The following questions and statements were suggested to the breakout groups as possible topics for discussion:

- Consider the previous talks regarding successful diversity models and discuss which models can likely be replicated.
- Discuss potential problems that may be encountered in trying to replicate a given model.

Rapporteurs from the breakout groups then reported in plenary session what they believed to be important ideas and topics that had emerged during the discussions.

**Rigoberto Hernandez, Georgia Institute of Technology:** As in our earlier breakout session, our group discussion centered around a series of key questions and our attempts to answer them.

One of the key questions discussed within our group is, *When should we identify future chemists?* I want to restate this question as, *Who is failing our potential chemists?* Is it at the K-12 level where our future chemists are failing to emerge? Is this the reason why we are not getting the African Americans, the Latino Americans or women in science? Is it in college? Is it that we are not producing them with the requisite qualifications at the end of four years? Is it that once they arrive in our graduate schools, a sink-or-swim attitude prevails in these institutions and because of this, graduate students are not entering the chemical workforce? Yes is not the answer to any of the questions I have just posed. In fact, I am going to claim that the answer is us. We are failing them.

Where are we failing them? We are failing them in general chemistry. What we need to do is excite the students coming into their freshman year of college about general chemistry. We see all of them, either in our universities, colleges, or community colleges taking general chemistry. The numbers are large in the beginning, and it is not too late. If we could maintain their excitement by the end of general chemistry, the students would want to do science, and the numbers would prove it. Even if they do not

pursue courses beyond general chemistry, many of them will go into public policy professions. So it behooves us to convince them that chemistry is good.

Another key question is, *What exactly is the problem?* The problem is the dearth of diversity in the workforce. One example is the fact that only 18 African Americans and only 22 Latinos are currently employed in chemistry faculty positions by the top 50 institutions as ranked in a recent National Science Foundation (NSF) study. The top 50 institutions have been defined as those receiving the most governmental or private research funds available to academia. It does not mean that these are the best institutions; it just means that they are getting the most funds. The net effect of these statistics is that we are averaging less than one African American or Latino per each one of these institutions. Thus the numbers are small.

One might believe that this is a problem only in academia. But it is more general than this as illustrated by the following example. The Dow Chemical Company has only three Latinos out of 150 employees in their R&D department. This low number (and ratio!) is not good and it is not Dow's fault. Dow is a great company. They are forward thinking. They have at least three representatives at this meeting today, and they do want to recruit Latino Americans and African Americans. But yet, they are not getting them because they are not coming through the pipeline.

The consensus within our group is consequently that *the problem* is the result of the low numbers of students entering the chemical field. And the numbers are low for many reasons. One possible reason for the lack of more success stories within academia is the low probability of success regardless of race, gender, or ethnicity. Let us look at the numbers and make a rough estimate. There exist about 1,600 faculty members in the top 50 institutions. Approximately 1,600 students are being produced with Ph.D.s in chemistry each year. So, assuming that no other factors contribute and that the average turnover of a faculty member is about 20 years, then the chances of obtaining a faculty position are about 1 in 20. This is a very conservative estimate because many chemistry faculty in this country earned foreign doctoral degrees, and the average turnover rate is probably longer than 20 years. Regardless, whether it is 1 in 20 or 1 in 100, the odds of becoming a faculty member are still low. Given these odds and the fact that we are producing only about 20-50 African American Ph.D.s per year, it is no small wonder that we have so few in the academic ranks. Moreover, the students entering the pipeline also see this calculus and use it to assess whether or not to pursue this unlikely path in favor of other more financially remunerative nonchemical professions.

Another key questions is, *Who is going to provide the solutions?* Among the possible answers are

- Professional societies. The American Chemical Society (ACS) has been doing a number of things to identify the problem and take action.
- Funding agencies. Funding agencies could consider requiring principal investigators to deliver on the promises of diversity, with severe repercussions for failure. Perhaps this would cause principal investigators to take this issue more seriously and consequently effect change at a grass-roots level.
- Universities. Chemistry departments and upper administration could also use a yardstick-measuring impact on diversity in judging their faculty with respect to case of retention, promotion, and tenure on this basis. In other words, at the end of the year, salary raises would be impacted by what you have done or not done with respect to diversity. But in fact, most promotions, tenure, and salary decisions at the top 50 institutions or any research department are judged almost exclusively on how much you have done in terms of research. How much teaching you have done and service you have provided is judged with a small t and small s, respectively. And the issue of diversity is but a small component within that small s. But if we really believe that diversity is important, then this small fraction will need to be given a higher priority.

Another key question that we found to have been central within the talks of this session is, *What are the key elements for replicating success stories?* In no certain order, below is a list of elements that we believe play a role:

- A critical mass entering the pipeline. If you have enough students entering your program, then you have a chance at producing them at the end. This is why I emphasized general chemistry above. That is, the supply of able students entering the pipeline is greatest in general chemistry. The graduate level is perhaps different because the number of graduating seniors who are members of minority groups is very disproportionate as compared with the general population. Nonetheless, it is clear that if you are able to recruit these students in large numbers as Louisiana State University (LSU) has done, and you create the right program for them as LSU has also done, then you are able to obtain remarkable success. The experience at the University of Maryland, Baltimore County (UMBC), in which they have created both a critical mass entering and exiting the pipeline at the undergraduate level, is consequently grounds for hope that we can achieve the necessary numbers. Unfortunately, this kind of success is not being achieved at many other schools. In Georgia's premier public colleges—University of Georgia and Georgia Institute of Technology—we have a few success stories in chemistry, but not 20, and certainly not 100.
- Assessment and/or evaluation criteria. This criteria should be applied uniformly. Otherwise one has to worry about whether students feel that they are being treated differently, and this may lead to counterproductive results. In addition, nonuniform standards may lead to legal vulnerabilities that may ultimately shut down the program. One possible criteria that emerged is the measurement of a student's passion, or stick-to-it-iveness. Maybe their GRE scores are not as strong, or maybe their science background is not as strong because they did not get the opportunity to take the right courses in college, but they still have a passion for science. If you just give them the chance, they will do well. Maybe they will not just do well. They might excel because they are going to be determined and they are going to succeed despite whatever adversity they see in their first year or two. The obvious problem, though, is how to measure a student's passion, and this is the question that we all need to devote some effort to solve.
- Buy-in. Buy-in needs to come from the general faculty, the administration, AND the student body. If the students do not feel that they can succeed, then whatever plans you put into place are not going to work. So it is imperative to convince students that they are part of the solution. It is this buy-in that seems to have led UMBC to great success. They have clearly shown that if you get buy-in from students and their social network, then all sorts of positive outcomes readily follow.
- Mentoring. Sometimes these students are not receiving optimal advice from their social network. They do not know what they should do simply because they have not been advised. If only we were to advise them properly, they would then be able to make informed and hopefully positive decisions. Again, that mentoring does not have to be coddling. Mentoring can be challenging—as in tough love. The idea is that you tell them that they can do it but you set that bar high, thereby letting them achieve something more than they would have done without the challenge.

To implement a program that can replicate the success stories, you need leadership. One metaphor that many of us have used to describe the necessity of leadership is that you need a champion. That is, a champion within an institution that pushes the rest of us along. But the key question is, do you need a champion from the top down or the bottom up?

Several of the members of our group said, "I have been trying to push this for the past 20 years, beating at the door, and haven't gotten very far. But I am in the trenches and no one at the top is helping

me." This person could be a wonderful champion, but if she or he does not have the support from the top, then their effectiveness at promoting diversity is diminished. There is a lot of pressure on the 18 African Americans and 22 Latino Americans in the pool or cadre of top 50 institutions to go bottom up. Maybe some of the members of this group of 18 and 22 have to wait until they are at the top so they can truly affect policy decisions. They can still be cognizant of diversity, and they can still do all the right things to help students along. But the real impact is going to come when you have someone from the top such as Freeman Hrabowski, who pushes it down and says, "This is where we want to go, and this is how I am going to support you." That is, we need champions (and role models) at the bottom, but we really need champions at the top.

Finally, we need to take risks. You have to gamble on some people because if you do not you are never going to know if they are capable of being successful. It is a chicken and egg problem. If Freeman Hrabowski had never been president, he would not have had the chance to demonstrate his abilities as a leader. Someone had to be the first to give him the opportunity to be president, and look what he has done.

The last question that emerges is consequently, *Who is going to take that risk, and who is going to pay for that risk?* Quite often, the ones that have to take the risk and pay for it are the cadre of 18 and 22. Although that cadre of 18 and 22 wants to take the risk, it is a big price to pay. It should be society's price to pay. It should not be me with my little NSF grant having to take a risk on a Latino American or African American student or a female. The student may or may not have a different chance of success than any other, but if the student proves unsuccessful and it results in the nonrenewal of my grant, not only have I lost the student, but also you have now lost me.

NSF, National Institutes of Health (NIH), governmental agencies: Those are the ones that have to take that risk on a promising but risky candidate. I will accept my own risk in a project, but the question is whether I or anyone else should also absorb the risk in such a student. If the student does not have the background at the start of the program, but has that passion, should we risk our NSF or NIH grant on him or her? At this meeting, we have heard that in some such cases, NIH will give you extra money for taking that risk. More agencies have to give such investment serious thought. This is not a recommendation, but we are arguing that it should not be those of us at the trenches that have to take all the risks.

**Krishna L. Foster, California State University, Los Angeles:** Our group discussed the success of expanding diversity in the chemical workforce. I would like to break it down into three categories:

1. Students
- How do we keep students interested in the chemical sciences?
- At what level do we intervene?
- What attributes are presented that get the students excited about pursuing science careers?
- Where do we need to improve our student recruitment and retention?

From our discussion group, it seems that, even before high school general chemistry, there is a lot we can do. It does not necessarily have to be large scale. For instance, one-on-one communication can help. Mentorship programs in the form of tutorials with undergraduates working together with high school students can actually build confidence in the undergraduate student simply because they have something of value to share with the younger high school student. This also gives the high school student an opportunity to see that there is a life in science that is rewarding and enjoyable. It exposes them early to science as a career that they might like to pursue.

An idea that came up in our discussion was that faculty from colleges and universities could collaborate with high school teachers to identify students with above-average GPAs or SATs who have shown an interest in the sciences. This actually starts the pipeline because it is not always easy to

determine which student will be successful in the sciences. Establishing early links can help us identify students to build into the pipeline.

Our group was also concerned about risk and recruitment. Lawsuits are a real risk and we need to start thinking about new ideas to expand what we mean by diversity. Perhaps ideas like identifying first-generation college students, identifying local zip codes, or family income could be a means to make sure that the underrepresented population is inclusive as we try to diversify.

And finally, while we are busy concentrating on the Ph.D. success, we cannot ignore those people who do not pursue the Ph.D., but receive master's or bachelor's degrees and do have a positive impact on the chemical workforce because of their passion for science.

2. Faculty
- What do we do about new hires?
- How do we decide if we are serious about recruitment and retention?
- What do we do to join as junior faculty?

If we are serious about diversity, then we have to think about the hiring criteria by asking what we expect this person to do to diversify that goes beyond the standard requirements of teaching a course. Counting publications and pedigree is probably not enough.

To promote diversity, the new hire should have time in his or her schedule to pursue that diversity ambition by granting release time.

One institution mentioned in our group had special funds that were used to hire underrepresented people throughout the entire campus. These funds allowed them to offer a job to a new hire whenever the opportunity presented itself. It has worked well for them.

3. Champions
- Senior faculty and administrators.
- Funding agencies.
- Spearheading the effort.

We want to find some way to institutionalize, develop, and compensate champions for their effort. It should not be just one person who decides to be the sacrificial lamb. There should be time, salary, and a real commitment made by the institution for allowing faculty to diversify. We need to find a way to take more of these people with this passion on campuses across the United States to teach our senior faculty how to be the diversity spearheads. People are out there but they lack the support they need to get the job done right. To do that, we need an institution to buy in. The institution needs to take responsibility. It cannot just be one person. One person can spin his or her wheels for 20 years, but you need to have a group of faculty working together and support from the central administration. So this has to be a group effort. You can do this by having discussions in the department, in the college, in the university, talking about how diversity fits into the core values of the institution. Not just making diversity a charity effort, but more like what has been presented in this workshop: Diversity is good for the community, and we need to get that message out there to see how it fits into institutional values.

**Iona Black, Yale University:** Our group was to attack the problem by asking two questions. From the two programs that were presented, which can be replicated, and then what is necessary to replicate it? There are four things that seem to be essential.

The first is leadership—someone who wants to take charge. The second is team support, people who are willing to make that change. Third, is the need to go out and attract people. You cannot sit back and

be passive. Fourth, is the need to retain them by doing a personalized infrastructure, such as mentors. Having one or two of these four things will not work, you need a synergy of all four.

What is it that UMBC seems to have done? They have gone to faculty members who have some money and a name and tried to work with them until a grant can be achieved. The seed money needs to come from the top down.

So along the lines of money, the next question that arose in our group was, for undergraduate education, which is more important: to have faculty who have significant research money, competitive money, and are producing peer-reviewed articles, or to have block grants for the institutional environment for the educational base?

Well, I think it depends on what the institution is. For the larger institutions, handling undergraduates is not a problem, because they are just added onto the existing class for the graduate students or postdocs or whatever. But for the historically black colleges and universities (HBCUs), the block grant seems to be important, because then people can have money to engage in research and build up the faculty, and they can be on a competitive basis.

It was also noted in our group that 40 to 50 percent of the African Americans who are in the majority institutions for Ph.D.s come from the HBCUs. So when we look at the LSU program, one concern was whether that pool would continue to exist or be exhausted.

Hampton University, for example, has a one-sided success story. The students are coming in and they are graduating. But if you look with regard to chemistry, then there is some real work that needs to be done. So we need some workable models for other types of institutions, models for institutions that can be feeders outside of the HBCUs. Funding is needed. UMBC is useful because it gives us a projection of what the outcome can be.

What is it that is reproducible from the UMBC model? One thing is the expectation for excellence. That can be adopted everywhere. They take tutoring to get high As; it is not viewed as just being able to pass. It reinforces this expectation.

Can a program be successful without financial support? UMBC had financial support from Howard Hughes Medical Institute, NIH, and a variety of other sources in addition to the institution. The answer was viewed as a qualitative yes. There were some examples of some institutions that are operating without the money, such as Fiske, but the money would be helpful. There is another route that the majority institutions could take, which is to have the faculty work with those that are in student services. The collaboration between student services and the faculty could bring together this type of change in the major institutions.

What can be done to increase the numbers in chemistry? The rate of success of graduates overall in an institution is high. But for chemistry, that is not the case. Is chemistry different regarding the retention of students? The answer is yes, because chemistry is a gatekeeper kind of course. So, as we have heard from the two previous groups, some of the chemistry courses mentioned might be worth a try. Maybe the structure or the amount of material that is covered could be changed, or maybe the curriculum could take the biology approach, by examining case studies, or maybe you could make the program writing intensive. There were some examples of places that incorporated all of these types of things.

Chemistry seems to have been flat with regard to growth in Ph.D.s, whereas growth in the biological sciences, including biology and psychology, seems to have grown exponentially. Does chemistry have any growth? Yes, growth is at the intersections with other disciplines, such as biology, or engineering, or modeling, but do we know the pool of people that we are going to be dealing with? The American Institute of Physics is putting out a statistical-based data format that is going to be very useful and have high visibility. A possibility is to do the same type of thing with the data that are collected by the ACS.

Forty percent of the listed graduates of the ACS obtain their B.A.s from non-Ph.D.-granting institutions, but they finish their Ph.D.s at major institutions.

In summary, have we come full circle with 50 percent attrition in chemistry? Is this due to curriculum or the way that it is taught, or is it due to the way that we progressively retain science majors? A synopsis is that the answer to the second question is yes. That is the true strength of the Meyerhoff program. Can the Meyerhoff program be reproduced? Yes, it can be reproduced in the following areas:

- You have expectation of excellence and with the four essential themes.
- You have to have some type of leadership, someone who wants the change.
- You have to have the team support, the faculty who are willing to do the change.
- You cannot be passive, you must go out and aggressively attract people to you.
- You must personalize the infrastructure to aid in the retention of these students.

The synergy of all these things is what we concluded would be necessary.

## DISCUSSION

**Isiah M. Warner, Louisiana State University:** Did any group talk at all about the problem of setting aside funds? Minority faculty enter the system with enough stigma associated with them already. To set aside funds suggests that they came in under different criteria than normal faculty, and it presents a problem, particularly at a majority institution.

I am against this personally. Unless the entire faculty buy in to the premise that these persons are being hired and accepted as regular faculty, I do not think that any additional stigma needs to be associated with their employment.

**Krishna L. Foster:** We did not discuss that at all.

**Rigoberto Hernandez, Georgia Institute of Technology:** I would hope that whenever one hires a faculty member, then one hires them for all the right reasons. However, once you have made such a decision, it is fair game to secure funds earmarked for minorities, even if it is for all the "wrong reasons," as long as it is found money that you would not have had otherwise. So if you get another $100,000 or $200,000 for that hire that he or she would not have otherwise received, great. But if you use those funds to replace money that he or she was going to get anyway, then you are not being fair to that hire.

**Isiah M. Warner:** But think about it this way. You are a new assistant professor coming in and somebody is telling you that you were hired only because of some special criterion. That can have a psychological effect.

**William M. Jackson, University of California, Davis**: I would disagree with Isiah Warner. The recommendations you made for hiring faculty, putting money aside for opportunities to hire minority faculty was something the University of California was doing very successfully. These people still had to be qualified to be on the faculty of the university, but it gave the department fewer excuses for not hiring qualified minority faculty. Judging the quality of faculty is always a difficult value judgment.

There is even recognition of this in the university by making faculty prove themselves before granting them tenure.

We had to stop using diversity as one of the factors used to evaluate potential candidates for faculty position because the University of California Regents passed an edict preventing us from doing it. Later there was a voter initiative that also prevented us from considering race in the appointment.

In fact, I was hired at the University of California on this set-aside money. We need to do a job on our own students to strengthen their egos such that they do not allow themselves to be stigmatized. I grew up in Alabama at a time when society stigmatized us all solely by the color of our skin. When you walked out of the classroom into any place other than your segregated classroom, you knew that they knew you were black and assumed that you were inferior. Therefore, you knew there to be successful if you were black, you had to be twice as good and work twice as hard, as Freeman Hrabowski said.

Now, the first thing that we have to do for all minority students is to get them to understand that no matter what is said in society, they still have to have better qualifications than nonminorities. They cannot expect it to be fair. It is never going to be fair. As long as people can distinguish you and make judgments ahead of time before they even know you, there is no possibility of being treated fairly. Eventually we hope that this changes, but it has not happened yet.

There is a history at Morehouse College where I attended that Morehouse men were extremely confident in their ability to compete in society. This was drilled into them deliberately by President Mays to counteract the negative images African Americans received from the larger society. We have lost this feeling in the African American community that we have to be better and work harder. I am not saying that we have to blame ourselves as victims. I am not talking about that. But we have to continue to know that success in this is not going to be an easy road. We are going to have to work hard at it.

I understand the problem of the stigmas, but overcoming that is going to have to come from within. We must always remember that if you ever let anybody else define you, you have already lost the game.

**Gregory Robinson, University of Georgia:** I think there is a middle ground. We have had this debate on our campus and some other venues. What seems to work is a pool of money to allow a department that is hiring adjunct faculty to combine those adjunct faculty into a single new faculty position. Then add enough money to make it a permanent tenure track position, or to allow a department to borrow money against the pool for future retirement. Those are things that work and address your problems as well.

**Sharon L. Neal, University of Delaware:** The University of Delaware is not my first institution. I was at the University of California, Riverside. I wanted to say that, even though I think William Jackson's point is well taken, it is something that we need to be concerned about, that a new faculty member who is perceived as being hired under a set-aside is a target for special retribution from faculty who are entrenched and who do not like the idea of their faculty quality being undermined.

**D. Ronald Webb, Procter & Gamble:** This is not a question, but a comment. I am hearing a lot of discussion on what could be done to address particular issues. But, from a business standpoint, focusing on the work, before nailing down the reason for the work, may not be efficient or even yield the desired effect.

I would like to suggest that somewhere, somebody has to sit down and prioritize what issues you want to address. I submit that you cannot fix everything right away, but prioritizing the issue is essential. Once that is done, you then need to figure out what you need to do to solve the problem.

There is a work model we use in industry that helps us tackle big problems and get to the endpoint quickly, and I want to share it with you. It is called OGSM, and it stands for objectives, goals, strategies, and measures. This model allows us to take a big problem, break it down into smaller pieces, identify the work that needs to be done, and measure our outcome over time.

For example, let us say that you are at a university and you are now unhappy with the representation of minorities on your faculty. Based on this sample problem, one could develop an OGSM by first defining an objective such as having the highest representation of minorities on the faculty relative to other departments in your academic conference.

