

Free Executive Summary

Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering



Committee on Maximizing the Potential of Women in Academic Science and Engineering, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine

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SUMMARY

The United States economy relies on the productivity, entrepreneurship, and creativity of its people. To maintain its scientific and engineering leadership amid increasing economic and educational globalization, the United States must aggressively pursue the innovative capacity of *all* of its people—women and men. Women make up an increasing proportion of science and engineering majors at all institutions, including top programs such as those at the Massachusetts Institute of Technology where women make up 51% of its science undergraduates and 35% of its engineering undergraduates. For women to participate to their full potential across all science and engineering fields, they must see a career path that allows them to reach their full intellectual potential. Much remains to be done to achieve that goal.

Women are a small portion of the science and engineering faculty members at research universities, and they typically receive fewer resources and less support than their male colleagues. The representation of women in leadership positions in our academic institutions, scientific and professional societies, and honorary organizations is low relative to the numbers of women qualified to hold these positions. It is not lack of talent, but unintentional biases and outmoded institutional structures that are hindering the access and advancement of women. Neither our academic institutions nor our nation can afford such underuse of precious human capital in science and engineering. The time to take action is now.

The National Academies, under the oversight of the Committee on Science, Engineering, and Public Policy, created the Committee on Maximizing the Potential of Women in Academic Science and Engineering to develop specific recommendations on how to make the fullest possible use of a large source of our nation's talent: women in academic science and engineering. This report presents the consensus views and judgment of the committee members, who include five university presidents and chancellors, provosts and named professors, former top government officials, leading policy analysts, and outstanding scientists and engineers—nine of whom are members of the National Academy of Sciences, National Academy of Engineering, or the Institute of Medicine, and many of whom have dedicated great thought and action to the advancement of women in science and engineering. The committee's recommendations—if implemented and coordinated across educational, professional, and government sectors—will transform our institutions, improve the working environment for women and men, and profoundly enhance our nation's talent pool.

Findings

1. Women have the ability and drive to succeed in science and engineering. Studies of brain structure and function, of hormonal modulation of performance, of human cognitive development, and of human evolution have not found any significant biological differences between men and women in performing science and mathematics that can account for the lower representation of women in academic faculty and scientific leadership positions in these fields. The drive and motivation of women scientists and engineers is demonstrated by those women who persist in academic careers despite barriers that disproportionately disadvantage them..

2. Women who are interested in science and engineering careers are lost at every educational transition. With each step up the academic ladder, from high school on through full

professorships, the representation of women in science and engineering drops substantially. As they move from high school to college, more women than men who have expressed an interest in science or engineering decide to major in something else; in the transition to graduate school, more women than men with science and engineering degrees opt into other fields of study; from doctorate to first position, there are proportionately fewer women than men in the applicant pool for tenure-track positions; active recruiting can overcome this deficit.

3. The problem is not simply the pipeline. In several fields, the pipeline has reached gender parity. For over 30 years, women have made up over 30% of the doctorates in social sciences and behavioral sciences and over 20% in the life sciences. Yet, at the top research institutions, only 15.4% of the full professors in the social and behavioral sciences and 14.8% in the life sciences are women—and these are the only fields in science and engineering where the proportion of women reaches into the double digits. Women from minority racial and ethnic backgrounds are virtually absent from the nation’s leading science and engineering departments.

4. Women are very likely to face discrimination in every field of science and engineering. Considerable research has shown the barriers limiting the appointment, retention, and advancement of women faculty. Overall, scientists and engineers who are women or members of racial or ethnic minority groups have had to function in environments that favor—sometimes deliberately but often inadvertently—the men who have traditionally dominated science and engineering. Well-qualified and highly productive women scientists have also had to contend with continuing questioning of their own abilities in science and mathematics and their commitment to an academic career. Minority-group women are subject to dual discrimination and face even more barriers to success. As a result, throughout their careers, women have not received the opportunities and encouragement provided to men to develop their interests and abilities to the fullest; this accumulation of disadvantage becomes acute in more senior positions.

These barriers have differential impact by field and by career stage. Some fields, such as physics and engineering, have a low proportion of women bachelor’s and doctorates, but hiring into faculty positions appears to match the available pool. In other fields, including chemistry and biological sciences, the proportion of women remains high through bachelor’s and doctorate degrees, but hiring into faculty positions is well below the available pool.

5. A substantial body of evidence establishes that most people—men and women—hold implicit biases. Decades of cognitive psychology research reveals that most of us carry prejudices of which we are unaware but that nonetheless play a large role in our evaluations of people and their work. An impressive body of controlled experimental studies and examination of decision-making processes in real life show that, on the average, people are less likely to hire a woman than a man with identical qualifications, are less likely to ascribe credit to a woman than to a man for identical accomplishments, and, when information is scarce, will far more often give the benefit of the doubt to a man than to a woman. Although most scientists and engineers believe that they are objective and intend to be fair, research shows that they are not exempt from those tendencies.

6. Evaluation criteria contain arbitrary and subjective components that disadvantage women. Women faculty are paid less, are promoted more slowly, receive fewer honors, and hold fewer leadership positions than men. These discrepancies do not appear to be based on productivity, the significance of their work, or any other measure of performance. Progress in academic careers depends on evaluation of accomplishments by more senior scientists, a process widely believed to be objective. Yet measures of success underlying the current “meritocratic” system are often arbitrary and applied in a biased manner (usually

unintentionally). Characteristics that are often selected for and are believed, on the basis of little evidence, to relate to scientific creativity—namely assertiveness and single-mindedness—are given greater weight than other characteristics such as flexibility, diplomacy, curiosity, motivation, and dedication, which may be more vital to success in science and engineering. At the same time assertiveness and single-mindedness are stereotyped as socially unacceptable traits for women.

7. Academic organizational structures and rules contribute significantly to the underuse of women in academic science and engineering. Rules that appear quite neutral may function in a way that leads to differential treatment or produces differential outcomes for men and women. Structural constraints and expectations built into academic institutions assume that faculty members have substantial spousal support. The evidence demonstrates that anyone lacking the work and family support traditionally provided by a “wife” is at a serious disadvantage in academe. However, the majority of faculty no longer have such support. About 90% of the spouses of women science and engineering faculty are employed full-time; close to half the spouses of male faculty also work full-time.

8. The consequences of *not* acting will be detrimental to the nation’s competitiveness. Women and minority group members make up an increasing proportion of the labor force. They also are an increasing proportion of postsecondary students. To capture and capitalize on this talent will require revising policies adopted when the workplace was more homogeneous and creating new organizational structures that manage a diverse workforce effectively. Effective programs have three key components: commitment to take corrective action, to analyze and use data for organizational change, and a campus framework for monitoring progress.

To facilitate clear, evidence-based discussion of the issues, the committee compiled a list of commonly-held beliefs concerning women in science and engineering (see Table S-1). Each is discussed and analyzed in detail in the text of the report.

Table S-1 Evidence Refuting Commonly Held Beliefs About Women in Science and Engineering.

Belief	Evidence	Where discussed
(1) Women are not as good in mathematics as men.	Female performance in high school mathematics now matches that of males.	Chapter 2
(2) The matter of “under-representation” on faculties is only a matter of time; it is a function of how many women are qualified to enter these positions.	Women’s representation decreases with each step up the tenure-track and academic leadership hierarchy, even in fields that have had a large proportion of women doctorates for 30 years.	Chapter 3
(3) Women are not as competitive as men. Women don’t want jobs in academe.	Similar proportions of men and women science and engineering doctorates plan to enter postdoctoral study or academic employment.	Chapter 3
(4) Behavioral research is qualitative; why pay attention to the data in this report?	The data are from multiple sources, were obtained using well-recognized techniques, and have been replicated in several settings.	Chapters 2-5
(5) Women and minorities are recipients of favoritism through affirmative-action programs.	Affirmative action is meant to broaden searches to include more women and minority-group members, but not to select candidates on the basis of race or sex, which is illegal.	Chapter 4
(6) Academe is a meritocracy.	Although scientists like to believe that they “choose the best” based on objective criteria, decisions are influenced by factors—including biases about race, sex, geographic location of a university, and age—that have nothing to do with the quality of the person or work being evaluated.	Chapter 4
(7) Changing the rules means that standards of excellence will be deleteriously affected.	Throughout a scientific career, advancement depends upon judgments of one’s performance by more senior scientists and engineers. This process does not optimally select and advance the best scientists and engineers, because of implicit bias and disproportionate weighting of qualities that are stereotypically male. Reducing these sources of bias will foster excellence in science and engineering fields.	Chapter 4
(8) Women faculty are less productive than men.	The publication productivity of women science and engineering faculty has increased over the last 30 years and is now comparable to men’s. The critical factor affecting publication productivity is access to institutional resources; marriage, children, and eldercare responsibilities have minimal effects.	Chapter 4
(9) Women are more interested in family than in careers.	Many women scientists and engineers persist in their pursuit of academic careers despite severe conflicts between their roles as parents and as scientists and engineers. These efforts, however, are often not recognized as representing the high level of dedication to their careers they represent.	Chapter 5
(10) Women take more time off due to childbearing, so they are a bad investment.	On the average, women take more time off during their early careers to meet their caregiving responsibilities, which fall disproportionately to women. But, over a lifelong career, a man is likely to take significantly more sick leave than a woman.	Chapter 5
(11) The system as currently configured has worked well in producing great science; why change it?	The global competitive balance has changed in ways that undermine America’s traditional S&E advantages. Career impediments based on gender or racial or ethnic bias deprive the nation of talented and accomplished researchers	Chapter 6