Thus, appropriate goals for meeting this objective could be hiring two African Americans or Hispanics in the next year and ultimately having a 10 percent minority representation within ten years.

To define strategy, one has to identify the work that needs to be done to accomplish the specified goals. Finally, having set the strategies, measures are then defined that allow the work to be measured over time. If the measures track with the goals then you will know that you are on the right track and the strategy should continue. If not, you need to redefine the strategies accordingly.

My main point here is that the work is not defined until the objective and goals are first established, versus the discussions in this meeting that have focused on things that could be done without determining what needs to be done. With the OGSM model you can take any problem and make it much more focused, much more actionable, and much more solvable, but first you have to sort the many issues down to the few.

**James D. Burke, Rohm & Haas:** Earlier, somebody raised the point about promoting chemistry or selling chemistry as their career, particularly in the first year of college. I want to give you an example of that happening.

Some of you may know David Thompson, a faculty member at the College of William and Mary. When he became chairman of that department a number of years ago, he noted that only 15, 16, or 17 chemistry majors were graduated every year. It was a disappointment, because things had not been that way.

As chair, Dr. Thompson appointed himself the lecturer for freshman chemistry and decided to not just teach it, but to motivate the students about why chemistry was so much fun, interesting, and valuable.

He converted a lot of premeds and biology students to studying chemistry so that, three years later, they had 55 students completing a B.S. degree in chemistry. His dean challenged him and said, “Dave, you are soft-balling this course. You are making it easy, you are attracting students who are below average because they need a home, too.” His instinctive response was to get annoyed, but Professor Thompson thought of something better: He got the data. He went back and looked at the admissions folders for all these students and discovered that, in reality, their average SATs were 50 points higher than the norm for the college. In fact, he was not recruiting the less able students at all, but instead the better ones. The department was able to sustain that high level of majors, simply because Professor Thompson had stood up and talked about chemistry as a way of life, as a career, rather than something one takes as a freshman.

So I offer that as an effective example of promoting chemistry as a major.

**Billy Joe Evans, University of Michigan:** I think that many issues impact what we do in chemistry, but to a considerable extent, I think that we in chemistry can override and overcome some of those broad issues and be successful, without having to consider factors outside of our control.

My analysis is that we have to admit that we have not succeeded in making a career in the chemical sciences broadly available to the American public. It is conceivable that even if we were to replicate the model programs presented here, there would be no significant gain overall in the number of minorities and women taking on careers in chemistry at all levels. The great difficulty and the great promise are in serving the economically and socially disadvantaged sectors of our population. The models presented here only hint at what can be done in this connection.

True, chemistry is a beginning, and I agree that is a beginning. There is no need to go back to grade 2 and 3 to make a difference. But in terms of the model presented, I think that is something we can do and measure our success readily.

I also think that we fail to use those paradigms and activities that are unique to chemistry. Again, I think that is something that is in our control.

A word of caution. In our commitment to bring about change, it is essential that we continue to be the scientists that we are. It is critical for us to take the time to fully develop those concepts that are believed to be essential to generating the outcomes that we need.

Important in this connection is the notion of critical mass. I do not believe we understand fully what is meant there. There is the term passion. I do not believe we have fully explored that. Then there are the two terms that we have heard interchangeably: nurturing and mentoring.

In the example of nurturing and mentoring, I would claim that if you have one of those, you do not need the other. We need to be careful about that, because the words that we use turn people on and off to the kinds of things that we would like to change.

Further, I would argue that even if diversity does not continue to be a value, I think we can all agree that the quality and level of participation of African Americans, Hispanic Americans, Native Americans, and women in the chemical sciences are unsatisfactory. We can work to bring about those changes without being bogged down in all of the difficulties and complications that go along with a term like diversity, which also has a nebulous meaning.

I would argue that we hard-nosed chemists who can wipe the dream of a young child out with the strike of a pencil ought to be just as hard-nosed about those things that we know to be valid and adequate and to just say, we are dealing with African Americans, Hispanic Americans, Native Americans, and women. We do not have to carry this diversity baggage with us.

I am speaking to the point made by D. Ronald Webb, who is trained in these kinds of things: Let us be clear about what it is we are trying to change, and then move on. If we are using nebulous language, then there is no way that we can be clear about the kinds of things we would like to bring about.

**Gregory Robinson, University of Georgia:** You raise an interesting point about the nurture and mentor. Do you have a feeling which one of those is more important, or are they equally important?

**Billy Joe Evans:** If you mentor someone, the nurturing will always be appropriate for the person and the situation. If you nurture someone, that may be inappropriate for the person and the situation. It is quite clear that the term we want is mentoring.

I think in terms of the operational definitions that members of the audience have given, that is really what they were saying. I think it is mentoring. We should go with that. It is clear what we mean. There is no issue about appropriateness. For nurturing, there are people who play hardball, and there are kids who can survive in that setting. So let us not raise that this issue of stigma—let us not say that with minorities, you have to be *this* and you have to be *that*. We have to be *this* and we have to be *that* with everybody, but we need to find out who everybody is before we start being *this* and being *that*. So I think mentoring is the superior term.

**Michael P. Doyle, Research Corporation:** Mentoring is the correct format for some of the things we are looking to do. Billy Joe Evans has defined mentoring, and his definition says what I think has been a profoundly important and effective way of bringing students into the chemical workforce and giving them the attention needed for undertaking careers in chemical sciences. That has been studied at the undergraduate level.

I think if there is one way that we could look to enhance, develop, and nurture students to a greater extent to draw people into the chemical sciences, it would be mentoring. But there is another way. It is very important, because it has come out of three of the group sessions and in the presentations. There is a problem in the way we introduce students in their college and university careers to the chemical sciences.

I learned a long time ago that the English departments in our colleges and universities had a much closer attachment to students because, first of all, they restricted the size of their classrooms to 20-30 students; they said that they could not effectively teach any more than that. We have not been so smart about that.

The second thing is that they offered a diversity of entry courses for their subject matter. In other words, their selections were unlimited by offering courses in literature of the 17th century, science fiction, novels, and mysteries. But what do we do for general chemistry? We offer no variety in chemistry. Every college and university does the same thing. And in the end, students are not attracted to chemistry. They are turned off.

Students learn in different ways. Perhaps an introduction to chemistry as it relates to nutrition, or an introduction to chemistry as it relates to the environment would help. Still some would like to hear basic philosophical chemistry that we usually teach. But let us recognize that there is diversity in chemistry.

Fortunately, the ACS Committee of Professional Training does not impose a general chemistry format. It says you have to have a background in chemistry. It is our own individual institutions that have the control to impose a specific format. I found it very interesting; for four years at the University of Arizona I attempted to change the curriculum a little bit, to contract general chemistry, because most of the students were coming in sufficiently prepared to do general chemistry. They can do it as a review course in a semester. I wanted to start organic chemistry as a second course and present it in the second semester. I think we are ready for a lot of interaction. We are going to do it, by the way. We are going to do this.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** It is extraordinarily hard to follow Dr. Evans. It is immeasurably hard to follow both Dr. Evans and Dr. Doyle, so I am not going to try. Incidentally, if you have never seen or heard Dr. Evans talk about mentoring, you should, because it is like Dr. Hrabowski's talk last night: It is a real treat.

I wanted to elaborate on a couple of points. One of the rapporteurs commented about focusing on what we can do at the college level and beyond, and not worry too much about what happens before then. I am sure the implication was not that we do not have to worry at all, but rather, to focus on what we think we can actually do.

We can indeed do something at the college level that does affect that arena below it: teacher preparation. Departments of chemistry have both the obligation and the opportunity to affect in a highly material way the quality and the numbers of the people who become the teachers of those students whom we want to bring into our classes. That is our responsibility, which of course, many institutions are recognizing. This is not a new subject, but I just wanted to get it on the table.

The other point deals with the notion of undergraduates doing research, with which I profoundly agree. If the students are going to do research, there have to be faculty who are doing research. I want to

remind you, who all share a commitment to diversity, that first and foremost you are all scientists and are there to advance and teach the science, or to promote its advancement and teaching. If you let that go, nothing else of substance will happen. Fundamentally, you have to maintain your roles as scientists who do and teach science. The other things will follow from that.

**Isai T. Urasa, Hampton University**: I just want to underscore what Robert Lichter just said about the quality chemistry curriculum that has been implemented at the undergraduate institutions. Even before we can draw up success stories, there are a lot of stories out there that are ongoing, both in the instructional process as well as in undergraduate research that we have identified as being very important.

I think it is critically important that we have good knowledge of what is going on and who are we dealing with at the undergraduate level. If it does not work there, chances are it probably would not work at LSU or any other place.

Perhaps another session should be organized sometime in the not too distant future that would include predominate undergraduate institutions, for I believe there are a lot more stories to be told out there.

**Barbara A. Burke, California State Polytechnic University, Pomona:** I was thinking of more of a practical type of suggestion, which has to do with textbooks. If you page through general chemistry textbook, whose pictures do you see? You certainly do not see Percy Julian, you do not see Gertrude B. Elle, and you do not see Marie Maynard Dailey or other people like them.

I think that is a challenge for those of us who write general chemistry textbooks, to try to infuse diversity into the textbook. I wish there were textbook publishers here who would be able to hear this as a suggestion, to make them more inclusive, which has not been done up to now.

I will tell you about my work. I have been collecting a database on women and minority chemists. It is on the *Journal of Chemical Education* website. The column now has almost 40 women and minority chemists. This includes non-European males. It is, I believe, a valuable piece of work. I use it in my chemistry classes. I have my students write papers on chemists who are not majority-type chemists, and it is very enlightening for them. They go to my website and then they go to other places on the web, or the library, and they find it is difficult to get information on women and minority chemists. So I think we can do more.

**Cornelia D. Gillyard, Spelman College:** What I have to say may be a bit provocative, but I feel strongly about teaching assignments in first-year chemistry courses.

We should give careful consideration to how we place faculty in teaching assignments in freshman chemistry classes. It is my perception (based upon common practices at institutions) that a new hire (junior faculty), with little experience, is typically assigned to teach the lower-level courses populated by students struggling to grasp new and challenging concepts. I do not think that this a good policy because junior faculty are preoccupied with adjustment and career issues, such as doing the right things that will enhance tenure and promotion possibilities.

Speaking from a personal perspective, I am still growing as a professor but, as a senior faculty person, many of the issues of adjustment and tenure have been alleviated. There are some strengths, including confidence and comfort level with the discipline, that I bring to the classroom that are yet to be cultivated in the more junior faculty who are adjusting to the new area of teaching. When senior faculty—who possess a breadth of experiences and who are not preoccupied with doing the right things so that they can get tenure—engage in motivating and teaching freshmen, a rich reservoir becomes available in capturing the attention and peaking the interest of students in chemistry. Seasoned faculty in

the classroom can make a big difference! I offer this comment not as a criticism of junior faculty, but as a point of consideration relative to factors that can affect teaching effectiveness.

In our department, I try to give junior faculty a teaching assignment that matches the strengths they can best offer our majors (their fresh ideas, discipline, and research expertise), in a seminar, discussion, or advanced-level class, for example. I think that we need not deprive our junior faculty of the opportunity to teach some of the upper-level courses populated by students who have already progressed to the point at which they can survive the curricular demands.

# 9

# Diversity in the Industrial R&D Workforce: Challenges and Strategies

D. Ronald Webb
*Procter & Gamble*

It is a pleasure for me to be here today and speak to the topic of "Diversity Models that Work." I want to thank the workshop organizers, and in particular Dr. Isiah Warner, for inviting me. This invitation came, in large part, based upon Dr. Warner's understanding of Procter & Gamble's (P&G's) past success with, and future commitment to, diversity. When first invited, I was not entirely sure how our experiences would complement those from the academic and government sectors. But after listening to the speakers yesterday who represented academe and government, I am now confident that our perspective should be quite helpful.

As manager of doctoral recruiting at P&G, I have the responsibility to attract advanced-degreed candidates to apply for R&D positions with our company. P&G has a commitment to building a diverse workforce, and thus I also own the particular responsibility of ensuring that our applicants represent minority, as well as majority, scientists. This has allowed me to develop an information-based perspective on how successful P&G has been in meeting diversity goals, and I will share these results with you today.

But before I do, I want to roll the clock back to 1971 when I first joined the company. I think that it will come as no surprise that our R&D workforce at that time was a monoculture, comprised largely of white males. Particularly in regards to Ph.D. employees, I saw very few women or people of color. Unfortunately, we heard from the speakers yesterday that this is still an accurate cultural description for departments of chemistry in most of the academic institutions in our country. What is my point? It is that academe should take comfort in the fact that we had the same problem, namely lack of diversity, but we proactively and successfully addressed it. In other words, there are solutions, and I believe they can be successfully modeled. We have made great strides, as I will demonstrate, and we are quite proud of our accomplishments. Can we do more? Absolutely, and we will do more by recognizing that our work here is not done, but needs constant focus and attention.

## WHAT IS DIVERSITY?

First and foremost, diversity is valuing our uniqueness. It has already been pointed out in this workshop that diversity is not just defined in terms of race or ethnicity, but also should be extended to reflect other measures of difference, including sex, age, nationality, cultural heritage, sexual orientation, etc. As I prepared for this presentation, it was unclear to me what the workshop organizers had in mind as they used the term "diversity" in setting today's agenda. I cannot possibly address all measures of diversity, due to time constraints, but instead chose to focus on a few of the more common topics, namely, race and sex. However, I want to assure the audience that we at P&G view diversity in its broadest sense and work very hard to value all of its components.

Diversity is also a matter of ethics. It is "doing the right thing." A diverse workforce is proof positive that the organization respects the individual, providing equal opportunity to all for personal growth and development. A diverse workforce is also an outward indication that all individuals in the organization value diversity. If this were not the case, if diversity was only important to top management, then their majority peers would not make minorities welcome, and lack of retention would be an expected outcome. Respecting diversity yields cultural inclusion, and inclusion provides a positive environment for minorities to feel welcome.

Last, but of equal importance, diversity is a fundamental business strategy for success. Why? P&G markets consumer products globally, and thus we have to understand the needs of very diverse customers. A monoculture of white males cannot have all the answers to all questions. However, by building a diverse workforce, we will better understand such consumer needs, understand them more quickly than our competition, and thereby build and maintain a critically important competitive edge.

## DIVERSITY AT P&G: A CORPORATE PERSPECTIVE

Valuing diversity is today an essential component of building a world-class, global organization at P&G. I recognize that this may sound like a company line, but let me expand on this theme. P&G has a set of core values, with "people" lying at the heart of this core. Thus, other values, such as leadership, trust, integrity, etc., must be seen as secondary. Valuing people first is clearly a natural springboard to valuing diversity

With this as a backdrop, when people are your most important asset, I submit that it is much easier to bring about a cultural change and develop a more diverse workforce when such a workforce may not currently exist. This also fits well with other cultural goals, such as "hiring the test" and "promote from within." By attracting the best applicants, regardless of majority or minority status, and giving them equal access to higher level positions, we build upon any hiring successes we may have and turn them into retention successes. I will come back to retention issues shortly.

I now want to build on a theme highlighted by previous speakers, namely that commitment to diversity must begin at the top. This was essential to the diversity success seen most recently at the University of Maryland, Baltimore County (Dr. Freeman Hrabowski), and at Louisiana State University (LSU) (Dr. Isiah Warner). The message is clear. You have to have someone at the top truly believe that building diversity is the right thing to do, and then see to it that it happens. Leaders must marshal the forces to make change and be consistent in their demand for change to take place. It cannot be an "on again, off again" program, but one of sustained advocacy. In other words, if there is no incentive to change, then change is unlikely to happen.

We are fortunate at P&G, in that building diversity has been the commitment of our top corporate officers for decades. Today, our president and CEO, Mr. A. G. Lafley, recently summed this up by

stating that, "I am putting particular importance on increasing the representation of women and minorities in leadership positions at all levels of the Company." With such unambiguous expectations, it is no surprise that we now have a Corporate Diversity Leadership Council to track diversity progress and hold management responsible for meeting diversity goals and expectations.

I would like to conclude this portion of my talk by highlighting a different aspect of corporate commitment to diversity. Remember that one of my tasks is to attract minority doctoral candidates to seek research and development (R&D) careers with P&G. I submit that my task is incrementally easier if P&G is also sending other, non-R&D-related, positive signals to the minority workforce, demonstrating that ours is an attractive and welcoming culture for such workers. This is what we have done for the majority workers for decades, and it needs to be done for all employees.

P&G has a rich history of embracing diversity. For example, there are a number of industry initiatives that demonstrate, in a very public way, such a message. Perhaps the best example is in our supplier diversity programs. This effort has been in place for more than 30 years and has led to minority suppliers to P&G growing from only 5 to 6 suppliers at that time, to over 1,000 today. As a result, total Company expenditure to minority suppliers exceeded $500 million in 2000.

Similar examples can be cited in the area of charitable giving. The philanthropic P&G Fund contributed about $4.5 million in 2000 to a wide variety of minority-related causes. This included funding for education-focused initiatives, such as the United Negro College Fund, the Hispanic Scholarship Program, just to name two, as well as financial support for other nonprofit organizations such as the National Underground Railroad Freedom Center and the Minority Women's Health Initiative.

Refocusing on R&D, P&G participates in, and/or financially supports, a wide variety of professional societies and organizations. For example, our scientists, minority as well as majority, are active members of such organizations as the Society of Women Engineers, the Society for Advancement of Chicanos and Native Americans in Science and the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE). Dr. Leonard Small, a P&G researcher, is a recent past president of NOBCChE. Such efforts provide us with the opportunity not only to show corporate support, but also to allow our employees the possibility to be a mentor, to network, and to make a difference at the personal level in regard to attracting minority scientists to industrial research careers.

Last, diversity efforts, such as those previously discussed, have resulted in numerous diversity-related awards. It is not possible at this time to identify them all, but some of our more noteworthy examples of public signs of recognition in this area include the Opportunity 2000 Award, presented by the Secretary of Labor in recognition of P&G workforce strategies to ensure equal employment opportunities; the 2000 Corporate Circle Award from the National Medical Association for facilitating the development and use of state-of-the-art biomedical knowledge for improved therapeutics in African American patients; and The 100 Best Companies for Working Mothers, as published in *Working Mother Magazine* (2001). In regard to the latter award, it should be noted that P&G was in the top ten of these 100 companies.

## THE R&D ISSUE: UNDERREPRESENTATION OF MINORITIES IN SCIENCE

P&G averages hiring about 60 Ph.D. scientists each year. Approximately a third are chemists; another third are life scientists; and the latter third are a broad mix of specialties including medicine, statistics, pharmacy, engineering, etc. Thus, this represents P&G's "demand" for advanced-degree candidates. The academic "supply" of such candidates should also be considered. Because the theme of

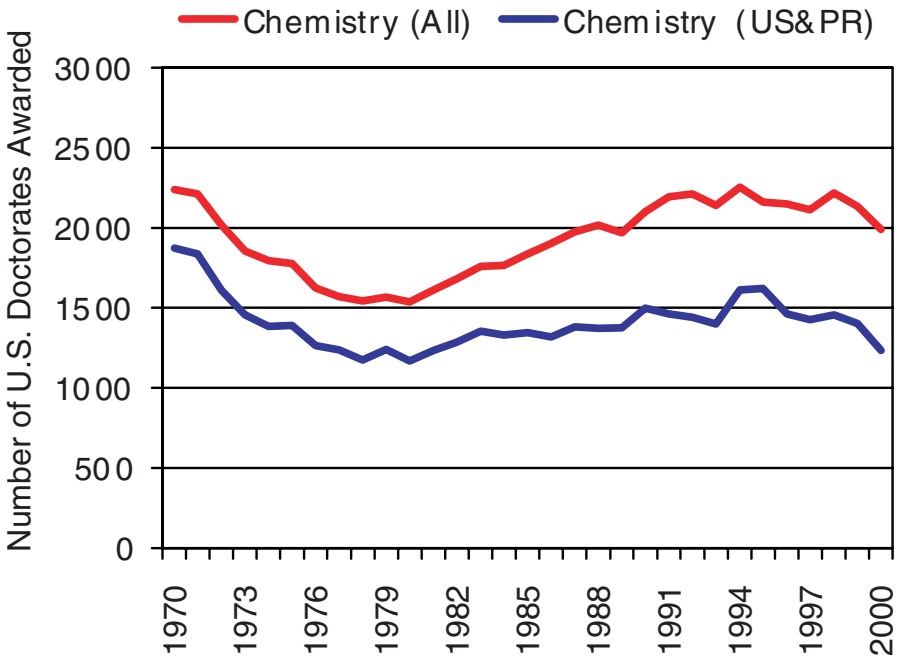


FIGURE 9.1 Doctorate degrees in chemistry awarded in the United States, 1970 to 2000.
SOURCE: National Science Foundation, *Science and Engineering Doctorates: 1960-88*, NSF 89-320, NSF, Washington, DC; and National Science Foundation, Doctorate Recipients from United States Universities: Summary Reports (Individual), 1989 through 2000.

the workshop is "Minorities in the Chemical Workforce," let us concentrate on the U.S. supply of doctorate degrees in chemistry.