Conclusions

The United States can no longer afford the underperformance of our academic institutions in attracting the best and brightest minds to the science and engineering enterprise. Nor can it afford to devalue the contributions of some members of that workforce through gender inequities and discrimination. It is essential that our academic institutions promote the educational and professional success of all people without regard for sex, race, or ethnicity. So that our scientists and engineers can realize their greatest potential, our academic institutions must be held accountable and provide evidence that women and men receive equitable opportunities, resources, and support. Institutional policies and practices must move from the traditional model to an inclusive model with provisions for equitable and unbiased evaluation of accomplishment, equitable allocations of support and resources, pay equity, and gender-equal family leave policies. Otherwise, a large number of the people trained in and capable of doing the very best science and engineering will not participate as they should in scientific and engineering professions.

Recommendations

Career impediments for women deprive the nation of an important source of talented and accomplished scientists and engineers who could contribute to our nation's competitiveness. Transforming institutional structures and procedures to eliminate gender bias is a major national task that will require strong leadership and continuous attention, evaluation, and accountability. Because those obstacles are both substantial and systemic, there are no easy fixes; however, many practices developed in the last decade by universities and funding agencies have proven effective in increasing both the participation of women on faculties and their appointment to leadership positions. In part, the challenge is to use such strategies more widely and evaluate them more broadly to ensure we are accessing the entire talent pool to find truly the best people for our faculties. We need to think creatively about opportunities for substantial and overarching reform of the academic enterprise—its structure, incentives, and accountability—to change outcomes and achieve equity.

The committee's recommendations are large-scale and interdependent, requiring the interaction of university leaders and faculties, scientific and professional societies, funding agencies, federal agencies, and Congress.

A. Universities

A1. **Trustees, university presidents, and provosts** should provide clear leadership in changing the culture and structure of their institutions to recruit, retain, and promote women—including minority women—into faculty and leadership positions.

- a) University leaders should *incorporate into campus strategic plans goals of counteracting bias against women in hiring, promotion, and treatment*. This includes working with an inter-institution monitoring organization (see below) to perform annual reviews of the composition of their student body and faculty ranks, publicizing progress toward the goals annually, and providing a detailed annual briefing to the board of trustees.

- b) University leaders should *take action immediately to remedy inequities in hiring, promotion, and treatment*.
- c) University leaders should as part of their *mandatory overall management efforts hold leadership workshops for deans, department heads, search committee chairs, and other faculty with personnel management responsibilities that include an integrated component on diversity and strategies to overcome bias and gender schemas* and strategies for encouraging fair treatment of all people. It is crucial that these workshops are integrated into the fabric of the management of universities and departments.
- d) University leaders should *require evidence of a fair, broad, and aggressive search before approving appointments and hold departments accountable for the equity of their search process and outcomes* even if it means canceling a search or withholding a faculty position.
- e) University leaders should *develop and implement hiring, tenure, and promotion policies that take into account the flexibility that faculty need across the life course*, allowing integration of family, work, and community responsibilities. They should provide uniform policies and central funding for faculty and staff on leave and should visibly and vigorously support campus programs that help faculty with children or other caregiving responsibilities to maintain productive careers. These programs should, at a minimum, include provisions for paid parental leave for faculty, staff, postdoctoral scholars, and graduate students; facilities and subsidies for on-site and community-based child care; dissertation defense and tenure clock extensions; and family-friendly scheduling of critical meetings.

A2. Deans and department chairs and their tenured faculty should take responsibility for creating a productive environment and immediately implement programs and strategies shown to be successful in minimizing the effect of biases in recruiting, hiring, promotion, and tenure.

- a) Faculties and their senates should initiate a *full faculty discussion of climate issues*.
- b) Deans, department chairs, and their tenured faculty should *develop and implement programs that educate all faculty members and students in their departments on unexamined bias and effective evaluation*; these programs should be *integrated into* departmental meetings and retreats, and professional development and teacher-training courses. For example, such programs can be incorporated into research ethics and laboratory management courses for graduate students, postdoctoral scholars, and research staff; and can be part of management leadership workshops for faculty, deans, and department chairs.
- c) Deans and department chairs and their tenured faculty should *expand their faculty recruitment efforts* to ensure that they reach adequately and proactively into the existing and ever-increasing pool of women candidates.
- d) Faculties and their senates should immediately *review their tenure processes and timelines* to ensure that hiring, tenure, and promotion policies take into account the flexibility that faculty need across the life course and do not sacrifice quality in the process of meeting rigid timelines.

A3. University leaders should work with their faculties and department chairs to examine *evaluation practices* to focus on the quality of contributions and their impact.

B. Professional societies and higher education organizations have a responsibility to play a leading role in promoting equal treatment of women and men and to demonstrate a commitment to it in their practices.

B1. Together, **higher education organizations** should *consider forming an inter-institution monitoring organization*. This body could act as an intermediary between academic institutions and federal agencies in recommending norms and measures, in collecting data, and in cross-institution tracking of compliance and accountability. Just as the opening of athletics programs to girls and women required strong and consistent inter-institutional cooperation, eliminating gender bias in faculty recruitment, retention, and promotion processes requires continuous inter-institutional cooperation, including data-gathering and analysis, and oversight and evaluation of progress.

- (a) As an initial step, the committee recommends that the American Council on Education, an umbrella organization encompassing all of higher education, convene national higher education organizations, including the Association of American Universities (AAU), the National Association of State Universities and Land Grant Colleges (NASULGC), and others to consider the creation of a cross-university monitoring body.
- (b) A primary focus of the discussion should be on defining the scope and structure of data collection. The committee recommends that data be collected at the department level by sex and race or ethnicity and include the numbers of students majoring in science and engineering disciplines; the numbers of students graduating with bachelors or master's degrees in science and engineering fields; post-graduation plans; first salary; graduate school enrollment, attrition, and completion; postdoctoral plans; numbers of postdoctoral scholars; and data on faculty recruitment, hiring, tenure, promotion, attrition, salary, and allocation of institutional resources. The committee has developed a scorecard that can be used for this purpose.

B2. **Scientific and professional societies** should

- a) *Serve in helping to set professional and equity standards*, collect and disseminate field-wide education and workforce data, and provide professional development training for members that includes a component on bias in evaluation.
- b) Develop and enforce guidelines to *ensure that keynote and other invited speakers* at society-sponsored events reflect the diverse membership of the society.
- c) Ensure *reasonable representation of women on editorial boards and in other significant leadership positions*.
- d) Work to ensure that women are recognized for their contributions to the nation's scientific and engineering enterprise through *nominations for awards and leadership positions*.
- e) Provide child-care and elder-care grants or subsidies so that their members can attend work-related conferences and meetings.

B3. **Honorary societies** should *review their nomination and election processes* to address the underrepresentation of women in their memberships.

B4. *Journals* should *examine their entire review process*, including the mechanisms by which decisions are made to send a submission to review, and take steps to minimize gender bias, such as blinded reviews.

C. Federal funding agencies and foundations should ensure that their practices—including rules and regulations—support the full participation of women and do not reinforce a culture that fundamentally discriminates against women. All research funding agencies should:

C1. Provide workshops to minimize gender bias. Federal funding agencies and foundations should work with scientific and professional societies to host mandatory national meetings that educate members of review panels, university department chairs, and agency program officers about methods that minimize the effects of gender bias in evaluation. The meetings should be held every 2 years for each major discipline and should include data and research presentations on subtle biases and discrimination, department climate surveys, and interactive discussions or role-modeling. Program effectiveness should be evaluated on an ongoing basis.

C2. Collect, store, and publish composite information on demographics, field, award type and budget request, review score, and funding outcome for all funding applications.

C3. Make it possible to use grant monies for dependent care expenses necessary to engage in off-site or after-hours research-related activities or to attend work-related conferences and meetings.