Figure 9.1 shows the number of doctorate degrees in chemistry awarded in this country over the past 30 years. The top line in this graph represents the total number of degrees granted annually in the United States, while the bottom line represents the number awarded to only U.S. citizens or permanent residents. I would like to make two points with this figure. First, the total supply has been relatively flat over this time period, roughly averaging about 2,000 doctorate degrees awarded per year. Last, the gap between the top versus the bottom line is a direct measure of the number of doctorate degrees in chemistry that is awarded each year to foreign national students, and this gap has been widening over the past few decades.

A theme we will continue to hear in this workshop is that minorities are underrepresented in the sciences, and chemistry is no exception. I will share the numbers shortly. If the goal is to increase representation of minorities among candidates receiving doctorate degrees in chemistry, then the only successful strategy to reach this goal is to accept more minority students in these graduate programs than have been accepted in the past. However, with a fixed supply of doctorate degrees, this can be achieved only at the expense of others who, in the past, have had relatively greater access to such degrees. We heard yesterday from Dr. Steven Watkins (LSU) that they are changing their historical demographics of their graduate student population by accepting fewer foreign national students and accepting more minority students who are U.S. citizens or permanent residents. This is certainly one approach, but there

are others. My key point is that chemistry departments in the United States must make such tough choices if we are going to narrow the national minority underrepresentation gap in science.

Figures 9.2-9.5 compare and contrast the annual percent representation of different ethnic groups in the U.S. population versus those receiving doctorate degrees in chemistry. For blacks, Hispanics, and women (Figures 9.2-9.4, respectively), it is clear that the percentage of doctorate degrees awarded to each group over the past decade was significantly less than their national representation. In other words, relative to national demographics, these groups are underrepresented minorities in science. In contrast, Figure 9.5 demonstrates that Asians are not an underrepresented group because they receive far more advanced degrees in chemistry than would be expected based upon their national demographic profile. Because this data set is for U.S. citizens or permanent residents only, the significant lack of underrepresentation in science for Asians could be highlighted even more dramatically if I were to also account for those advanced degrees in chemistry awarded to foreign national students who are of Asian descent.

A more compelling case for underrepresentation can be made by considering the number, not the percentage, of advance chemistry degrees awarded each year to minorities. For 2000, blacks received only 44 of the 1,990 doctorate degrees in chemistry awarded by all degree-granting institutions in the United States [1,236 of these degrees (62 percent) were awarded to U.S citizens or permanent residents]. Similarly, Hispanics and women received 50 and 422 doctorate chemistry degrees, respectively,

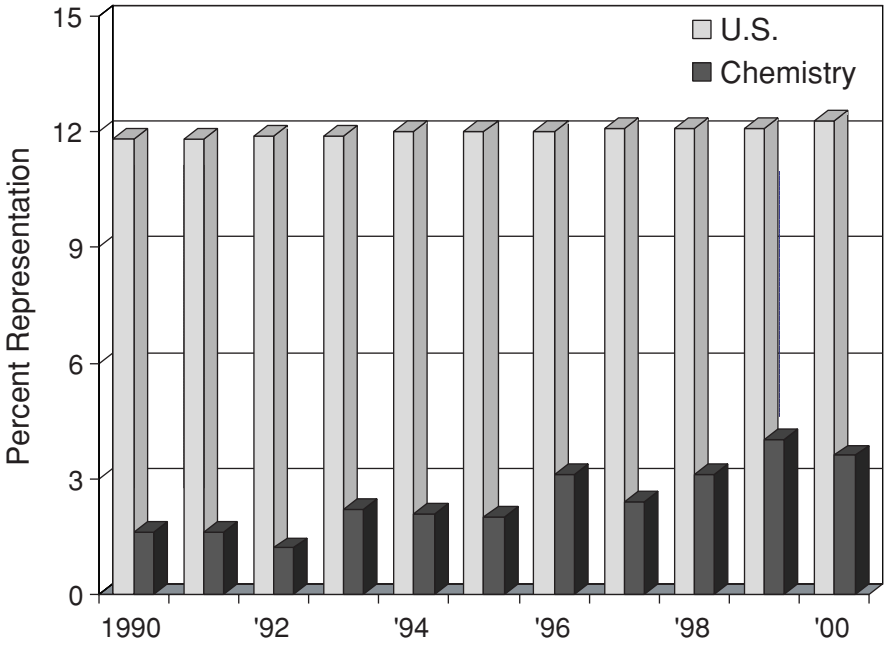


FIGURE 9.2 Representation of blacks in the United States vs. doctorate programs in chemistry, 1990 to 2000. SOURCE: NSF/NIH/NEH/USED/USDA/NASA, *Survey of Earned Doctorates,* Doctorates Awarded to U.S. Citizens and Permanent Residents by Race/Ethnicity, Gender, and Fine Field: 1990-2000, Table 3, National Opinion Research Center, The University of Chicago, Chicago, IL, 2000; and Population Estimates Program, U.S. Census Bureau, Washington, DC, December, 2000.

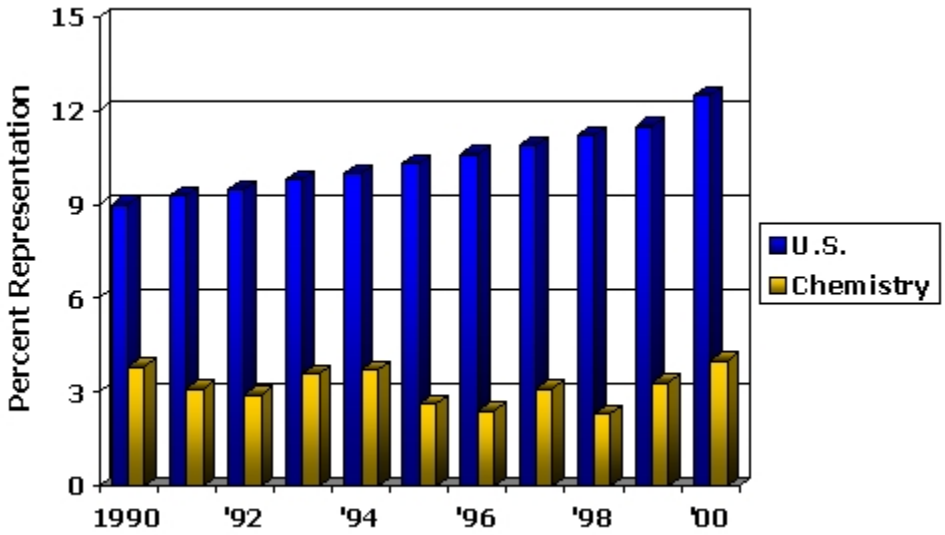


FIGURE 9.3 Representation of Hispanics in the United States vs. doctorate programs in chemistry, 1990 to 2000. SOURCE: NSF/NIH/NEH/USED/USDA/NASA, *Survey of Earned Doctorates*, Doctorates Awarded to U.S. Citizens and Permanent Residents by Race/Ethnicity, Gender, and Fine Field: 1990-2000, Table 3, National Opinion Research Center, The University of Chicago, Chicago, IL, 2000; and Population Estimates Program, U.S. Census Bureau, Washington, DC, December, 2000.

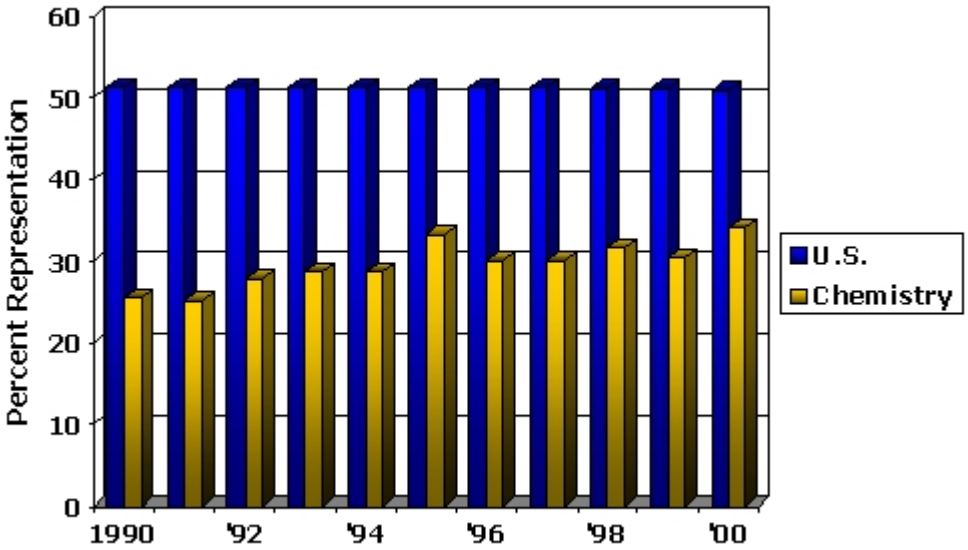


FIGURE 9.4 Representation of women in the United States vs. doctorate programs in chemistry, 1990 to 2000. SOURCE: NSF/NIH/NEH/USED/USDA/NASA, *Survey of Earned Doctorates*, Doctorates Awarded to U.S. Citizens and Permanent Residents by Race/Ethnicity, Gender, and Fine Field: 1990-2000, Table 3, National Opinion Research Center, The University of Chicago, Chicago, IL, 2000; and Population Estimates Program, U.S. Census Bureau, Washington, DC, December, 2000.

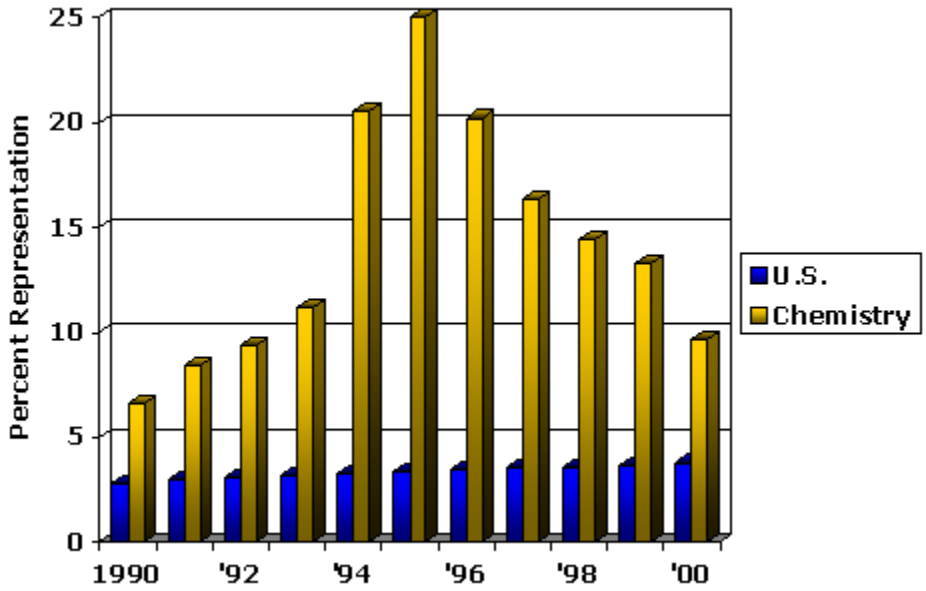


FIGURE 9.5 Representation of Asians in the United States vs. doctorate programs in chemistry, 1990 to 2000. SOURCE: NSF/NIH/NEH/USED/USDA/NASA, *Survey of Earned Doctorates*, Doctorates Awarded to U.S. Citizens and Permanent Residents by Race/Ethnicity, Gender, and Fine Field: 1990-2000, Table 3, National Opinion Research Center, The University of Chicago, Chicago, IL, 2000; and Population Estimates Program, U.S. Census Bureau, Washington, DC.

in the same time period. These numbers are especially noteworthy when one recognizes that the U.S. population demographics for each of these groups are measured in the tens of millions.

## ATTRACTING STUDENTS TO SCIENCE

As highlighted earlier in my talk, P&G is committed to building a diverse workforce, and our R&D community is no exception. However, our ability to attract and hire the best minority scientists is directly impacted by the fact that the number of minority candidates with advanced science degrees is woefully small. P&G cannot immediately or directly fill this academic "pipeline," but we can help by providing a demand for such candidates, and thus indirectly attract more minority students to pursue science careers. Because all aspects of our education system are potential "feeders" into this pipeline, we take the opportunity to interact with all phases of education and, in the end, hopefully make a positive difference.

The first place to start is in K-12 education. Our efforts here are primarily regional and are best exemplified by our Saturday Science program. Each spring, we invite between 60 and 100, predominantly African American, 5th graders to visit one of our research facilities and participate in this event. The students are drawn from a number of our inner-city schools and are selected in partnership with the local chapter of Minorities in Mathematics, Science & Engineering. Our objectives are to excite the students about science, give them a sense of scientific career opportunities, and also give them a chance

to interact with potential mentors and role models. The day begins with a science magic show, which does a wonderful job of setting a positive and up-beat environment, and then moves on to various interactive modules that focus on chemistry, nutrition, or math. Saturday Science is always well received and highly rated by the students and their teachers.

Additional efforts in the K-12 area include P&G's financial support for the National Board for Professional Teaching Standards and my personal participation in the Ohio Mathematics and Science Coalition. The latter is an independent organization committed to continuous, systemic, and sustainable improvement in pre-K-16 mathematics and science education for Ohio's nearly 2 million students.

At the undergraduate education level, one of our more longstanding efforts has been to attract these students to pursue an advanced degree. Giving such students the opportunity to conduct independent research projects is one effective strategy because it allows them the chance to have the challenging and rewarding experience of conducting original research. P&G has summer internship opportunities for undergraduates each year, and this has been a very popular and successful program for us. We also collaborate with local universities who independently developed the same approach. The most notable of these is the big ten's Summer Research Opportunities Program, organized and coordinated by their Committee on Institutional Cooperation. Hundreds of students across the country are invited each year to conduct independent research projects on any of their campuses, and hopefully attract them to choose the big ten conference if they decide to pursue an advanced degree. My office provides financial support for this program, and our employees also participate in their annual celebration event by providing mentoring and role model opportunities to the students.

There are other efforts, too numerous to mention, that P&G relies on to attract undergraduate minority students to science careers. But before I move on, I wish to highlight one that we are very proud of, namely, P&G's financial support of the American Chemical Society (ACS) Scholars Program. ACS conceived this program in 1995 as an effective way to provide scholarships for minority students interested in a chemistry career. It has been very successful, providing more than 600 minority students the opportunity to go to college and obtain an undergraduate degree. Their retention and graduation rate is outstanding, as is the fact that the GPA of their scholars is admirably high.

Turning my attention to graduate students, which is my area of focus, P&G has a number of successful efforts in place to attract minority students to industrial careers. P&G is one of the few companies to offer, to both minority and majority doctoral students alike, summer internship opportunities where they can conduct independent and original research in an industrial setting. We also offer industrial postdoctoral positions to any newly minted Ph.D., in essence mirroring the typically academic model of providing additional two-year research experiences to such candidates. The difference, of course, is that P&G postdocs gain an industrial research experience, which gives them a better understanding of what our employment sector has to offer in terms of professional growth and development. I can add that a large fraction of our postdocs will choose to apply for full-time positions after their postdoctoral contract has expired, and we are happy to make them job offers.

Our most successful, and original, strategy for attracting minority graduate students to industrial careers is our Research and Technical Careers in Industry (RTCI) conference. This is a three-day event, now in its 12th year, which is held each June in Cincinnati. Participants must be doctoral students in chemistry, biology, or engineering and in their final year of degree attainment, or currently finishing a postdoctoral assignment. In addition, the conference is offered to U.S. citizens or permanent residents who are also African American, Hispanic, or Native American. About 24 participants are chosen each year from an applicant pool that averages about 60.

The primary objective of RTCI is to provide a focused, fact-based insight into industrial research career opportunities and thus help conference participants choose between typical career paths such as

industry, academia, or government. Which path they choose is not the issue. With the facts made available, we believe the conference participants are better able to make well-informed career decisions.

What is RTCI all about? It is a conference intended to provide participants the chance to learn more about how industrial research is conducted and managed, network with minority scientists and scientific managers and learn about key factors for success, appreciate the value of team research and its role in bringing about innovation and technology development, evaluate their interview and resume-writing skills, and understand the value of diversity in a corporate culture. The conference is highly rated each year by participants and self-described as one of the more informative conferences many have attended. To learn more about this conference, please go to our website (www.pg.com/rtci) where more detailed information is available.

## RECRUIT, REWARD, RECOGNIZE, AND RETAIN

I would now like to move from discussing generalities of diversity models that work to considering some specific measures of success. The theme of the remaining portion of my talk is recruit, reward, recognize, and retain. These are important concepts in building a diverse workforce, because if you omit any one of them you will substantially decrease your likelihood of success. In other words, it is not enough to just recruit. If you cannot retain minority candidates in your workforce, then the recruiting cycle is nothing more than a revolving door and it yields no net gain. And as I will discuss, rewarding and recognizing your employees, essentially giving them a comfortable and inclusive environment to work in, are the best ways to ensure retention.

Recruit: The recruiting strategy I rely on to attract minority, as well as majority, candidates is fairly standard and easily duplicated by anyone. In addition to the RTCI conference noted above, we continue to rely heavily on campus recruiting. Representatives of my office visit about 40 campuses each year and annually conduct about 600 campus interviews with doctoral chemistry students who are no more than a year away from graduation, or who are completing a postdoctoral assignment.

Although some employers are not relying on this approach as much as they did in the past, I continue to see this as a key recruitment strategy. In any given year, about half of the chemists we hire come from our campus recruiting efforts. Other, and again traditional, strategies for finding candidates is advertising (print and Internet job posting), national meetings of professional societies (e.g., the National Employment Clearing House of the ACS), regional or campus job fairs, referrals, and occasionally search firms.

How are we doing? I conducted a doctoral recruiting benchmark study in 2001 with some of our industrial competitors, and I am pleased to report that we are doing very well. Representatives from Dupont, Dow, 3M, Eli Lilly, Union Carbide, Bayer, and Kodak provided doctoral hiring statistics over the preceding six consecutive fiscal years, which allowed me to compare and contrast such data with ours. Specifically, I evaluated the percentage of new Ph.D.s hired by each company who were black, Hispanic, or female. The data for the two ethnic groups were summed for analysis and presentation, while the hiring statistics for females were analyzed and reported separately. It should be pointed out that there were some nonrespondents, on any of these measures, for any fiscal year. The results are presented in Figures 9.6 and 9.7.

The results in Figure 9.6 show that, with the exception of fiscal 1996-1997, at least 10 percent of the doctoral candidates hired by P&G were either black or Hispanic, with an average annual underrepresented minority hiring rate of 15 percent over the six years measured. To put these numbers into perspective, we need to consider both the academic supply of advanced-degreed minorities as well as the average hiring rate of our industrial competitors.

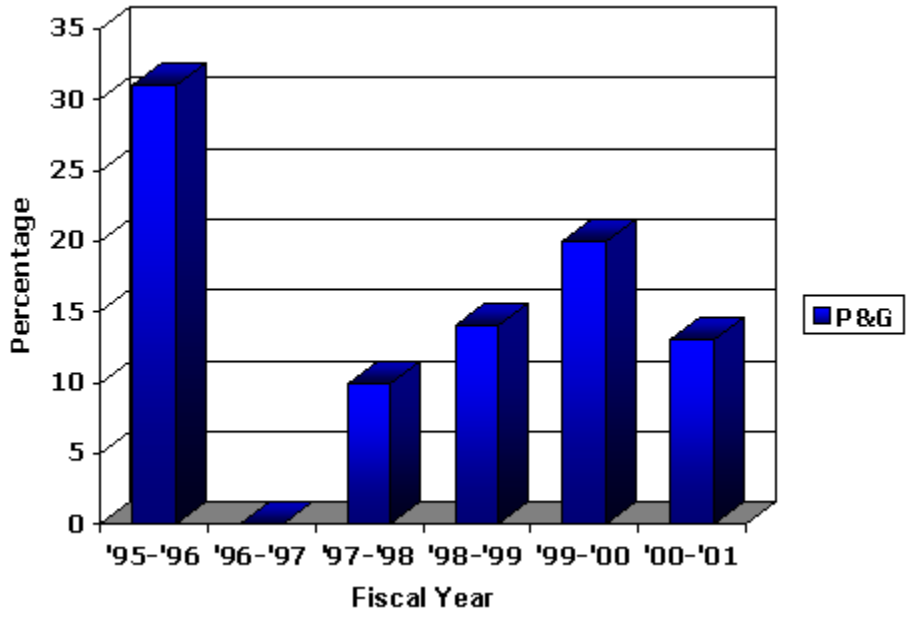


FIGURE 9.6 Annual hiring rate of underrepresented minority doctoral candidates (blacks or Hispanics, combined), 1995 to 2001.

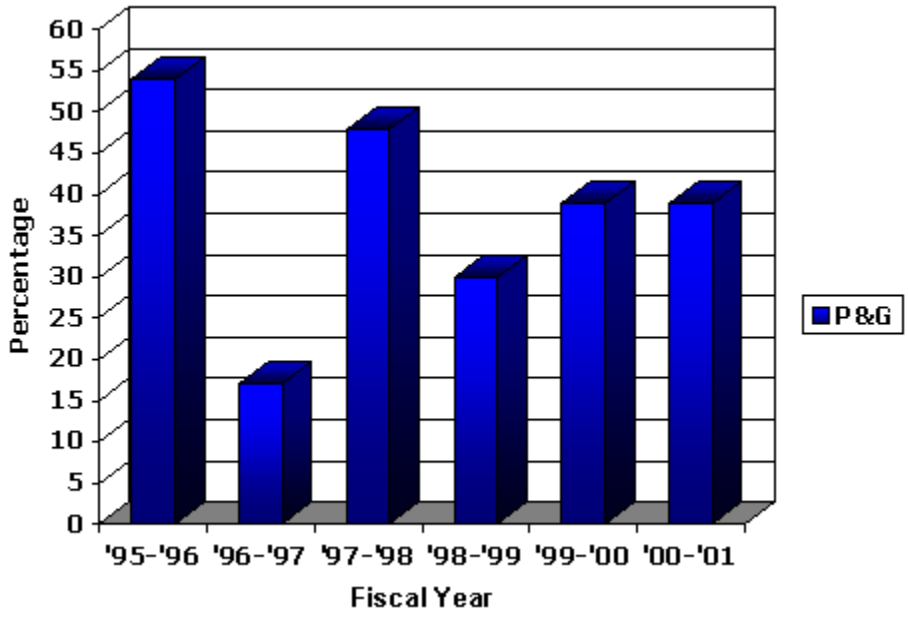


FIGURE 9.7 Annual hiring rate of female doctoral candidates, 1995 to 2001.

Figures 9.2 and 9.3 show that blacks and Hispanics each received about 3 percent of the doctorate degrees in chemistry that were awarded to U.S. citizens or permanent residents over the period of the industrial benchmarking survey (1995-2000), for a combined minority group representation value of 6 percent. Similar values (not reported) exist if one looks at the percent of doctoral degrees awarded to minorities in other fields, including life science and engineering. Thus, the results in Figures 9.2 and 9.3 provide a representative example of the broader issue of underrepresentation in science. It is thus clear that P&G's average annual hiring rate of advanced-degreed blacks and Hispanics (15 percent) is at least two times the academic supply value (6 percent) for this group. This is a conservative estimate, with our hiring rate increasing to about three times the academic supply value if doctorate degrees awarded to foreign national students are included in the analysis.

The benchmark study also indicated that P&G's minority hiring rate exceeds that of our corporate competitors. Over the six years evaluated, the pooled results of the seven industrial partners who participated in this study show that their underrepresented minority hiring rate averaged 7 percent over the six-year period, with a standard deviation of 6 percent (n = 28 data points). P&G is clearly leading the way in building a diverse R&D workforce, and I take great pride in this.

Our results for hiring advanced-degreed women are just as successful. Figure 9.7 shows that P&G's annual hiring rate for women with doctorate degrees ranged from 17 percent to 54 percent over a six-year period, yielding an average annual hiring rate of 38 percent. This average hiring rate exceeds academic supply by a considerable margin (Figure 9.4). P&G's average hiring rate for advanced-degreed women is also greater than that of our competitors, where advanced-degreed women represented about 25 percent of their incoming workforce (standard deviation = 10 percent, n = 31 data points).

It would be appropriate at this time to recognize the success P&G has had in attracting women and minorities to our workforce by looking beyond the R&D sector and focusing on management hiring results. I gathered data for the past two consecutive fiscal years, and I am pleased to report that for fiscal 2000-2001, 35 percent of managers hired were black, Hispanic, or Asian. Note that Asians are included here as a minority group due to their low representation in the U.S. demographics (see Figure 9.4). A similar value (37 percent) was achieved for the last fiscal year reporting period (2001-2002). For perspective, the appropriate comparative value in this case is about 28 percent (sum of U.S. demographics for all three groups, see Figures 9.2-9.4). And while females represent about 50 percent of the U.S. demographics, P&G's management hiring rate for females over the past two fiscal years was 52 percent and 48 percent, respectively. Both measures show quite convincingly that P&G is closing the minority underrepresentation gap, and validating the national diversity awards I spoke about earlier, which have been bestowed upon P&G in the recent past.

Reward and Recognize: There are three key components of a successful reward and recognition program, with ultimate success being measured in terms of retention, and each one is as equally important as any other. These components are (1) performance-based rewards and recognition must be made available to everyone, both for majority and minority employees; (2) public acknowledgment of success (e.g., awards, titles of advancement) is essential in achieving long-term employee satisfaction and professional development; and (3) all employees must proactively bring inclusion of others into all facets of the business.

This latter point, mentioned earlier in my presentation, is crucial. A leader can articulate the vision and set the tone, but the rank and file employees are the ones who bring about cultural change. I recognize that due to our "paramilitary" culture in industry, as compared with academe, it is relatively easier for the industrial rank and file to follow the lead of a leader. However, this is not an excuse for academia to use for justifying their lack of diversity today, but it does indicate that they likely will have

to develop their own strategies for recruiting their rank and file, and ultimately bring about their own cultural change.

P&G's reward and recognition system is best exemplified by our dual-ladder system for promotion. Employees in R&D will choose, early in their career, whether to advance as a technical expert or as a manager of science. Both are equally valued, and this is important, so there is no stigma associated with one choice or the other. The management path for promotion is traditional and basically resembles all other industrial corporations, as well as the tenure track promotion system in academia. But the key here is that such a promotion system is public, not personal and private. It goes beyond a handshake and a raise and awards titles to individuals selected for advancement. Our titles include such terms as section head, associate director, director, company officers, etc. Others may use different titles, but the title used is far less important than its symbol, namely, the outward recognition of personal success.

We modeled this approach in our technical ladder for advancement with titles such as senior scientist, principle scientist, research fellow, etc. Not every industrial employer offers such a dual-ladder system, but I submit it is invaluable in terms of employee retention. This is because if employees have satisfactory choices for promotion, versus the one-size-fits-all approach of a single management system for advancement, then you will have satisfied employees who tend to stay with their employer over the long term.

How are we doing in terms of reward and recognition? Based upon the most recent results I found available (October 2001), 5 percent and 10 percent of our company officers today are female or non-Caucasian, respectively. Importantly, these values are as high as 22 percent among such groups poised for promotion to company officer status. I conclude that we have come a long way from those days 30 years ago when there were neither women nor people of color at such levels in our organization. We are by no means done here, but I submit we have made great progress in the recent past.

Retention: One of the more effective strategies for ensuring retention of minority groups, beyond an effective reward and recognition plan as discussed above, is to proactively provide, and also value, mentoring and support groups. I cannot overemphasize how important this can be. I informally polled a number of blacks, Hispanics, and women in our R&D community, and asked them to share their views on this subject. I heard loud and clear that mentoring and support make them feel more welcome and secure in a majority population. This is no surprise if you realize that mentoring and support, for majority-to-majority individuals, has been in place since the company was founded 165 years ago. It is how we help others to grow and develop. But in this case, we are saying that majority-to-minority mentoring and support may not exist, or may not be as effective as it needs to be for minority populations.

The poll confirmed this, and in their words indicated that mentoring and support by and for minority groups provide a safe, family-like environment to discuss and understand important business issues. Specifically, this includes the opportunity to discuss and understand such topics as successful on-board technique, company politics and business strategies, personal and/or technical resources, models of success and histories of failure, unwritten rules and expectations, obtaining constructive criticism and feedback on performance, and how to develop leadership skills.

Based on this perspective, it should come as no surprise that there are a number of minority mentoring and support groups at P&G, and these are actively supported by majority peers as well as our company leaders. I mentioned RTCI previously, the summer conference designed to highlight industrial research careers for minority scientists. We have hired a number of individuals through this conference, and they use this experience to remain close. They get together to shape the future of RTCI and to participate in the conference in a very active way. In turn, they interact with each other and get something out of it at the personal level. Other more formal P&G support groups include the Black

Technical Ph.D. Group; Black Women's Development Network; Latino Ph.D. Group; and Women Directors and Above in R&D, just to name a few.

If we now look at retention results, as a measure of how we are doing, I can again state that we are doing very well. Based on average turnover data from 1997 to 2000, from all business sectors, the annual turnover rate at P&G was about 6 percent. The turnover for females was slightly less (4.5 percent), whereas the turnover for minorities (black, Hispanic, or Asian) was a little higher (7 percent). I do not have any benchmark data to quote, but anecdotally can share that double-digit turnover rates are not uncommon in business. More importantly, we do not see dramatic turnover rate differences when we look at women or minorities as employee subgroups.

So in conclusion, building a diverse workforce is not easy, but it can be done. Speakers at this workshop have shared examples of success for others to model, and they have some very common themes worth noting. First, to make a cultural change you need an active and unwavering leader or advocate of change. Such an individual will be responsible for defining success, insisting on results, and importantly, holding others accountable for change. You also need the rank and file to embrace the challenge of change. The leader cannot do it alone. Peers of newly hired minority coworkers must be willing to accept them, include them in their working groups, and thus make minorities feel welcome. If this does not happen, you will not be able to retain new hires, and the hiring process essentially makes no net gain in regards to building diversity. And finally, recruiting is a challenge, but as an end result it is not enough. An effective and healthy diverse workforce will be one that offers performance-based rewards and recognition to majority and minority employees alike, which in turn reduces turnover of minority groups.

## DISCUSSION

**Tyrone D. Mitchell, National Science Foundation:** I want to congratulate you on doing a lot of the things right on diversity at your company.

Some of the data I would like to see that you did not show are on retention. Do you track the number of unrepresented groups and women in the "years of service" category? Those data are going to show how well you are doing. For example, in a lot of corporations the "5 to 15 years service" category is not populated with a lot of underrepresented groups, because people tend to wash out during that period of time for various reasons. So, do you have that kind of data available?

**D. Ronald Webb:** Your point is well taken. I have some of the information you asked for, but not all.

I recently looked at this issue, but only for women. On any given year, the percent of women who are leaving the company is, as I said in my talk, about 4.5 percent versus a 6 percent annual turnover rate for all R&D employees. This means males are leaving annually at about a 7.5 percent rate.

We also see a difference when we look at how long females stay in the company relative to males. We have been hiring women since the 1970s. It is now 2002, and in 2001, we saw the first women retire versus leaving at an early stage of their career. More specifically, most women hired into R&D opted to leave prior to a typical retirement age of about 25 years of service, with a 10- to 15-year departure time frame being frequently encountered. Exit interviews showed that they left for all the various reasons you can imagine, such as choosing to stay home and raise a family, help aging parents, or start another career.

**Monica C. Regalbuto, Argonne National Laboratory:** I have a question for you. You have a postdoc program, and I was wondering what percentage of those Ph.D.s that you hire come from that program.

**D. Ronald Webb:** I am not sure I understand the question. P&G hires postdocs in two different ways. First, we hire individuals at an entry-level position who are completing an academic postdoctoral position at a college or university. Second, we offer freshly minted doctoral students the opportunity to get postdoctoral training with us rather than with a university. Which of these two postdoctoral individuals are you talking about?

**Monica Regalbuto:** The latter, the ones that postdoc with you and are then eligible for employment. The reason why I brought this up is, we also have a postdoc program. The younger staff have been resentful and it is what they call slave cheap labor—a mechanism that is being used by many companies, universities, the national labs, and all across the spectrum to keep these employees for two or three years at a much lower-ranked level and pay.

**D. Ronald Webb:** I should first point out that our industrial postdoctoral program is quite modest. We average bringing in about three to five individuals a year, relative to an average doctoral hiring rate of about 60 per year. I should also point out that we do it for positive reasons, not to use them as a cheap labor force. We want to give them the additional postgraduate "seasoning" they seek, but in this case in an industrial rather than an academic environment. Our annual salaries are also quite competitive, currently averaging in the mid-$50s versus the more typical academic pay scale of mid-$30s.

The vast majority of those who participate in our postdoctoral program are eager to apply for full-time employment with us once they have fulfilled their contractual obligations, and we certainly consider them if their skills meet current hiring needs.

Thus, to answer your question, I would estimate that we average hiring about two to three of our postdocs in any given year, which means that, relative to an average hiring rate of 60 per year, these individuals make up less than 5 percent of our new hires.

**James W. Mitchell, Lucent Technologies:** P&G is to be commended for the progress that you have made with respect to diversity. If you analyze what you have there, there are some key elements that have to be present in an institution if you are really going to make progress.

We have some of the same key elements, and I just wanted to mention a couple of them. You certainly have the top-level management, who speaks, and I am sure you also have widely dispersed written information about what the policy was with respect to representation within the institution.

**D. Ronald Webb:** Correct.

**James W. Mitchell:** That has to happen at the top. You also mentioned that people in the down line must also come aboard to make it happen.

**D. Ronald Webb:** Right again.

**James W. Mitchell:** But second, within institutions, in the R&D sector, for the majority of skeptics, there must be someone present—minorities and females—who have already provided existence proof that excellence of performance within them just like it occurs within anyone else. That is certainly necessary to get many of the people to embrace a program and go along with what the CEO says.

Then an institution must have specific programs that fit the corporate culture of that particular institution, and people within that institution have to figure out what are the specific programs that they must put into place.

You then have to have a process for identifying and attracting what I will call minorities and women who are immune against bias and racism. We talked about the perceptions that other people have, based on programs and so forth that are in place. You have to try on people who do not care about the perceptions of other individuals, people who are excellent in terms of their performance and their self-image, and who will come in and perform the scientific and research job that you have for them.

Finally, there are institutions who claim that they cannot find the caliber of individuals that they want to hire. Then you have to do something about generating them. Some 30 years ago, Bell Laboratories claimed that we could not find the number of minorities and women of the caliber that we would like to hire. So we did something to generate them. We now have a postdoctoral program that has a mentoring component and summer research prior to going to graduate school. Over 250 minority and women have finished that program, at a 71 percent completion rate. They have gone to the best schools in the country; 63 of them have academic jobs.

This is not confined to just chemistry alone, but it is all of the fields that we hire in. Those individuals are now in academia, providing a network that can replicate themselves. So when the question came, how can we find the number of people that we need to hire, we told the institution that we need to be in the business of helping to generate them.

Now, corporate America has a better opportunity to make progress than an academic institution, but some of the same ingredients are going to have to occur in an academic department.

**D. Ronald Webb:** I agree wholeheartedly.

**James W. Mitchell:** And on the entire campus, if progress is going to be made there as well.

**D. Ronald Webb:** Thank you.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** I did not come prepared to comment on what James Mitchell just said, but I did want to say something on this notion that "we cannot find them." That is one of the worst excuses given by academic institutions for not making change. Academic institutions have no problem raiding other places, or calling their contacts for help and leads, for the "best" people they want—if they are white. But they seem to have a problem doing this for the "best" people that they want if they are *not* white. There is a disconnect there that I do not get.

I look around this room and I see people who, if I were in an academic department and I wanted to get rid of its monochromaticity, I would go after them like crazy. But somehow they just do not do that, and I do not get it.

Anyway, that is not only why I stood up. I want to commend P&G for being an early and consistent supporter of the ACS Scholars Program.

**D. Ronald Webb:** Thank you.

**Robert L. Lichter:** But I do want to make a correction. The program provides support during the academic year. It has a summer research component, which is not a required part of the program, but it is certainly an encouraged one. Corporate donors who support the program have been very good about hiring these undergraduates for summer research appointments. However, the program's funds provide academic-year scholarships.

Now I have to make a pitch. The program continues to need more and more support. Many here are already contributors, but if there are others who have not already ponied up, please do so. It is a really

good program, one that will make a difference. I think Yvonne Curry mentioned this yesterday, but I will say it again, that 114 ACS Scholars have completed their bachelor's degrees. About half of them are now in graduate school. The first Ph.D. who was an ACS scholar has graduated from MIT and is now doing postdoctoral work at Berkeley.

Here is another example. I recently reviewed proposals in the National Research Council/Ford Foundation predoctoral minority fellowship program. Several applicants were ACS Scholars. So that program will make a difference in changing the numbers.

The other suggestion I want to make is that there is another venue for communicating to the broader community the notion that people who do science are not restricted to the ones that look like you and me. I am specifically speaking of museums. Every major metropolitan area has significant science museums, and smaller areas have them as well. Museum growth is spectacular in this country.

I do not know a lot about most other museums, but I do know a quite a bit about the New York Hall of Science. It has a program for training high school students to be "explainers" about the exhibits to museum visitors. These students come from the New York City school system and are about as diverse a population as you can get. So here is an opportunity both to train and to present to a broader public a broad, diverse array of youngsters who can and do, by that mechanism, become interested in science and who also serve as exemplars for others to become interested in science. That is something P&G might want to look into.

**D. Ronald Webb:** That is a good idea. Thank you very much.

**Myra Gordon, Virginia Polytechnic Institute and State University:** I, too, would like to applaud P&G for what it is doing. I work in faculty recruitment and your presentation has given me better insight into the kinds of things you are doing that make you, in many cases, more successful in recruiting some Ph.D.s than we are.

From the programmatic initiatives you have described, I can certainly understand why many Ph.D.s would choose industry over academia. You pay them more, whereas higher education seems to be struggling everywhere. Industry does not have the promotion and tenure pressures. Women who want families and who want to do good science seem to be able to find a more hospitable environment with you. I see that you are clearly mentoring and nurturing people. You are providing not just technical things that people need to know, but it sounds as though you are also providing networks and places where people can feel connected, cared about, and important.

**D. Ronald Webb:** That is really critical. If you do not provide it, they are not going to be happy and they will not stay.

**Myra Gordon:** The question that I have for you is related to an elitism I see in some of the attitudes that some faculty have about the research done in corporate environments. How much of your research is published? For faculty members in the top-tier research institutions to feel as if the research that is being done in other settings is really good, it must be peer reviewed and published.

**D. Ronald Webb:** P&G encourages our people to publish their research, in all of the most appropriate journals, and also to present their findings at national meetings, network with peers, etc. This is how we communicate to the world that we are doing good science. The only time it tends to be different is that a larger percentage of our work, versus academic research, may eventually lead to a patent. At the time

the proprietary nature of the work is recognized, you have to maintain some secrecy so that it does not become prior art and you lose your patent protection rights. This is not different in kind, but in scale. I would also add that another way we let the world know about the quality of our science is by having patents granted. Obviously, patents signify original research, and we want to take credit for this. We currently have about 27,000 active patents and average filing 8 new ones each year.

If I may, I want to go back to your point that our environment looks better than yours. I will challenge you as I have challenged others personally. Our world is not perfect. I can compare and contrast the benefits of an academic versus an industrial career and demonstrate that each of us has something to offer, as well as things that we would like to change. The things that we do well and do not do well tend to be the exact opposites of you. Said another way, our weaknesses are your strengths and your strengths are our weaknesses.

But that does not mean you just give in to the industrial sector and assume you cannot be effective in attracting new people. Academia needs to understand how to sell themselves. Emphasize the positive and go at it very aggressively by letting recruits know they have choices when it comes to an academic, government, or industrial career. It all comes down to choices.

**Steven F. Watkins, Louisiana State University:** First, I would like to thank P&G for supporting our program. We have a nice relationship with P&G.

**D. Ronald Webb:** You are welcome.

**Steven F. Watkins:** Some of our folks are buried in your blue bars there. My question is, did you mention the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. internships that you support?

**D. Ronald Webb:** Thank you for catching this, but no, I failed to mention the Graduate Education for Minorities (GEM) program.

**Steven F. Watkins:** I would like to pump that program, and ask that the industrial sponsors of GEM consider upping the ante.

The GEM program is a national consortium. All of the companies in this room belong to it, each supporting from one to maybe two or three or four of these very portable fellowships—they are now four-year fellowships—to virtually any institution in the United States. So this is a way to bring minority students into programs. It supports their four years with tuition, a nice little stipend, and so on.

I would urge all of the industrial folks to think about doubling their contribution, if possible. But the point is that this is a global contribution to graduate education. It also could seed your recruitment, because these folks spend a summer in internship in your institutions, and a lot of those people go back after they have gotten their degrees. So it is a good feedback mechanism for you, it is wonderful for us, and it works.

**Billy M. Williams, Dow Chemical Company:** First, I have to commend P&G on an outstanding program from an industrial standpoint. I know that we in Dow have many similar efforts under way, and we are always running into you on campus.