C4. Create additional funding mechanisms to provide for interim technical or administrative support during a leave of absence related to caregiving.

C5. Establish policies for extending grant support for researchers who take a leave of absence due to caregiving responsibilities.

C6. Expand support for research on the efficacy of organizational programs designed to reduce gender bias, and for research on bias, prejudice, and stereotype threat, and the role of leadership in achieving gender equity.

D. Federal agencies should lay out clear guidelines, leverage their resources, and rigorously enforce existing laws to increase the science and engineering talent developed in this country.

D1. Even without additional resources, federal agencies should *move immediately to enforce the federal anti-discrimination laws* at universities and other higher education institutions through regular compliance reviews and prompt and thorough investigation of discrimination complaints.¹ Federal enforcement agencies should ensure that the range of their enforcement efforts covers the full scope of activities involving science and engineering that are governed by the anti-discrimination laws. If violations are found, the full range of remedies for violation of the anti-discrimination laws should be sought.

¹ Applicable laws include Title VI, Title VII, and Title IX of the Civil Rights Act; Executive Order 11246; the Equal Protection clause of the Constitution; the Equal Pay Act; the Pregnancy Discrimination Act; and the Family Medical Leave Act. Each of these statutes is discussed in detail in Chapter 5.

D2. Federal enforcement efforts should *evaluate whether universities have engaged in any of the types of discrimination* banned under the anti-discrimination laws, including: intentional discrimination, sexual harassment, retaliation, disparate impact discrimination, and failure to maintain required policies and procedures.

D3. Federal compliance review efforts should *encompass a sufficiently broad number and range of institutions* of higher education to secure a substantial change in policies and practices nationwide. Types of institutions that should be included in compliance reviews include 2-year and 4-year institutions; institutions of undergraduate education; institutions that grant graduate degrees; state universities; private colleges; and educational enterprises, including national laboratories and independent research institutes, which may not be affiliated with universities.

D4. Federal enforcement agencies, including the Equal Employment Opportunity Commission, the Department of Justice, the Department of Labor, the Department of Education, and individual federal granting agencies' Offices of Civil Rights should *encourage and provide technical assistance* on how to achieve diversity in university programs and employment. Possible activities include providing technical assistance to educational institutions to help them to comply with the anti-discrimination laws, creating a clearinghouse for dissemination of strategies that have been proven effective, and providing awards and recognition for model university programs.

E. Congress should take steps necessary to encourage adequate enforcement of antidiscrimination laws, including *regular oversight hearings* to investigate the enforcement activities of the Department of Education, the Equal Employment Opportunity Commission, the Department of Labor, and the science granting agencies—including the National Institutes of Health, the National Science Foundation, the Department of Defense, the Department of Agriculture, the Department of Energy, the National Institute of Standards and Technology, and the National Aeronautics and Space Administration.

Call to Action

The fact that women are capable of contributing to the nation's scientific and engineering enterprise but are impeded in doing so because of gender and racial/ethnic bias and outmoded "rules" governing academic success is deeply troubling and embarrassing. It is also a *call to action*. Faculty, university leaders, professional and scientific societies, federal agencies and the federal government must unite to ensure that all our nation's people are welcomed and encouraged to excel in science and engineering in our research universities. Our nation's future depends on it.

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Committee on Science, Engineering, and Public Policy

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NATIONAL ACADEMY OF ENGINEERING, AND
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Denice Dee Denton, 1959-2006.

A valued member of this committee, Denice Denton was an extraordinarily talented scholar, educational leader, and relentless voice for progress. She helped shape the direction of our nation's science and engineering enterprise through her research, teaching, technology development, service, leadership, mentoring, public communication of science and engineering, initiatives to promote diversity and inclusion, and outreach to our schools.

She was bigger than life. She opened doors, and stood in them to let others through. She mentored young scholars and students. Her enthusiasm for science was clear and infectious.

She was a force—a magnificent force. She pushed the institutions she inhabited to be better than they wanted to be.

With her tragic death we lost a friend, a colleague, and a champion. We proudly dedicate this report to her.

We will miss her.

Donna E. Shalala

Chair, Committee on Maximizing the Potential
of Women in Academic Science and Engineering

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* Served from September 2005 to June 2006.