**D. Ronald Webb:** Thank you, and I too am well aware of Dow's presence during the campus interviewing season.

**Billy M. Williams:** A couple of points I wanted to make, and maybe just add to the record a couple of others—what I consider to be best practices or resources for future consideration.

In the K-12 arena, there is a group known as the National Science Resource Center (NSRC) based in Washington, D.C., which is sponsored by the Smithsonian Institution, the National Science Foundation, and the National Academy of Sciences. The NSRC is involved in K-12 educational improvement in the math and sciences. They do have a website, so I will refer you to that if you are looking at sponsorship and support for a very active K-12 support.

**D. Ronald Webb:** I would like to learn more about that. We will talk later.

**Billy M. Williams:** For my other point, you mentioned your affinity groups and employee networks. Within Dow, we have had in place the past several years companywide affinity networks. We now have a women's innovation network, an Asian development network, an African American network, a Hispanic network, and a gay and lesbian network across the company, which we have found to be effective in providing the type of environment that you talked about and that has been discussed in other venues here.

These are supported quite heavily from the top in our corporation and have been effective in helping change the culture and environment across Dow Chemical Company.

**D. Ronald Webb:** Point well taken. Thank you.

**Iona Black, Yale University.** I was wondering if you have tracked your RTCI participants.

**D. Ronald Webb:** No, we do not track them but that might be interesting to do. I know many of them go on to industry, for example, Dow, DuPont, and Pfizer. Others have chosen academia as a career path, with one of our most recent RTCI alumni accepting an assistant professorship at Xavier University in Cincinnati, Ohio. But I cannot speak for all of our former RTCI participants.

**Iona Black:** I was in your first group. I was a second-year graduate student, so I thank you.

**D. Ronald Webb:** Thank you for sharing that.

# 10

# Recruiting and Advancing Minority Scientists: Doing It Right

James D. Burke
*Rohm and Haas Company (retired)*

## INTRODUCTION

Let me begin by dedicating this contribution to the memory of Dr. Joseph Morris and Dr. Slayton Evans. Joe Morris began his career at DuPont and later headed the chemistry department at Howard University. His gift for reading people enabled him to become a mentor *par excellence*. He inspired many students to reach for dreams beyond their grasp and convinced them—sometimes by plain talk—that all they usually had to do to close the gap was to grow. Slayton Evans was in a class by himself. He saw things with great clarity. When he encountered something flawed, his response was not to dismiss it, but, if possible, to redeem it. Slayton was a gifted listener; and he stayed faithful to his calling as a teacher, mentor, and guide. Joe and Slayton were extraordinary men. We owe them a lot, and we miss them.

In my talk, I will start by relating affirmative action and diversity, and introduce the business value of diversity. Then I will discuss what some organizations do to improve their diversity through recruiting, employee development, and advancement. My comments will reflect my experience with my recent employer, Rohm and Haas Company, as well as my familiarity with other organizations.

Diversity is still such a new concept and business practice that little research exists that critiques its impact. However, its value seems intuitively obvious. Most employers are trying to understand what it can offer them. They engage employee groups to explore the opportunities and propose action plans. Then, like scientists, they try to apply a practical logic, learn from trial and error, and expect to be surprised. Wherever the ultimate expression of diversity may take us, the diversity journey is something no organization can afford to miss.

## THE BUSINESS VALUE OF DIVERSITY

Diversity and affirmative action are like different sides of the same coin. Affirmative action uses the

law of the land to ensure equal employment opportunity. It focuses *on employees*. It advocates resources for certain categories of employees to ease their path around obstacles to advancement because of racism or sexism. It seeks ultimately to secure their fair treatment by giving them a path around the institutional barriers that others do not face.

Although affirmative action has achieved much progress, it has been resisted in organizations where management has not challenged the majority's belief that affirmative action creates opportunities for certain employees at the expense of others. Management has too often been passive in helping employees to recognize that team success comes through cooperation and mutual support and that when individual team members are strengthened, the entire team is strengthened.

Diversity achieves the same ends as affirmative action but by a different path. Diversity is a deliberate business strategy to incorporate a spectrum of human resources and perspectives into the organization, with the goal of creating opportunity and competitive advantage for the business. The focus is on using diversity to improve the workforce, innovation, and customer appeal, and thus to advance the *employer*. The "war for talent" has successfully challenged conventional wisdom because the labor pool is changing. Minority groups entering the labor market now represent, in aggregate, the new majority. Companies must make themselves visible to the new majority as preferred employers, because people will choose to work where others like them are visible as leaders.

Companies are beginning to see a linkage between diversity and innovation. Diverse product teams foster intellectual diversity. When you surround problems with different and complementary perspectives, the solutions are more likely to be richer and more widely applicable. In other words, divergence in information gathering will lead to better convergent decisions. General Motors attributes the success of its Saturn vehicle to the diversity of its product design team. Intel also assembled its celebrated Pentium chip design team with diversity in mind.

Diversity enlarges the very notion of customer. Employers cannot help seeing the increasing diversity of their customer base. Customers want products and services designed by companies that understand their needs and respect their diversity. Who can do this better than employees with links to their communities and cultures? It seems inescapable that any company whose customers live in different cultures and different nations ought to have a workforce that is a microcosm of the world it seeks to serve. Companies have come to realize that you can sell only in the language of the customer.

Employers must give careful attention to articulating the business value of diversity to their employees to make sure everyone understands the benefits. It is a tool for creating openness and influencing organizations. Top management must be visible in promoting diversity. It needs champions at the executive level and at the unit level, where hiring occurs. Middle management, where immediate needs and long-term goals can clash, is the battleground. Managers must attack the notion that diversity is somehow in conflict with meritocracy, that it implies softer standards for reward and advancement. Efforts to broaden and transform the organization's future through diversity should be a performance element for managers.

Diversity gives new life to organizations. Incorporating diversity into the organization vitalizes it. If the organization works at eliminating all barriers to talent, the new employees will transform the organization. By contrast, the corporate mission of assimilation, avidly pursued in the 1970s and 1980s, was merely a digestive process to herd new employees into organization uniformity. Through it, organizations could indeed grow but they could not be transformed. Diversity has become a corporate core value and, indeed, a means of survival and growth. It is no longer an option to be pursued "when we can afford it." How does your corporate culture view diversity? What are you willing to try in the name of nondisruptive change? Management will get what it accepts.

## KEY STEPS IN ACHIEVING DIVERSITY

Next, let us explore what companies do to achieve a vibrant workforce through diversity. I will begin with recruiting, then discuss employee development practices, and conclude with advancement practices and an example of diversity paying dividends.

### Recruiting

About 20 years ago I became involved with a group of 10 or 12 research managers and scientists at Rohm and Haas who regularly met to discuss minority recruiting. We called ourselves the Research Division Minority Recruiting Committee. It was a study group to understand the minority recruiting process and make recommendations to me, since I was the recruiting manager. The effort originated with Dr. Jim Clovis, a research director who was years ahead of his peers in valuing diversity. Because I knew this group was ultimately for my benefit, I thought it advisable to be a member. The managers were mostly white but included an African American and a Mexican American. All the scientists were minorities. The group included men and women who were B.S., M.S., or Ph.D. chemists. On the committee, we were equals and all were expected to speak up. Slayton Evans was a consultant for our group.

As a result of several discussions, we finally parsed the minority recruiting process into four separate stages: identifying candidates, attracting them to the organization, interviewing and making them offers, and getting them started. In outline, it is like any other recruiting process. The difference lies in the details.

### Identifying Candidates

Our focus was on students because, at that time, most of our new employees came to us through campus recruiting. We had learned from observing other employers that, if you wait until their year of graduation to identify students, you will have already lost the best ones to your competitors. Thus, we decided to expand our college relations programs with a few chemistry departments in historically black college and university (HBCU) institutions of particular interest to us. Key elements of the program were

- unrestricted funds for the department,
- grants to support the research of specific faculty,
- donations of equipment,
- faculty seminar visits to our site,
- visits to the departments by our scientists who would present seminars and instruct students in advanced instrumental techniques, and
- internships and summer employment for students.

In every department where we recruited, our representatives were expected to identify the minority students—whatever their academic year—and become acquainted with them. At MIT, one of our engineering managers became prominent in supporting and mentoring minority engineering student groups. We became active participants in NOBCChE and the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc., fellowship program. Our involvements were intended to

get us introduced early to students and their educators. These efforts generated a stream of excellent minority students as summer employees, many of whom we later recruited.

## Attracting Candidates

Possibly the most important tool for companies to use in attracting a pool of promising diversity candidates is an appealing summer employment program. In organizing it, the company should seek a critical mass of minority summer employees so that they can also organize their own social community for life outside working hours. If companies design social events into summer employment programs, their minority employees should lead the effort. The objective is to make each summer employee, who may be far from home, feel personally welcomed and respected. A company also benefits by engaging the community and the locale, with their cultural and recreational opportunities, to attract the students as future employees.

An effective summer employment program will have minority students participate in essential work so that their presence will not be perceived as a part of a corporate social mission. Their jobs should be fair tests of their current knowledge and give them opportunities to reinforce what they have learned in the classroom.

We sought to employ students after their freshman or sophomore year as technical assistants. More advanced students were given independent project work, with their managers offering guidance, supervising at an appropriate level, and making sure the students saw how their work fit into the larger team effort. At the end of their terms, upper-division students were expected to present written and oral reports on their work. Coaching beforehand and critique afterward made their seminars a developmental experience. We made employment offers to standout rising seniors as they returned to school and gave them the fall semester to interview other employers before deciding.

Every student employee should be assigned a mentor. We found that matching the mentor and student by race and gender has some obvious value, but less than providing a mentor who is competent and sincerely interested in guiding the student. Using regularly scheduled appointments with the student, the mentor should

- exhort and guide the student to demonstrate professional excellence,
- show him or her how to get things done with and through others,
- make sure the student connects with the professional work community by attending appropriate seminars,
- stimulate his or her thinking on career issues, and
- arrange for the student to be invited to eat with the regular employees.

This last point is important because, too often, minority summer employees will eat by themselves because it is a comfortable thing to do. However, getting together with the regular workers benefits both groups. The mentor should also speak up for the student and collaborate with the manager to ensure a successful summer work experience. In return, the company should recognize mentors for the value they add.

For summer employment programs to contribute effectively to the organization's candidate pipeline and maintain credibility with the academic community and professional societies, they should have continuity. They should not suffer when economic hard times occur. Companies must stay the course with their investments in summer programs, internships, and aid to colleges. Their cost, as a fraction of the corporate budget, is insignificant. Companies that hold diversity as a core value find the money to

sustain their summer employment and other outreach programs. They make them succeed, even when budgets are tight.

Through summer employment and internship programs, employers help to develop the general pool of candidates. Each employer contributes to the students' practical education and helps them get ready for professional life. Some managers express frustration when other employers later hire candidates whom they helped to develop—even though they hire candidates who had been summer employees elsewhere. However, while they are your summer employees, you have a unique opportunity to influence them and predispose them to become your employees later, if circumstances permit. Even if they choose to work elsewhere, they may still speak up for your company within their organizations and in their communities, provided you have treated them with respect, given them work that challenged them to develop, and offered the resources to do so. Properly managed, minority summer employment programs always earn their way and are often worth more than expected. Our summer program was very good, and it had to be. We were well aware of the fine programs in place at DuPont, Procter & Gamble, Union Carbide, Dow, Amoco, and other leading companies competing for the same talent.

## Candidate Interviews and Offers

Looking back at our recruiting practices in the mid-1980s, I think we were somewhat complacent, like many successful companies at the time. We were hiring a lot of talent. And yet we were not satisfied with the quality or quantity of our minority job candidates. We did not know whether the candidate pool was at fault—we thought it was thin—or if we simply did not understand it. We had almost resigned ourselves to just trying harder to meet our goals, when someone offered this insightful question that suggested we change our approach. Suppose you were a job candidate coming to interview for a job with a group of people who did not look like you, did not grow up like you, and did not understand how you felt about some basic issues. What specific things could the employer do to make you feel welcome and at home? We took this question and turned it around: What should we do, how should we respond if an important person, but someone we had never met, was coming to visit?

We decided we would make respect and hospitality priorities. In our pilot effort, we designed our interviews—especially site interviews—of minority scientists and engineers with hospitality and respect in mind. Instead of treating them as a series of candidates, each one would be welcomed as a company guest. Also, there would be no softening of standards for excellence. If anything, we felt that high standards would be taken as a mark of respect, and a good candidate would respond well to them.

Then along came Total Quality Leadership (TQL), a management improvement program developed by W. Edwards Deming. You will recall that Japanese automobile manufacturers used TQL principles to transform their inferior products into the worldwide leading products that remain today. TQL was unique because it used statistical analysis to study problem processes. As scientists, we found that approach appealing.

We organized a team of research managers and scientists for a meticulous TQL study of our Ph.D. recruiting processes. What we discovered was disconcerting: We were causing every one of our problems, and we urgently redesigned all of our recruiting programs. Without going into all the changes we made, let me simply note that respect and hospitality were installed as bedrock principles. Thus, as often happens, a conscious attempt to vitalize a program for minorities resulted in transforming the program for all. The quality of the candidates we hired, including that of minorities, improved significantly; so did our acceptance rate. Slayton said he was impressed.

Regarding offers, we sought to offer a competitive salary, but never top dollar. We believe money should be a wash issue so that candidates will focus on more important items, e.g., the appeal and

challenge of the job, the resources and opportunities provided, and the quality of life on and off the job. We contracted with relocation consultants who were cognizant of diversity issues to address the off-the-job aspects for us. We also recognized our obligation to welcome the candidate's family during the interview process. If the spouse had employment or career needs, or if children had special needs, these were addressed.

## Tracking Talent

Let me return for a moment to the topic of identifying candidates. Everyone recognizes that minorities in chemistry and chemical engineering curricula remain an underrepresented group. So, where do you find them? Only a few universities, such as Georgia Institute of Technology, Howard University, and LSU, have a critical mass of minority Ph.D. students. Like everyone else, we developed our list of preferred sources whom we visited every year. Nevertheless, extra effort was and still is needed. We have found the employment fairs of NOBCChE and National Society of Black Engineers helpful, and occasionally those at American Chemical Society (ACS) national meetings. We always welcomed write-ins, faculty referrals, and employee referrals, recognizing that talent is everywhere. The Graduate Education for Minorities and ACS Scholars programs are excellent sources if you wish to invest time and funds to support their fine students.

There is currently much discussion about how few women and minorities are on chemistry and chemical engineering faculties, especially in the top 50 departments. Every large company I know seeks to identify and attract minority candidates early. Some who are completing their doctoral programs we first knew as college sophomores. One wonders how many more minority chemists and chemical engineers would opt for academic careers if universities tracked them as avidly as companies do.

## Orientation of Diversity Employees

For many organizations, orientation is a short, mechanical process that involves signing the employment agreement, safety indoctrination, and a review of the work rules and practices of the site and new employee's department. These are necessary functions but, if there is nothing more to orientation, the new employee may feel disappointed. When done right, orientation programs will address a variety of needs for the new employee and the organization. They help to

- welcome new employees,
- inform new employees that they are valued within the organization,
- reinforce positive impressions about the employer,
- validate the employee's decision to join the organization,
- provide basic organizational information,
- help new employees understand their jobs and managers' expectations,
- communicate performance standards,
- help bring employees into the organization's culture, and
- set the stage for training and early development.[1]

[1]Hulton III, E.F., and S.S. Naquin, *Helping Your New Employees Succeed*. Barrett-Koehler Publishers, San Francisco, pp. 7-8, 2001.

Orientation programs present many opportunities for organizations to re-recruit their new employees and make all of them understand the commitment to diversity.

## DEVELOPMENT

Organizations take different approaches to employee development. Deeply embedded and venerated corporate values frame what is possible and not possible for employees. If an organization values teamwork as critical, one can expect it to offer training in utilizing diversity as a tool to develop more effective teams. However, if an organization has always promoted success through individual effort and independent activity, offering training programs for adding value though diversity-based teams will seem inconsistent.

Although many companies have excellent developmental programs for employees, few have modules designed specifically for minorities, although minorities may have special issues that need to be addressed. For example, a recent study indicated that African American college graduates in entry-level jobs experience more underemployment and less job satisfaction than other groups.[2] When orientation programs do not address diversity issues, mentors must do so individually.

No matter what values may drive an organization, there are common training areas that all employers should cover. First, one must recognize that college does not train students for the transition to work. In fact, it countertrains them. College is a different world, where the culture and the process for succeeding are so unlike those of the workplace that even the best students will struggle if left to figure things out by themselves. They will focus on applying task-related knowledge and skills, whereas management will be more interested in the new employees succeeding at the nontask elements of their jobs. Task training may be necessary for some, but lack of skills is rarely the reason why employees fail. Management must step up and lead their new employees with integrated training.[3]

The first year of employment sets the tone for the career. The link between initial work experience and employee commitment is well known.[4] More than anything, initial job challenge is the issue.[5] Organizations need to look carefully at new employees' jobs to ensure they offer challenge, so that the employees will feel they are utilizing their talents and abilities. Effective early (first-year) development programs have the following key elements:

- The organization makes early development a priority.
- Early development is an ongoing and structured process.
- Early development begins when the candidate accepts the offer, not the first day of work.
- Early development involves conversation and interaction at all levels of the organization.
- Early development extends through the first year.
- Early development presents goals for nontask as well as task performance.

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[2]Mau, W.C., and A. Kopischke, Job Search Methods, Job Search Outcomes, and Job Satisfaction of College Graduates: A Comparison of Race and Sex. *Journal of Employment Counseling,* 38:141-149, 2001.

[3]Holton III, E.F., The Flawed Four Level Evaluation Model, *Human Resource Development Quarterly*, 7:6-10, 1996.

[4]Meyer, J.P., and N.J. Allen, Links Between Work Experiences and Organizational Commitment During the First Year of Employment: A Longitudinal Analysis. *Journal of Occupational Psychology*, 61:195-209, 1998.

[5]Bray, D.W., R.J. Campbell, and D.L. Grant. *Formative Year in Business: A Long-Term AT&T Study of Managerial Lives.* Krieger Publishing Company, Malabar, FL, 1974.

• Early development teaches everyone in the work unit how to collaborate for a successful first year.

First-year development programs should focus on four areas. The program must help in developing skills at the following levels:

*The Individual*
- Fostering the right attitudes.
- Managing new employees' expectations.
- Cultivating ice-breaking skills.

*People*
- Teaching impression management skills.
- Building effective relationships.
- Teaching good "followership."

*Organization*
- Helping new employees to understand the organizational culture.
- Helping them to adapt to the organization's way of doing things.
- Helping them to understand their roles.

*Work Tasks*
- Help new employees to become work savvy.
- Help them to master the tasks of their jobs.
- Help them to acquire the knowledge, skills, and abilities needed for recognition.

## Success-Building Attitudes

It is essential for new employees to come with the right set of attitudes. The following are attitudes that will serve new employees well:

- Humility: accepting the value of being in a new learning environment
- Adaptability: being receptive to new assignments or training, whenever feasible
- Flexibility: willing to set new personal goals, open to change
- Respect: recognizing the talents of others and the value they bring
- Perspective: understanding the company's goals and their role in achieving them
- Work ethic: going all out, starting on time, and staying focused
- Positive attitude: learning from everything, without complaint

## Mentors

New employees also need mentors. Consistent with the goals of early development programs, the mentor should explain to the employee

- organizational politics—how to get things done within the system,

- the need to work with and through others,
- success through cooperation not competition, and
- how others perceive the employee (but only if the employee asks for it).

### Later Development

When new employees have progressed satisfactorily through their first year or two and are now respected as professionals by their employers, they need appropriate resources for development in their new career stage.[6] Employees need mentors all the way through. They must recognize that professional life is a process based on sponsorship and that mentors are their sponsors. Having a mentor is a visible sign of inclusion.

Professionals also need a professional community, where members gather to make one another successful. Rohm and Haas has one for its research scientists and another for its engineers. We also encouraged membership in ACS, American Institute of Chemical Engineers, and Society of Women Engineers. Additionally, minority employees benefit from membership in a professional community that addresses their particular issues, such as the Society for the Advancement of Chicanos and Native Americans in Science, NOBCChE, and American Indian Science and Engineering Society.

At Rohm and Haas, the Global Black Employees Network (GBEN) began through initiatives of African American professional employees. Its mission is to offer solidarity, mentoring, and career information to its members. A large fraction of these, incidentally, are active members of NOBCChE and thus expect such resources from employers. In the GBEN, mentoring takes several forms. There is traditional top-down mentoring. Considerable peer mentoring also occurs as an expression of the members' commitment to one another's success. Finally, there is "mentoring up," whereby the members offer perspective on diversity and other issues to the highest levels of management.

The GBEN has official status at Rohm and Haas. Its rotating leadership, elected by the group, is responsible for maintaining the conduit to top management and for organizing the annual networking conference. The corporate executive officer and chief operating officer take turns giving the annual conference's keynote address. They devote plenty of time to meet with attendees and exchange information. The conference also features a motivational talk and numerous forums with business value.

Although 2001 was a dismal economic year for Rohm and Haas, as it was for most chemical companies, the GBEN conference proceeded as scheduled. Its budget was not at risk. The company views the GBEN as a good investment. Participants obtain information and ideas, and they become more widely visible. By providing such recognition, the company expects to enhance the value of each member to the organization and to improve the retention of its minority workforce. It also gives top management immediate acquaintance with some of the rising stars.

### Corporate Programs for Developing and Advancing Diversity Employees

Companies seek ways to expedite the advancement of diversity employees. At Bristol-Myers Squibb, to induce managers to place diversity candidates in job openings, an "Evergreen Fund" was created that would subsidize a department with up to a year of a minority employee's salary in exchange for a commitment to retain that employee in the job afterwards. Also at Bristol-Myers Squibb, senior man-

[6]Dalton, G.W., and P.H. Thompson, *Innovations: Strategies for Career Management*, Scott, Foresman & Co., Glenview, IL, 1986.

agement recognized that too few minorities were advancing to upper ranks. In response, they changed the leadership profile to a military officer model. The Corporate Associates Program annually hired three or four minority officers leaving military service. These were assigned to two years of rotational programs, after which they could choose a permanent job or go off to business school, as an employee, for the M.B.A. degree and then come back. The proviso was that the employee would repay the tuition over time and work for Bristol-Myers during the summer between the first and second year. Otherwise, there were no strings. Most did come back.

*Catalyst* is a New York organization that promotes women's issues in business. A few years ago, it recognized Procter & Gamble's Mentoring-Up Program, which assigned 30-40 senior executives to work with up-and-coming women employees as their mentors. The women, in turn, were assigned to educate them about the needs of up-and-coming women employees and how to respond to them. It alerts organizations; opportunities abound for mentoring up, down, and horizontally.

Companies now participate in diversity strategy consortia, to work diversity issues in common and develop best practices for application by the group's members. As one of their participants said to me, "Diversity is a journey; know where you want to go and expect to be surprised."

I close by bringing my presentation full circle, with an example of how investing in diversity pays off. I have a friend, an African American scientist whom I helped to recruit nearly 20 years ago. During his years as a college student and later as an early graduate student, Peter received critically important mentoring from Joe Morris. He is now an executive, and will likely move to a higher level within the next few years. We had a conversation recently about the value that his diversity brings. He sees his contribution having two main dimensions.

Peter recently served as the senior manager of one of Rohm and Haas's overseas units for several years. By virtue of being a black executive, while other companies' leaders there were Caucasian or Asian, he recognized that he was uniquely situated as an ambassador, to influence the way other global organizations regarded his employer. He acted accordingly, and succeeded. Within the company, his diversity enables him to educate, motivate, and mentor others differently. By virtue of the individuality, talents, and culture that he brings to the workplace, he is helping to shape a different and better future for his company than it might experience without him.

And that is what investment in diversity is all about. It is a powerful resource to build a different and better future for all of us.

*Acknowledgment*. In addition to the sources cited, I am indebted to Dr. Carleton Barbour, Mr. Joseph Forish, and Dr. Peter Holmes of the Rohm and Haas Company for important contributions to this presentation.

## DISCUSSION

**Tyrone D. Mitchell, National Science Foundation:** Do you think that the programs that reward white managers with bonuses for doing the right thing in recruiting minorities puts a lot of pressure on minorities, in terms of backlash, and from other managers who do not get those rewards?

**James D. Burke:** That is a good question. I guess it depends on how you do it. If the message is clearly communicated from the top that this is where the organization is going—that as a manager you are expected to support and promote it, it will be a performance element for you, and you do not have a lot of wiggle room—then you do it.

If managers do not want to go along, then their jobs as managers are at risk. I can also say that when I was at Rohm and Haas, I once saw a Ph.D. employee fired because he was chronically disrespectful to a diversity employee of a lower level. That got attention. So you do what it takes. You would rather reward, but sometimes you just need to do what it takes to get their attention.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** You and Rohm and Haas—and I presume that these programs and commitments are continuing even after your departure—are to be commended for setting lots of examples from which universities could learn. But I do want to issue one caution. It gets back to language. We talked about it a little bit yesterday. The expression "diversity employee" or "diversity candidate" is replete with all kinds of potentially negative implications. I caution against using that expression.

Also, the array of programs and activities you have for new employees would be great to have as part of graduate education.

**James D. Burke:** In 1988, there was a symposium by the ACS, and its mission was to try to get graduate school Ph.D. programs to be four years. It was in New Orleans, and I was one of the speakers.

One of the things that I was advocating was to introduce this kind of training at the beginning of graduate school. You do not need to create special orientation courses. Nor do students need to take business classes in order to understand what chemical businesses do. Students need only to read the *Wall Street Journal* and *Chemical & Engineering News* regularly.

No one from any chemistry department known to me has invited faculty from the business school to give a seminar on the nature of the chemical business. It is amazing that this never happens, for often, the business school is just down the street.

I think there is a shared mission here. Faculty who are concerned about the readiness of students should, even if they are in other departments, make themselves available to teach the students. I think we employers must also step up and help. It would be best for us to act concertedly, rather than individually. Instead of chemical employers going to campus merely with presentations promoting our organizations, it would be better if we could cooperatively design a lecture series covering basic training issues and share the responsibility for its presentation. Students and faculty would then understand that there are common issues that employers hold important, even if we approach them in different ways.

**William M. Jackson, University of California, Davis:** First, I would like to acknowledge and commend Rohm and Haas as a company. Back when NOBCChE was founded, they gave us the initial seed money for the organization. So I have known about them a long time.

Secondly, I would like to say that I think I know the guy that you were talking about, because he was in my class. He was probably the only organic chemist who was better than any of the physical chemistry students we had in the class. I tried to lure him into physical chemistry, but he was always smarter than I was and stayed in organic chemistry.

I would like to say that I think we in universities can learn from some of the things that you said. When I went to the University of California, I went to a new-faculty orientation program that they had. I had never had an orientation at any of the other places that I had worked in government, industry, or universities. I had about 15 years experience by that time.

This orientation program was interesting because it gave you a chance to learn something about the culture of the university. Unfortunately, when budget cuts come at a university, these are the things that get cut off. That is one lesson I have learned. I think it is probably a good idea not to cut these things out.

But the other thing that I learned, and it is not always followed, at the orientation they made it very

clear that we in the University of California do not recruit people to fire them. In other words, when we recruit an assistant professor we do so with the expectation that he or she will achieve tenure. It is actually one of the duties of the chair of the department to mentor junior faculty toward tenure. Not all chairs do this. Some of them are very detached. But the deans should be able to insist on more of this kind of mentoring, since they are supposed to be monitoring chairs anyway.

There are things that the universities can do to emulate what has been done in industry. For example, the University of California had a minority postdoctoral program, which unfortunately was cut out because of Proposition 209. That program prepared several minorities for tenure track positions at the University of California, Davis. This program also helped prepare other minorities for such positions at other universities.

These kinds of programs work. They help to increase the diversity in the university. They can be done in ways that do not put stigma on the people involved.

**James D. Burke:** Thank you. I just wanted to comment on that too. There are a lot of examples around about why diversity makes things better. The one that any American ought to be able to understand is professional sports. If diversity works with sports, why not elsewhere?

**D. Ronald Webb, Procter & Gamble:** Very good talk. I enjoyed it. I just wanted to pick up on one thing you said that I did not mention in my presentation, and I want to echo it here because it is important. In attracting a diverse workforce, you cannot lower the bar and you cannot lower expectations. It might work to get someone in the door, but the reality is, as time goes by, everyone is compared with their peers. If they cannot keep up, it will become obvious. They will be unhappy, we will be unhappy, and it does not work.

Having said that, we are talking about models that work in bringing about a diverse workforce. As a doctoral recruiter at Procter & Gamble, I see about a hundred applications for every person we hire. We typically focus on identifying the top four or five candidates to eventually extend one job offer. I submit that the distinctions between the top four or five people out of a hundred applicants are very subtle.

My point is that we will commonly see a woman or a person of color among our top five candidates. However, if the tendency of the hiring manager is to go for the majority person, i.e., the white male, they can justify the decision by stating they hired the "best" person. I submit this can be a case of subtle bias, because we are talking about fine distinctions between individuals at this point of the hiring process. What you need to do is give people chances. It is not necessarily taking risks, because overall their skills and experiences may be very much alike. What you want to do is open up your mind to change and let other people who might not have been picked previously have a chance to be offered a position.

**James D. Burke:** One of the things that we ended up having to do with our recruiters was to say, "If you have a strong candidate and you want to see the person interviewed, for heaven's sake, in your report, will you 'sell' the individual, and not just talk about what they did." Make it irresistible for a manager to say, "I want to have this person in."

# 11

# General Discussion

The Workshop concluded with a general discussion in plenary session that was moderated by Michael P. Doyle.

**Michael P. Doyle, Research Corporation:** This morning we had enormously stimulating discussions of programs that, from everyone's perception, work. They work at Procter & Gamble, they work at Rohm & Haas. One of the points for consideration is, how general are they, how can they be as programs described at Louisiana State University and University of Maryland, Baltimore County, be replicated elsewhere, particularly in the academic enterprise, and perhaps also in government operations.

I think the best practices that have been laid out for us are oftentimes at the back end of any consideration, if they are considered at all. Their flexibility within the corporate structure or within the academic structure is a lot different.

**Isiah M. Warner, Louisiana State University:** I think if we look at our discussions here and at the best practice success models, there is a common theme; several factors are common from academia to industry. The mentoring component is there. There is buy-in by employees in the case of industry and buy-in by faculty in the case of academics. There are at least three or four components that are in common. Buy-in, mentoring, the critical mass sort of thing, even though it was not quite as apparent in the industry forum.

**Participant:** This has been interesting. I saw recruitment as a theme. Recruitment was a theme yesterday and a theme today. I think it is a big issue.

I get concerned, because my sister was a Phi Beta Kappa, a chemistry major, and she works for Kimberly-Clark, but she will not get a Ph.D. I am concerned that we are talking about the chemical workforce as if the Ph.D.s were the only participants there. While they are a good measure of how things are going, Ph.D.s are not the only ones there.

I wanted to talk about recruitment, because I think that the same type of recruitment that goes into

recruiting Ph.D. candidates can go into recruiting people for the chemical workforce. Maybe we need to recruit more people to be chemistry majors.

I was talking to John Schwab about how. This is like a chemical synthesis: Do we want to improve recruitment from 60 to 80 percent? From an industrial point of view it is cheaper, but can you do both if you want to recruit more? Ronald Webb pointed out objectives, goals, strategies, and measures (OGSM). If we have a goal of improving the diversity of the chemical workforce, maybe one goal should be to get two people from every high school who want to major in chemistry. Maybe a strategy should be for universities and businesses to work with high schools and high school teachers to get students interested in science and chemistry. Maybe a part of that strategy could be a small scholarship, such as $2,000. Two people per school, or we will buy all their chemistry books. A company can do that.

We could do things like that. We could have the goal of getting two students out of every high school to major in chemistry. We could have a strategy for doing it with scholarships or buying books or having universities work with schools. It is a measurable objective.

I am pushing recruitment, because recruitment is as important and as useful as most of the other things that we need to try, and we need to try them all.

**Stanley C. Israel, Southwest Texas State University:** If we are talking about the chemical workforce, there is a part of the chemical workforce that we have not addressed except tangentially, and that is the K-12 teachers.

In fact, the other part that we have not really addressed is what happens to our undergraduate students that do not go on for a Ph.D. This is the feedback loop that we are missing. We can affect the pipeline, but what we need is teachers in K-12 who are chemists, who are scientists, who have love of the discipline and can convey the excitement of that discipline to their students.

We are not educating our undergraduates about what is important. That is the only way we are going to greatly affect the pipeline. Across the country, school boards are downgrading the qualifications of the science teacher. Rather than be a chemist and go into the teaching profession, their requirements are teachers who can teach any science course. If they take three courses in each of chemistry, physics, geology, and planetary science, they can then teach any science course in grades 9-12.

That is the trend across the nation, and we should be addressing that with our chemistry students by saying, this is a viable profession for you, K-12th-grade teaching. One other point: It has been said here that we lose a lot of students because chemistry is too hard, and they go over to the liberal arts—to the departments of letters as I like to refer to them—because they get better grades.

Let me explain to you why they are at the departments of letters and we are at the departments of numbers and why they get better grades over there. When one of our chemistry or science students takes an exam and gets 100 and takes the next exam and gets a zero, 100 and zero averages out to 50, and that is an F.

The same student in liberal arts gets an A and an F. An A and an F averages out to a C. They look at science as unforgiving. They cannot make a mistake in science. If they miss an exam, they get a zero, and a zero and 100 equal an F. But over in liberal arts, an A and an F average out to a C. That is why they are in letters and we are in numbers.

**Isai T. Urasa, Hampton University:** Just a comment about orientation. I want to underscore the importance of orientation even in our academic institutions. I would say that orientations are even more important in our academic institutions than in industry.

When you come into academia, there are three things that you are supposed to do: teach, serve, and

research. The order in which you do those things depends on where you are. The emphasis that you place on those things depends on where you are. But you are expected to succeed.

Now, let me make another point. Teaching at the college level is probably the only profession we do not really get trained to do what we do. Most of us do not take teaching lessons. We are not trained to become teachers, so it is almost on-the-job training. You learn as you go along. So orientation is very important. Those of us who have been in it for some time have the responsibility of telling those who are coming behind us some of the loopholes, some of the things you have to do, because you do not get trained formally as a teacher.

At Hampton University, we do a lot of that, because we are now trying to look at those three segments of college levels. They are very important, and we are trying to help people balance their importance.

**Sandra M. Bowe, DuPont:** Just a couple of comments. There is a lot of work going on with regard to science that is associated with diversity. Much is published on this because companies are all trying to correlate the benefits of the work around diversity to the bottom line. So there is some science out there, for instance, calculations as to what we lose after we have invested when people leave a company.

As we evolve in our understanding of diversity, it started out being a program. And now we think of diversity as diversity management, so there is a journey. For that journey of management, we are getting smarter and smarter about opening up our definition of diversity. This morning we have seen some of the dimensions, but, of course, just looking around this room, diversity is much more than the few characteristics that were described this morning.

One of the things that I think is applicable and we ought to rally around and be appreciative of is diversity of thought. Please do not shortchange the constituencies and the people we represent, because diversity of thought for employees is very important. It is how we get problems solved in a different kind of way that is being valued more and more.

**Tyrone D. Mitchell, National Science Foundation:** I want to speak about affirmative action and diversity. The ideal situation would be to have affirmative action and diversity, because people talk about them together like one is replacing the other, but this is not the case at all.

The problem is that there has been affirmative action, and people have bought into that, and people have bought that diversity is going to replace affirmative action. Well, it is not going to do that.

My wife is an expert in both areas. One of the things that we talk about is writing a paper or a book on the downsides of diversity, but the misconception is that people think that diversity is going to replace affirmative action. Affirmative action is a legal ruling. Affirmative action is the law. It was created in a skillful way. If you have government funds, or if you have somebody you are working with that has government funding, then you have to abide by this law.

That brought a lot of companies of a certain size into compliance with hiring and promoting women and underrepresented groups, but with this push now for diversity and the deemphasis on affirmative action, there are a lot of companies, that do not have diversity models like we saw today. That is the problem, because that is where the majority of the workforce is.

So we can talk diversity, but it is going to be a long time before you get some of the smaller companies to pick up on this diversity. Basically, with all these companies it is the bottom line, and the bottom line means making money. It is still a situation in which the last hired is the first fired, I do not care what you say. If you look at any corporation that starts downsizing, you will see who are the people who are gone first.

**Barbara A. Burke, California State Polytechnic University, Pomona:** My colleague, Edward Walton, and I were able to gain a tremendous amount of credibility in changing the way we teach one of our freshmen chemistry courses, because we were able to get National Science Foundation (NSF) and NASA funding. To the people in our department, that raised our credibility. Otherwise, they would have just cast us aside as regular individuals doing our thing. This gave a certain amount of credibility as we demonstrated our ability to go after those curricular grants from these agencies that can be helpful in promoting change. Other people have looked at what we have done in our class and have taken some of that to heart.

The other thing I want to mention is that I do a lot of chemistry magic show type things. But I am always mindful to have any undergraduates help me with these shows, and they come away really jazzed; this is so much fun, I wish we did some of this stuff in our regular chemistry classes, and just talking about the applications of chemistry.

So maybe we just need to involve our undergraduates a little bit more, whether they are a chemistry major or not, in some of these outside activities that show what chemistry is all about and how exciting it can be.

**D. Ronald Webb, Proctor & Gamble:** I want to add something. We discussed the loss of incoming undergraduates who fail and do not make it through the system. We have discussed the rate of people who enter doctoral programs and do not succeed.

However, let us examine the postgraduate who actually gets a Ph.D. that no one wants. These are the people that I seek and the people I try to hire. My competition is the faculty at any university who want to include them as assistant professors. You are not my competition. You do not seek them, you do not woo them. I get them from your campus. That helps me, but there is a point here that it is not fair to the student.

Government is another competitor, and a fair number go to government. But in life science more than chemistry (although chemistry is included), what about the graduating student or Ph.D. that nobody woos, nobody wants? Right now in life science, the average length of stay for a postdoc is four years. I have met students on campus in life science completing their third postdoc, six or seven years after earning their Ph.D. They cannot find a position in industry; they have no place to go.

That is a problem. You have built a huge resource, you have encouraged people to reach for a high goal, you have granted them a degree, and nobody takes them. We cannot absorb all of them in industry. Think about that!

**E. Kent Barefield, Georgia Institute of Technology:** I just wanted to comment to Professor Jackson about doing away with faculty orientation at your university because of cost.

The administration at Georgia Tech puts on a quite lengthy orientation. Spanning four or five days, it has some interesting effects. I am sorry to say that, when I went to Georgia Tech, I did not think I needed to be oriented, so I did not go to the two-day program that they had in those days. That was a mistake on my part, because I did not build the connections with the other people coming in, which is quite a sizable number these days. It builds a camaraderie among the people that come into the group. I see this persisting for many years afterwards, the connections they have made in orientation.

Plus, you do learn about the culture of the place. All institutions have their special culture. I think it is just as important and maybe more so for academic institutions to do this as it is for industry.

**Isiah M. Warner:** I would like to follow up on Ronald Webb's comment about the oversupply. When I was in undergraduate school we used to be taught that a liberal arts education was the best kind of

education you could have, because you can work in all kinds of cross boundaries and work in all kinds of different parts of industry.

I contend that in this century, a science education is the best kind of education you can have. With all of the technology that is being developed, physical chemists have recognized this for a long time. But those students do not have to get jobs in physical chemistry; some of them are working on Wall Street.

If we train scientists for the next generation, there will be jobs. It may not be in chemistry, but there will be jobs. There are jobs out there for people that are science oriented and that are science knowledgeable. This is not going to be a problem in the foreseeable future. In fact, I would like to ask Douglas Raber to speak to what might be possible even at the National Research Council (NRC) and beyond. Could you do that now, because it follows up on exactly what Isai Urasa was thinking about.

**Douglas J. Raber, National Research Council:** My role is normally to give you institutional advice, but I would like to offer a challenge to you. The challenge is for you to turn around and challenge me.

The NRC is a remarkable place. I spend a considerable amount of time working with the scientists and engineers from around the country. Five to ten times a year we hold meetings like this, interacting with the best of the best in the chemical sciences community.

In perspective of the discussions of the past two days, I hear a clear need. Together we must show the rest of the world that our top minority, young scientists are as good as everybody else. We have to do some showcasing.

I challenge you to call me and tell me you have a really good young student who just received his or her Ph.D. and might like to spend a summer here as an intern, or a year with us as a postdoc. Or maybe you know somebody else who is a little older, who would like to come spend a year on sabbatical. The latter might be more difficult, but placing an intern or postdoc is possible, and I believe that we could come up with the funds to do that—I even challenge some of you here who have the funds to support this.

But I believe this is important. Think about it. The NRC is a place where you could send someone for a few months or a year. It is a place where they would meet many people who could help them develop their networks. They could use the time to help themselves succeed as well as benefit our profession, and they would be role models for many others.

**Rigoberto Hernandez, Georgia Institute of Technology:** What would that person do at the NRC?

**Douglas J. Raber:** A postdoc would do things like we are doing right now, for example, by helping us organize these workshops. We usually work as a team, sharing the tasks and responsibilities. For example, many of you have corresponded with Shawn Robertson, who is an intern with us this summer. I am proposing now the idea of recruiting some minority recent Ph.D.s to work with us.

**Isiah M. Warner:** I have a Ph.D. student who wants to go into science writing. Is there an opportunity like that here?

**Douglas J. Raber:** I would say the answer is yes. We produce reports. Those of you who were here for the workshop on "Women in the Chemical Workforce" may remember Susan Morrissey, who was an intern at that time. She subsequently was hired by *Chemical & Engineering News*. So the answer is yes, there are opportunities here right now. It might even be a good experience for somebody who wants to stay in research—to gain the experience here and then go back to the laboratory.

**Participant:** It is time for an American Chemical Society (ACS) plug, for the congressional fellowship program and policy fellowship program that we have at ACS, that is bringing in recent completers of masters and Ph.D.s, who want to go work on Capitol Hill. We need the voice of science on Capitol Hill. When they are looking at basic issues, they need someone who knows what the science is about. We also have a policy fellowship. That person works in our office, deals with policy matters, and puts on congressional briefings and such.

**Krishna L. Foster, California State University, Los Angeles:** My comment comes on the same stream of ideas. I am dealing with the marketing of the chemical workplace. I am teaching general chemistry right now, and what I notice is that the students want to know how the course material applies to the biological sciences, or how some people make huge salaries as chemists. Not only that, but they remember the material for the exams, right?

I think part of the problem that we have not addressed is marketing and letting students know what they can do. All they realize is that it is challenging, it is a high activation barrier to get into the sciences, and that is all they see. Our jobs as professors are not very glamorous, and they do not see any of the other possibilities, or understand what those of us who are faculty enjoy about the jobs.

**Michael P. Doyle:** Thank you very much. It is problem that needs addressed.

**Parry M. Norling, RAND:** I want to speak of one aspect of recruitment or getting people into the chemical workforce that we tried and were only successful to a small degree.

Thirty years ago, I was a plant superintendent. I ran the methyl methacrylate plant in Memphis, Tennessee, for DuPont. It was a time when the farm community furnished most of the workers, most of the wage roll in the plant, and things were changing. We were beginning to get workers from the inner city, primarily having high school degrees.

The thing that was interesting was that the unit that I ran was about 50 percent African American, 50 percent Caucasian, high school educated. During that time the people that were running the plant began to learn a lot of chemistry. We began to realize how smart they were and how much they were excited and interested in how the chemistry was working in the plant and how the process worked.

The thing that was also interesting was that several of them started working back-to-back shifts, or they would work 16 hours a day, and then go to school at night. Continuing education made them another source of employees for the chemical workforce, basically because they started learning chemistry by doing chemistry. They received a degree and essentially moved up in chemistry. Initially they were learning by doing, and this was another source of employees for the chemical workforce.

There was another issue that I found exceedingly difficult. Thirty years ago I had a talented minority working in my group, and I was trying to convince management to transfer her to a higher position. There were still barriers to making that move, and it might take an extra year to convince people in other places. This person was really fantastic, did wonderful work, but there were still internal barriers that management had to work on. This is one of my experiences with diversity management and a case history of one person that is doing a fantastic job still today. But it took a little extra time to get her in the right place.

**Michael P. Doyle:** Did DuPont provide support for the educational advancement?

**Parry Norling:** Yes, the continuing education and providing those funds certainly was one thing. There sometimes could be more education on the job in some cases. But there are certain ways of upgrading

people's education and skills, either on the job or off the job, that can certainly help populate the chemical workforce with more diverse and more talented individuals.

**Michael P. Doyle:** Thank you very much.

**Robert L. Lichter, The Camille and Henry Dreyfus Foundation:** I am going to lower the intellectual level a bit. I have been contemplating a notion that was triggered by a comment somebody made. I mentioned it before: We cannot find them. I am reminded of the old saw about Willie Sutton, why he robbed banks—because that is where the money was. In this case, go where the people are. There was a time when, if you wanted to hire an African American scientist, you called up Dr. McBay. He knew where every African American scientist was, because he taught most of them. Many of his former students are or have been here.

Now that process has been much more delocalized. But you still go where the people are. So go to the Society for Advancement of Chicanos and Native American Scientists meetings, go to NOBCChE meetings, go to a whole host of places where the people are. That is where you are going to find the people to hire.

Similarly, with respect to the notion of students, particularly undergraduates and high school teachers taking part in research: If you are going to do research, go where the research is.

I do not want to get into an argument about whether liberal arts colleges are better places for students to do research than universities, but the fact is that universities are where the research is, because that is what doctoral institutions do. They do not sell themselves well enough as places for undergraduates doing research. I have had people at universities ask me, "Why should we invest our time in undergraduates in our laboratories if they are not going to become chemistry majors?" We do not have time for me to respond to that. Many of the answers are obvious, many of them came up here. The fact is there is a real opportunity and a real obligation for chemistry and other departments to be available for people who are going to benefit from doing chemistry, including those who are not going to be chemistry majors.

Earlier, I mentioned the NRC/Ford Foundation minority predoctoral fellowship program. Everyone who was on the list of finalists in the physical sciences and mathematics panel had done research as an undergraduate. So there is a positive outcome for getting students into research labs, to meet all of those criteria and opportunities that we talked about here—mentoring, nurturing, advancing, opening pathways, strengthening intellectual capacity, strengthening skills, at the earliest possible stages.

Finally, in terms of affirmative action and diversity, the take that I find most useful is that affirmative action is a strategy and diversity is an outcome. Diversity is a characteristic that applies to a group. It does not apply to an individual.

**James D. Burke, Rohm & Haas:** I wanted to ask a question. How many people here are representing community colleges?

**Participant:** There were some here earlier.

**James D. Burke:** More than half of the first- and second-year college students in this country are educated in community colleges.

A leading reason why people go to community college is economics. If you look at how riches are distributed in this country, you are more likely to find an African American or Hispanic in a community college than somewhere else.

So, two thoughts. One is, if colleges want to form better links to historically underrepresented student bodies, they would do well to take a look at their local community colleges to see who can move over. Companies can look in that direction because somebody who has come through two years of chemistry is certainly well qualified to be a chemical technician. Parry Norling fed me this idea, although he did not know it.

When you are employed with a company, certainly a company like Rohm & Haas or DuPont or Procter & Gamble, employees go to college free. The company picks up the entire bill, including books. So there is opportunity. Of course, employees must attend school at night, unless they can get shift work that will allow them to go to school during the day. But they have an opportunity to advance through different kinds of resources.

When I was at Rohm & Haas, the good B.S. chemists were encouraged to go on for the Ph.D. degree. But if they did not, we would encourage them to leave research eventually and maybe go into manufacturing, simply because nobody that I know on campus ever proposes manufacturing chemistry as a viable career. We are very unlike Europe in that way, where industrial chemistry is highly respected.

It would be wonderful if you could have plant managers in Memphis or Knoxville who were successful African American chemists, who now had become respected managers and citizen leaders. But we see little of that, because no one is trying to fill the pipeline of manufacturing chemists with minorities.

**Patricia Phillips-Batoma, University of Illinois at Urbana-Champaign:** I heard people say here that one of the barriers to minority students succeeding in the chemical sciences is perhaps, for certain students, a poor preparation in high school in chemistry, math, and the sciences in general.

But something that was said last night by our speaker Freeman Hrabowski made me think about another possible barrier to their success that we may not have recognized. I was wondering what people might say to the idea that perhaps skills in general are a barrier to success in scientific courses.

**Joseph S. Francisco, Purdue University**: I would like to comment on that. When I was at Wayne State, I always heard in my freshman class, "Dr. Francisco, I really studied for this class. I studied so many hours for this class, and I flunked your test. The problem was you." I constantly heard that.

As an assistant professor, I can relate to what you are saying. That puts extra pressure on me, because my evaluation is going to be low, my worst nemeses are going to use that against me at the promotion and tenure time. I had to be a little bit creative on how to address that issue, to remove the burden of responsibility from me.

So I went over to the University of Michigan, to their social science school, and got a social psychologist to come in the classroom to evaluate me and tell me what I am doing wrong. I could then understand what I need to do better to help these kids, if the problem was me.

She evaluated me, gave me some comments, and it was not bad. I said, I can do that. However, she decided she wanted to come back again. The second time she came back, she sat around the classroom and she watched the students. She watched what they were doing when I was giving them clear instruction of what to think about and what to look for. She discovered that the kids were not listening in terms of basic skills. We, as professors, assume that students all have these skills when we admit them.

When she pointed all these things out to me, I said, "We can work with that. I know what to do." So instead of telling this kid with these deficiencies to go to the university student resource (and feel stigmatized or inferior), we brought the study skills person to the classroom. I then got the social psychology person to come in for some extra things outside the classroom. We addressed that within the

context of the classroom. All those kids who struggled, by the end of the course, were making As and Bs.

We learned something. A lot of kids do not acknowledge that they have a problem. Yet as instructors, if you address these things within the context of the course, in a positive learning process, correction can be made that is successful for all senior courses. We have now published these results in the *Journal of College Science Teaching* (2000), where the results were statistically significant, in terms that it was less threatening to the students and the students were more apt to utilize it.

**Rigoberto Hernandez:** I want to mention something with regard to what Dr. Francisco just said to give further context to his point that stigma is not necessarily self-inflicted. When I first went to graduate school, I went in with an NSF doctoral fellowship. It does not matter that it was a minority scholarship or not; it was a cool thing that I got it and I am happy for anyone who gets either. But my colleagues, my so-called friends, assumed it was a minority scholarship immediately, because they saw the color of my skin or where I originated. So that is a stigma you have to live with, and it exists regardless of whether or not you have your hand out.

The other point I want to address begins by reiterating Jim Burke's comment. Earlier, he said something that was very apropos. He said that among the models that are successful in creating success stories—whether they be faculty, industrial, or not-for-profit success stories—the keys are the same. It does not matter whether the individual is a member of one of these many groups that we have identified. The fact is that when a program is successful, it is going to be successful for everybody. So we need to also look at what things have been done or which techniques have been implemented to bring about any particular success story and bring those in as part of our approaches to achieve success.

I want to give a personal example of this. When I was in high school in the 11th grade, I had the opportunity to participate in a research experience at the Mailman Center at the University of Miami. This had nothing to do with being a minority student; it was just a program within Miami-Dade County, and many of its students took advantage of this opportunity. I am sure that it led to several future scientists. I know, for example, of a friend—not of color—from this program who is now a professor at the University of Washington in physics. The opportunity certainly helped me. Thus such a program was instrumental in creating success stories, but the same elements—providing research opportunities to high-school students—served to create success stories with people of color.

The other point I want to reiterate is what I said about involving the chances of creating success stories to the extent that they are defined within the context of academia. This problem must be discussed within the context of a lack of color in our academic ranks. This is clearly a problem in terms of numbers. (It is also a problem in terms of gender, but we are addressing color.) If we want to fix it, we need to recognize the fact that the chances of success for anyone who obtains a Ph.D. to enter into an academic position is very small, one out of 20 or one out of 50. I obtained this figure using a simple argument involving ratios of large numbers across all chemistry departments. Now, it gets better if you notice that 47 percent of those faculty members in the top 50 chemistry programs, according to funding in the chemical sciences, come from ten of those 50 schools.

So maybe your chances are better than one in 20 if you come from one of those top-ten schools. But we do not have that many Latino Americans or African Americans or Chicano Americans or Native Americans going to those top-ten programs, and for whatever reason only a few of those that do attend those top-ten programs are becoming academic success stories.

Moreover, if we want to solve the problem of the lack of color in our academic workforce, we have to recognize that it is hard to succeed, whatever color you are. I face that difficulty in recruiting students. I tell them, "yes, I love my job, look how cool it is to do what I am doing, and that is why I am doing it,

because it is the thing I always wanted to do, and you should do it too, because you will find job satisfaction for life." However it is hard to honestly tell them that they are going to be offered a faculty position at one of the top 50 institutions at the end of their 15 years of effort.

I use the top 50 as an example. I would argue that it is not a much higher percentage of success for graduating Ph.D.s to obtain an academic position in any Research-I university. It is still a crapshoot. That is why it is hard for me to convince a student to do it. I have graduate students come into my office that tell me, "I do not want your job; you work too hard and you're not clearly rewarded." On the other hand, one of these students already has interviews at two different four-year colleges. She is probably going to do just fine. She is going to love teaching at a four-year college, and I am very proud of her. But part of her choice lies in the fact that she knows the difficulty of going into a Research-I institution.

**Sharon L. Neal, University of Delaware:** I am glad I came to this workshop, but when I first heard about it, my first reaction was, "Oh, no, not another one of these things." My reason for feeling that way was that I was the only black child in my first-grade class. I have been hearing people talk about how to fix this problem for 35 years.

Anyway, what strikes me beyond globalization is that we do not seem to be able to get at a kind of analysis that empowers us to use those four letters, OGSM. This is not very well thought out, because I have just been thinking about it while I have been trying to listen, too. It seems to me that maybe one of the things that is at the bottom of our struggle is that we still have not really embraced dealing with the tension that exists between the maintenance of standards and change.

Now, we all are in this room because we all pretty much agree in the intrinsic value of our public institutions, in particular reflecting the makeup of our population. I love this, because to me this is a democratic ideal. I love America, I love the idea of the importance of the individual, the opportunity for individual actualization, all of this to me is the most important thing. That is why if you get called up for service, you go, because these are noble ideals that mean something to people. Somehow or another, that truth does not get imparted into our conversation about these racial issues. We struggle over the tension that people have. The people who are not pro diversification, are not against democracy, they are not against equality, they are not against the actualization of the individual. So why is it that we have a struggle over this? I do not know the answer to that. But I know that if we can find a way to harness that, then we can do a better job of getting people to buy in, of getting that faculty collusion, of getting the collusion of the middle management, getting the students to buy in.

I want to comment about what Joe Francisco said. If he had been a white guy, those students may have complained, but they more than likely would have thought it was their fault, and they would have took that C or F and they would have gone their merry way. But, when somebody who looks like me, probably even more so than somebody who looks like him, says, "You are inadequate, you got an A in high school but it just was not up to snuff," then it cannot be true. So they march off to the chairman's office and they say, "she is too hard."

This is another important thing. Professor Francisco did not take that in. He said, "Let's be proactive, let's problem solve." I want to be a scientist about this challenge. That is a powerful thing. I think we need to make people resilient to resistance, because resistance is actually a powerful thing for character development. We do not want all the hot feeling to go away, not really. If there is good in the world and there is evil in the world, you want to be on the side of the angels.

**Joseph S. Francisco:** I wanted to reemphasize a point, that Michael Doyle brought out and a point echoed by Robert Lichter. It is the importance of undergraduate research. I feel that you cannot start too soon with that.

I will tell you the reason why it is important. First, I have got to prepare for an ACS talk in April, for which I have been invited to honor this man for his true commitments to undergraduates and undergraduate research.

I want to just reflect on why it is important for me. As an undergraduate going to the University of Texas, one of the reasons why I picked the University of Texas aside from receiving a scholarship, was that I wanted to hide behind my social security number. I did not want anyone to know me, and I did not want my performance to be impacted by someone who saw who I was. Because of the size of the university, I can keep a low profile and perform with my social security number and never be identified and not have to worry about how my performance would ever be compromised.

But I learned that this could never happen, even at the University of Texas. That was the biggest shock. The biggest shock came when Professor Ray Davis one day saw me coming over to pick up my exam and he said to me, "You do not have to worry about your exam and your score, it will not change."

I thought, what does that mean? Upon deeper reflection, I realized it meant that he knew who I was. As it turned out, it was my exam that forced a regrading of the entire class. So he came after class one day and said, "I would like you to come to my office to talk to me." I knew I was in trouble. I just could not imagine why this guy wanted to talk to me. I assumed he thought I was cheating or something like that. I had no positive thoughts whatsoever.

I went there to see him, and I was shaking. He looked at me and said, "I would like to invite you to come into my laboratory and do undergraduate research." This is right after my first semester. I had no clue what undergraduate research was all about. I did not know what that meant. In fact, I was not even a chemistry major at that particular point. But he saw something. Actually, my mission was to go to the New England Conservatory of Music, which did not happen.

But the interesting thing for me was getting into that laboratory, seeing the postdocs, seeing the graduate students, seeing other very bright undergraduates. By the way, one is now on the faculty at Berkeley, one went on to Harvard and works for the BASF Corp. in upper management, and one is at the University of Illinois. These were the members of that group. I got to see how they thought, how they were looking at problems, how they were functioning. By the time I was as sophomore, I had already decided that I was going to go to graduate school.

That was interesting, what Ray Davis did for me, as he did for all undergraduates who came in as freshmen. I did not really know enough about chemistry to do anything and make a worthwhile contribution. But he said, "We are going to give you a Robert Welch Foundation undergraduate fellowship." I needed money. He said, "Do not consider it as work. I just want you to come in here and just be here." That was so important for shaping all the directions that I picked for the past 15 years. That was one of the reasons too that I am always welcome to teach at the freshman level. That is why I always keep undergraduates coming in. Undergraduate research is key to making this impact.

**Derrick C. Tabor, National Institutes of Health:** I want to follow up on some things that Joseph Francsico said, as well as what research is all about, or what it is not about.

We talk about research as being the important thing, that it is important to get students in the laboratory to do research. But I would contend that research and getting them into the laboratory to "do research" is really not what is important. What is important is establishing the relationship with the students. Research just provides the means, because it is that relationship that transforms.

Now, during the process they learn a lot about themselves, but, more importantly I think, they start to feel like they are part of something. The mere fact that someone invites a student, especially an underrepresented student, to come into their laboratory, given all the things that Professor Francisco

described, who did not want recognition as a minority student on campus, to just let them do what they are going to do, and not have a lot of attention brought upon themselves.

I doubt that my white colleagues at the time when I was in school carried these thoughts in their head. That is what happened to me; I was invited. "Derek, why do not you come work in the lab?" And do what? That was not important, but it was the fact that I was invited, the fact that this guy took me in, showed me, helped socialize me to what chemistry and the chemical enterprise were all about.

I would contend that we do not pay enough attention to the fact that it is the relationships that we are starting with our students, especially the relationships that go between different ethnic groups, that help make the change, whether we are working in inorganic chemistry, photochemistry, or organic chemistry. It does not matter. It is really about the relationships.

I think that when we start looking at why things are not working, sometimes it is because people are uncomfortable with establishing the kinds of relationship that so many people in this room are very comfortable in establishing.

**William M. Jackson, University of California, Davis:** The kind of description that Joseph Francisco talked about is what we actually tried at University of California, Davis, with an NSF grant. It was in physical sciences and not just in chemistry. What we found was that just by putting freshmen in the research groups and laboratories of professors, students whose average grade point levels were Cs were raised in the basic core courses—chemistry, physics, and math and calculus were raised to Bs. They were doing research, and then we had some other interventions, but it was an observation that I had made before I got to the Davis campus.

I found another black student, the only one remaining in the second semester out of 200 who left when I was teaching general chemistry. His name is Craig Bond. He is now a Ph.D. in chemical engineering from MIT. He was the first graduate in chemical engineering who went to MIT. I found out later that he left, too, but he went to the other professor and said he was bored, so he came back to my class. I consider that a compliment.

But anyway, he went through the same kind of experience. I have seen African American students walking the halls with chemistry majors who were almost flunking out, and I have gotten them through their undergraduate career just by putting them in my lab. Sometimes I paid them. It is that kind of relationship, talking to them, that you need to do and intervene with. That can be done with no money.

Now, actually we have institutionalized even undergraduate research at Davis through something called the creative work load policy. You get work load credits if you can get undergraduates to sign up for undergraduate research. There are 99s and 199s. When you are a junior you get a 199, before that you are a 99. You get some leave off of the normal work load if you build up enough credit.

This is really a painless way to reduce your teaching load. We have an official teaching load of one undergraduate, one lower division, one upper division, and one graduate course every year for every professor. The smart professors use that.

**Robert L. Lichter:** I want to take slight issue with Derrick Tabor's comments. The relationship is clearly important, and the fact that somebody indicates by such an invitation to come into the laboratory shows that that person really does care about the individual.

In the end, as came out in the summary of the yellow breakout group, you can have all the programs you want, but in the end, it is people that make a difference. However, if you want to invite a student to do research, I will assert that you do not do the student a favor by not having good research.

It is not just a matter of being invited; it is a matter of also being invited to do good research. Otherwise, the student gets misled: Encouraging the student to go to graduate school, into a high-

powered graduate research enterprise, can then be—and you talk about culture shock—pretty hard. There is good anecdotal evidence for this, and it is something that maybe bears some proper study.

But I also want to correct an oversight that I made in my last outburst. I talked about how we used to call up Dr. McBay. The fact is, there are still people you can call up, and some of them are sitting right here—Dr. Gillyard and Dr. Bozeman, and I'm sure Dr. Foster, and anybody at the City University of New York, anyone who teaches in a place where there are large numbers of underrepresented minority students. People know where their students are.

I will say it again: There is absolutely no excuse for anyone who wants to hire faculty members who are not white males to be unable to find them.

**Sylvia Bozeman, Spelman College:** I have been waiting and I have not heard anyone bring up this one subject that we wrestle with in the mathematics community. I have not heard you worry about it in the chemistry community. You can see I am an infiltrator.

We talked about recruiting young faculty from underrepresented groups into the majority institutions, but I have not heard anybody worrying about those faculty members staying there and getting tenure there. Is that not a problem, is that not an issue?

We often worry about what happens to those faculty members, what kind of experience they have, if they progress toward tenure at the same rate and get tenure at the same rate, or maybe at a higher rate than other faculty, given that they are under more scrutiny when they are brought in. What kinds of special issues and challenges do they face in those departments?

We hear stories about students coming to them at all times of the day, even after hours, and worrying if their teaching is good because it is so visible, and then doing research after hours. So maybe you do not have those kinds of issues with young faculty who are at majority institutions, but I just thought I would raise that to see if it is an issue.

**D. Ronald Webb:** I just have a short comment for the record. We have heard about diversity of thought. We have heard about how diversity helps us solve problems. Isiah Warner in his wisdom and other organizers have done something very good. They have brought industry, government, and academia together on a common theme. I think we have all learned we have the same interests and issues, but we have different ways of approaching problems.

I mentioned OGSM. I have heard it mentioned here three or four times. So in the future, as we continue to work this, I am sure all my industry colleagues, as well as the government sector, would agree that we would love to be part of the thinking process to help find a solution and not put the burden only on one sector to the exclusion of the others. I offer that as an invitation to include us.

**Michael P. Doyle:** Thank you very much. This session and its length and its intensity is a tribute to the topics that we are involved with and to the people who have spoken up. I would like to take special recognition of those who gave personal insights to their feelings, their histories, and their involvements, because we are all enriched by what you have said.

So with that, I am going to turn over this microphone to the organizers of the conference, to whom we owe a great deal of gratitude, Isiah Warner and Joseph Francisco, whose time and effort were unmistakably important in making this an unmitigated success. Thank you very much.

## CLOSING REMARKS

**Isiah M. Warner:** It is nice to have a dream, but if the dream does not come true, you are really disappointed. But to have a dream exceed your expectation, you cannot ask for any more than that. The special fuzzy feeling around my heart will be with me for another week, because of what has gone on here in the past couple of days.

I wanted to have something very different happen, from when I have been at other conferences where they have talked about minorities. I think something different has happened in the past couple of days. Now, whether that leads to positive action remains to be seen, but something different will be put on paper. Joseph Francisco and I have been brainstorming about how to get this out further into the community.

The other thing is, I learned something—I have been interacting with one of my colleagues, Saundra McGuire, who is a chemist, but she specializes in chemical education. There is something I never knew anything about, called Bloom's taxonomy. I just learned about this. Bloom's taxonomy has to do with recall. The next steps are interpretation, application, analysis, and all of that sort of thing.

When you put a student into the laboratory, what you are doing is taking that student one notch above into Bloom's taxonomy. Most students come into college operating on the recall level. They memorize it and spit it back out. When you have them working with their hands in the laboratory, you take them up Bloom's taxonomy, so they operate on a higher level of learning. That is why those students' grades begin to improve.

I knew this happened. I did not know why until I started talking with Saundra McGuire. We learn a lot from interacting with our colleagues who are not necessarily just in chemistry research, but colleagues who are in education. I think we need to do more education, more interaction with our people in education, and learn more about things that we had learned by happenstance. We need to learn why they are working, and I think we can do a more effective job.

Thank you for attending the conference.

**Joseph S. Francisco:** Thank you. I have just done a good job of restraining myself from interrupting these discussions. I am very excited here. I want to tell you why I am so excited for this opportunity to interface with all of you and have these important discussions.

Back in 1987, I was privileged to stand in this very room. At that time, a number of talented young chemists were invited here to talk about chemistry departments with the chemical industry, CEOs and vice presidents. Then they brought the faculty of the future, who will be leading the chemistry departments in this century.

I was invited, and I was the only black face. I did not understand why I was there, because I was not from MIT nor from Berkeley. I was from Wayne State University. That was also the anomaly. I thought the only reason why I was there was because they needed a black face. All of you know what I mean. That was my first time experiencing that feeling. Nevertheless, I decided to listen to what the issues were.

Now, one of the big problems back then was the chemical workforce. This is a problem now, but in that discussion, the question at the time was where the bodies were going to come from for the chemical industry. We knew that it would be places like the Eastern bloc countries, where the walls were going to be coming down. This was going to be the opportunity for the chemical workforce, because it was easy, because they had already been trained, and because our economy was moving toward globalization; we

could actually make our workforce appear global. Remember, we wanted to be a global player in the global market with global people.

When I came to the Chemical Sciences Roundtable, I was privileged to hear this discussion on diversity in the chemical workforce, and I have to say, I cannot take credit for the organization of this workshop. It was the discussion of the minorities in the chemical workforce spearheaded by Isiah Warner, Robert Lichter, and Michael Doyle. I came in on the latter part of it. I was delighted when I heard the discussion here at the NRC. We finally have started to look at people in our own backyards.

We have a lot of talent in this country, and that talent has been largely untapped. I am delighted and happy that the NRC and industry and some universities are finally seeing the light about what we have to do to embrace our talent in this country. I hope that all the input and all your contributions and all your stories tell a story in itself that will impact every administrator, every chemistry department in this country for this new century.

# Appendixes

# A

# Workshop Participants

Richard C. Alkire, University of Illinois, Urbana-Champaign
Edna Ambundo, Massachusetts Institute of Technology
Jessica Arkin, Ventures in Education, Incorporated
E. Kent Barefield, Georgia Institute of Technology
Samuel J. Barish, U.S. Department of Energy
David Bergbreiter, Texas A&M University
Iona Black, Yale University
Sandra M. Bowe, E. I. DuPont de Nemours & Co.
Sylvia T. Bozeman, Spelman College
Barbara A. Burke, California State Polytechnic University, Pomona
James D. Burke, Rohm and Haas Company (retired)
Donald M. Burland, National Science Foundation
Thomas W. Chapman, National Science Foundation
Bhanu P.S. Chauhan, City University of New York
Todd Clark, U.S. Department of Energy
Michael Clarke, National Science Foundation
William E. Collins, Howard University
Hernan Cortes, Dow Chemical Company
Yvonne D. Curry, American Chemical Society
Michael P. Doyle, Research Corporation
Sol de Ande Eaton, National Institute of Standards and Technology
Ron Estler, Fort Lewis College
Billy Joe Evans, University of Michigan
Peter Faletra, U.S. Department of Energy
Paul Fitzpatrick, Texas A & M University
Krishna L. Foster, California State University, Los Angeles
Joseph S. Francisco, Purdue University

Fillmore Freeman, University of California, Irvine
Cornelia D. Gillyard, Spelman College
Myra Gordon, Virginia Polytechnic Institute and State University
Richard M. Gross, Dow Chemical Company
Rigoberto Hernandez, Georgia Institute of Technology
Lisa Holland, Kent State University
Michael J. Holland, U.S. Office of Management and Budget
Freeman A. Hrabowski III, University of Maryland, Baltimore County
Sylvia Hurtado, University of Michigan
Stanley C. Israel, Southwest Texas State University
John Jackson, National Science Foundation
William M. Jackson, University of California, Davis
Andy Jorgensen, University of Toledo
Linda Julius, E. I. DuPont de Nemours & Co.
Jack A. Kaye, NASA
Kristen M. Kulinowski, OSA/SPIE Congressional Science Fellow
Albert Lee, National Institute of Standards and Technology
Flint Lewis, American Chemical Society
Robert L. Lichter, The Camille and Henry Dreyfus Foundation, Inc.
Marvin Makinen, University of Chicago
James W. Mitchell, Lucent Technologies
Tyrone D. Mitchell, National Science Foundation
Cheryl O. Morton, American Chemistry Council
Sharon L. Neal, University of Delaware
Iraj B. Nejad, National Science Foundation
Parry M. Norling, RAND
Christie Patton, University of Tulsa
Patricia M. Phillips-Batoma, University of Illinois, Urbana-Champaign
Clifton A. Poodry, National Institutes of Health
Aleeta Powe, Food and Drug Administration
Linda R. Raber, American Chemical Society
Monica C. Regalbuto, Argonne National Laboratory
Gregory Robinson, University of Georgia
Michael E. Rogers, National Institutes of Health
Karla R. Saunders, American Chemical Society
John M. Schwab, National Institutes of Health
John G. Stevens, National Science Foundation
Michael F. Summers, University of Maryland, Baltimore County
Derrick C. Tabor, National Institutes of Health
Crispin Taylor, American Association for the Advancement of Science
Joseph S. Thrasher, University of Alabama
Isai T. Urasa, Hampton University
Matesh Varma, Office of Basic Energy Sciences
C. Reynold Verret, Clark Atlanta University
Charles Walton, Council of Environmental Professionals
Edward D. Walton, California State Polytechnic University, Pomona

Isiah M. Warner, Louisiana State University
Steven F. Watkins, Louisiana State University
D. Ronald Webb, Procter & Gamble
Robert M. Weis, National Institutes of Health
Billy M. Williams, Dow Chemical Company
Josef W. Zwanziger, Indiana University

*Staff:* Sybil A. Paige, Douglas J. Raber, Shawn P. Roberston, Jennifer J. Jackiw, Christopher K. Murphy, David C. Rasmussen

# B

# Biographical Sketches of Workshop Speakers

**Clifton A. Poodry** is the Director of the Minority Opportunities in Research (MORE) Division at the National Institute for General Medical Sciences (NIGMS) at the National Institutes of Health. He is responsible for developing and implementing NIGMS policies and plans for minority research and research training programs. Prior to assuming this position in 1994, he was a Professor of Biology at the University of California, Santa Cruz. Dr. Poodry is a native of Tonawanda Seneca Indian Reservation in Western New York. He 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 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.

**Sylvia Hurtado**, Associate Professor and Director of the Center for the Study of Higher and Postsecondary Education, conducts research on understanding diverse college contexts for the success of diverse college students. Her roles include research and teaching at University of Michigan's Center for the Study of Higher and Postsecondary Education (since 1992). She was a University of California Presidential Postdoctoral Fellow for the Sociology Department and Research Analyst for the Higher Education Research Institute and the Center for the Study of Evaluation at University of California, Los Angeles. Other administrative experience includes Assistant to the Dean, Division of Graduate Studies and Research at the University of California, Santa Cruz (1983-1986); Special Assistant to the Director of Admissions at Massachusetts Institute of Technology (1982-1983); and Assistant Regional Director of Admissions at Princeton University (1980-1982). She obtained a Ph.D. in education from the University of California, Los Angeles (1990), an A.B. in sociology from Princeton University (1980), and an Ed.M. from Harvard Graduate School of Education (1983).

She has served on the Board for the American Association of Higher Education, the Midwest Consortium for Latino Research, the Association for the Study of Higher Education, and the Council of

Division J (Postsecondary Education) of the American Educational Research Association. She was recently named among the top 15 influential faculty whose work has had an impact in the field by *Black Issues in Higher Education*.

Dr. Hurtado has published articles and research reports related to her primary interest in student educational outcomes, campus climates, and diverse students in higher education. Her recent books are entitled *Enacting Diverse Learning Environments* (Jossey-Bass, 1999), and a coauthored book *Intergroup Dialogue* (University of Michigan Press, 2001). She has written numerous articles on student transition to college, access, and on creating campus climates for learning among diverse peers. She also serves on the editorial boards of the *American Educational Research Journal, Journal of Higher Education*, *Sociology of Education*, and was associate editor of the *Review of Higher Education*.

Dr. Hurtado has coordinated several national research projects, including a federally sponsored project on how colleges are preparing college students to achieve the cognitive, social, and democratic skills to participate in a diverse democracy. She is also studying assessment, reform, and innovation in undergraduate education on a project through the National Center for Postsecondary Improvement; she also conducted the National Study of Hispanic College Students, in which she studied several longitudinal cohorts of Latino students entering college in the 1990s.

**Cornelia D. Gillyard** is an Associate Professor of Chemistry at Spelman College and is currently serving as the Chair of the Department of Chemistry. She earned a B.A. in chemistry from Talladega College and M.S. and D.A. degrees in organic chemistry from Atlanta University. Prior to coming to Spelman, Professor Gillyard worked as a research chemist at Battelle Labs in Columbus, Ohio, and in the Nuclear Medicine Laboratory at Ohio State University. At Spelman, Professor Gillyard is involved with students in classroom teaching, mentoring, academic advising, and in directed research.

Her current research activities and interests include the study of organoarsenicals (synthesis and characterization) and the use of spectroscopic analytical procedures for monitoring environmental pollutants and toxins. She has received research and training grants from several agencies, including NASA, the U.S. Department of Energy, Kellogg Foundation, Bureau of Mines, National Institutes of Health, and the National Science Foundation (NSF).

Professor Gillyard's mentoring activities include service as the Director of the NASA Women in Science and Engineering Scholars Program, Co-Project Director of the NSF Research Careers for Minority Students-scholars in chemistry program and Director of the Spelman College Summer Science Program and participates on local and national panels and programs directed toward encouraging young women to pursue advanced degrees in science. Her professional involvement includes service and membership in the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) and the American Chemical Society (ACS) (Women Chemists Committee, ACS Scholars Selection Committee, Blue-Ribbon Advisory Panel for Ministry Affairs, Student Affiliates Task Force, and Committee on Professional Training).

**Michael F. Summers** is Professor of Chemistry and Biochemistry at the University of Maryland, Baltimore County, and Adjunct Professor of Biological Chemistry at the University of Maryland School of Medicine, Baltimore. He received his B.S. degree in chemistry from the University of West Florida, his Ph.D. degree from Emory University, and was a postdoctoral fellow at the National Institutes of Health.

Dr. Summers' research in the area of nuclear magnetic resonance studies of complex biosystems is at the forefront of biomedical research. Each summer approximately 20 undergraduates work in his laboratory. They are given the same responsibilities as graduate students, completing their own projects

and becoming coauthors and first authors in major scientific journals. Dr. Summers also directs the Meyerhoff graduate program for high-achieving minority graduate students. The program now includes 26 minority students. To date, more than 100 graduate and undergraduate students' articles have been published by Dr. Summers' mentees. In 1999, nine of Dr. Summers' students, including seven African Americans, graduated and were admitted to Ph.D. or M.D./Ph.D. programs at leading universities. The research facility under the direction of Dr. Summers is a national model for producing large numbers of high-achieving African American students in areas of vital importance to the nation.

**Steven F. Watkins** is Associate Professor of Chemistry at Louisiana State University in Baton Rouge. He received his B.A. degree from Pomona College and his Ph.D. at the University of Wisconsin (Madison). His research specialty is in structural/materials chemistry using x-ray diffraction, and he has published more than 80 papers. From 1990 to 2000, he was Director of Graduate Studies in the Louisiana State University Chemistry Department.

**Freeman A. Hrabowski III** has served as President of the University of Maryland, Baltimore County since May 1992. His research and publications focus on science and math education, with special emphasis on minority participation and performance.

Born in 1950 in Birmingham, Alabama, Dr. Hrabowski graduated at age 19 from Hampton Institute with highest honors in mathematics, and he received his M.A. (mathematics) and Ph.D. (higher education administration/statistics) at age 24 from the University of Illinois at Urbana-Champaign.

He serves as a consultant to the NSF, the U.S. Department of Education, and universities and school systems nationally, and he sits on numerous corporate and civic boards. Dr. Hrabowski serves as a consultant to the National Science Foundation, the National Institutes of Health, the National Academy of Sciences, the U.S. Department of Education, and universities and school systems nationally. He is a member of numerous boards, including the American Council on Education, Baltimore Community Foundation, Maryland High-Technology Council, and the Joint Center for Political and Economic Studies. He is past president of the Maryland Humanities Council.

**D. Ronald Webb** received his B.Ed. in biological sciences from Miami University in 1971. Following eight years of biological research at Procter & Gamble (P&G) on insecticides, herbicides, plant growth regulators, and antimicrobials, he entered graduate school and obtained a Ph.D. in toxicology from the University of Arizona in 1984. He returned to P&G at that time and assumed positions of increasing responsibility as a toxicologist, product development scientist, and Section Head in Regulatory & Clinical Development. From 1988 to 1998, Dr. Webb had primary responsibility for obtaining national and international regulatory approval for the use of new food additives and food ingredients. During this time period, he also served as a scientific outreach representative for academic institutions, professional societies, the media, and state and local government affairs.

In 1999, Dr. Webb was appointed Senior Manager of Doctoral Recruiting, with direct responsibility for recruiting Ph.D., Pharm.D., D.D.S., D.V.M, and M.D. candidates for all of P&G's U.S. R&D organizations and coordination responsibilities for doctoral recruiting worldwide. In 2001 he was appointed Manager, Doctoral Recruiting and University Relations, in recognition of his increasing level of responsibility in P&G's external relations organization. Dr. Webb also serves as a company representative for national industry associations and as a P&G spokesperson with a number of professional societies.

**James D. Burke** retired in 2001 from Rohm and Haas Company, where he was Manager of Technical Recruiting and University Relations, with responsibility for scientific and engineering recruiting for his company's U.S. locations and for managing university relations programs. In addition to working in synthesis and product development research for seven years, Dr. Burke accumulated 25 years of experience in recruiting and career development programs. He has frequently lectured on these and related topics at various campuses, college placement conferences, and ACS meetings.

A past chair of the Philadelphia Section ACS, Dr. Burke has been an ACS councilor, an ACS career consultant, and is active in his local section. He was Chair of the ACS Committee on Economic and Professional Affairs and the ACS Committee on Local Section Activities. He currently serves on the ACS Board of Directors and is a member of its Executive Committee, Planning Committee and Strategic Alliances Subcommittee, and Professional & Member Relations Committee. He also chairs the Society Committee on Budget and Finance.

Dr. Burke received his B.S. degree in chemistry at Spring Hill College in 1961 and his Ph.D. in organic chemistry in 1965 at the University of California, Berkeley, where he was an NSF Predoctoral Fellow. Before joining Rohm and Haas as a Senior Research Scientist, he was a National Institutes of Health Postdoctoral Fellow at Columbia University.

Dr. Burke's awards include the ACS Division of Professional Relations Henry Hill Award, the Philadelphia Section ACS Ullyot Award, the National Association of Colleges and Employers Employer of the Year Award, Midwest Association of Colleges and Employers Honorary Life Member, and the Big Brother Big Sister Association of Philadelphia's Charles Edwin Fox Award.

# C

# Origin of and Information on the Chemical Sciences Roundtable

In April 1994, the American Chemical Society (ACS) held an Interactive Presidential Colloquium entitled *Shaping the Future: The Chemical Research Environment in the Next Century*.[1] The report from this colloquium identified several objectives, including the need to ensure communication on key issues among government, industry, and university representatives. The rapidly changing environment in the United States for science and technology has created a number of stresses on the chemical enterprise. The stresses are particularly important with regard to the chemical industry, which is a major segment of U.S. industry; makes a strong, positive contribution to the U.S. balance of trade; and provides major employment opportunities for a technical workforce. A neutral and credible forum for communication among all segments of the enterprise could enhance the future well-being of chemical science and technology.

After the report was issued, a formal request for such a roundtable activity was transmitted to Dr. Bruce Alberts, chairman of the National Research Council, by the Federal Interagency Chemistry Representatives, an informal organization of representatives from the various federal agencies that support chemical research. As part of the NRC, the Board on Chemical Sciences and Technology (BCST) can provide an intellectual focus on issues and fundamentals of science and technology across the broad fields of chemistry and chemical engineering. In the winter of 1996, Dr. Alberts asked BCST to establish the Chemical Sciences Roundtable to provide a mechanism for initiating and maintaining the dialogue envisioned in the ACS report.

The mission of the Chemical Sciences Roundtable is to provide a science-oriented, apolitical forum to enhance understanding of the critical issues in chemical science and technology affecting the govern-

[1] *Shaping the Future: The Chemical Research Environment in the Next Century,* American Chemical Society Report from the Interactive Presidential Colloquium, April 7-9, 1994, Washington, DC.

ment, industrial, and academic sectors. To support this mission, the Chemical Sciences Roundtable does the following:

- Identifies topics of importance to the chemical science and technology community by holding periodic discussions and presentations and gathering input from the broadest possible set of constituencies involved in chemical science and technology.
- Organizes workshops and symposia and publishes reports on topics important to the continuing health and advancement of chemical science and technology.
- Disseminates the information and knowledge gained in the workshops and reports to the chemical science and technology community through discussions with, presentations to, and engagement of other forums and organizations.
- Brings topics deserving further, in-depth study to the attention of the NRC's Board on Chemical Sciences and Technology. The roundtable itself will not attempt to resolve the issues and problems that it identifies—it will not make recommendations nor provide any specific guidance. Rather, the goal of the roundtable is to ensure a full and meaningful discussion of the identified topics so that the participants in the workshops and the community as a whole can determine the best courses of action.