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- SHEILA E. WIDNALL**, Abby Rockefeller Mauze Professor of Aeronautics, Massachusetts Institute of Technology, Cambridge, Massachusetts
- WM. A. WULF** (*Ex officio*), President, National Academy of Engineering, Washington, DC
- MARY LOU ZOBACK**, Senior Research Scientist, Earthquake Hazards Team, US Geological Survey, Menlo Park, California

Staff

- RICHARD BISSELL**, Executive Director
- DEBORAH STINE**, Associate Director
- LAUREL HAAK**, Program Officer
- MARION RAMSEY**, Administrative Coordinator

PREFACE

When I started graduate school at Syracuse University in the late sixties, the chair of my department informed me that I would not be eligible for fellowships, because I was a woman. Pulling out a page of statistics, he pointed to the data indicating that women didn't finish PhD programs, and if they did, they interrupted their academic careers for marriage and children and therefore didn't go back to catch up with their peers. They were, he concluded, "a bad investment" for the department and the university.

Needless to say, with assistance from the Dean and other more progressive members of the faculty, I did finish my PhD. Then I went to New York to begin my academic career at the City University. At the end of my second semester of teaching, the department chair called me in for an evaluation. After pointing out that I was an excellent teacher and had published more than all of the other professors in the department put together, he said that he felt it necessary to be candid with me. "We have never tenured a woman, and never will; a bad investment," he said. I immediately called a department chair at Columbia University who had been trying to recruit me and moved over there.

Overt gender discrimination is now very rare, but it is still an issue. There has been considerable progress since I started my career, but it has been painfully slow, especially in science and engineering. The playing field is still not level. Growing numbers of women have earned undergraduate, graduate, and professional degrees. More and more of these well-qualified scientists and engineers have sought to pursue their calling in both academic and nonacademic settings. However, although women have risen to the challenge of scientific, medical, and technical study and research, the nation's academic institutions have not hired them for their faculties. The academy has a disappointing record. Institutional policies for attaining tenure are still based on a rigid apprentice system that assumes that a total commitment to an academic career is possible throughout one's life. Women—and sometimes men who shoulder significant care-giving responsibilities—are still perceived to be "a bad investment." Women also must deal with lifelong questioning of their ability in science and mathematics and their commitment to a career. As a result, women are underrepresented in science and engineering, particularly in the higher faculty ranks and leadership positions. Women scientists and engineers with minority racial and ethnic backgrounds are virtually absent from the nation's leading science and engineering departments.

This needless waste of the nation's scientific talent must end. In addition to considerations of equity that govern employment in other sectors of the nation's workforce, the United States now faces stiffening science and engineering competition from other nations. We urgently need to make full use of all of our talent to maintain our nation's leadership. Affording women scientists and engineers the academic career opportunities merited by their educational and professional achievements must be given a high priority by our nation.

The Committee on Science, Engineering, and Public Policy formed our Committee on Maximizing the Potential of Women in Academic Science and Engineering and charged it to recommend methods for achieving that goal. The committee's mandate was to gather and analyze the best available information on the status of women in academic science and engineering and to propose ways of putting their abilities to the best use.

Specifically, our committee was charged

- To review and assess the research on gender issues in science and engineering, including innate differences in cognition, implicit bias, and faculty diversity.
- To examine institutional culture and the practices in academic institutions that contribute to and discourage talented individuals from realizing their full potential as scientists and engineers.
- To determine effective practices to ensure that women who receive their doctorates in science and engineering have access to a wide array of career opportunities in the academy and in other research settings.
- To determine effective practices for recruiting women scientists and engineers to faculty positions and retaining them in these positions.
- To develop findings and provide recommendations based on these data and other information to guide faculty, deans, department chairs and other university leaders; scientific and professional societies; funding organizations; and government agencies in maximizing the potential of women in science and engineering careers.

Our committee, composed of distinguished scientists and engineers who have attained outstanding careers in academic research and university governance, undertook its task with enthusiasm and dedication. As people who have held major administrative positions, committee members were able to put gender issues into the broadest context. In fulfillment of its mandate, the committee met in Washington, DC, on three occasions to examine evidence and consult with leading experts. We also conferred by conference call on numerous other occasions.

In December 2005, we hosted a public convocation with outstanding researchers to explore the impact of sex and gender on the cognitive and intellectual abilities of men and women and on the attitudes and social institutions that affect the education, recruitment, hiring, promotion and retention of academic science and engineering faculty. Over 150 interested people from academe, government, private funding agencies, and other organizations listened to the presentations, enriched the discussion with questions and comments, and presented their research in a poster session.

The convocation speakers discussed a number of crucial and, in some cases, controversial questions in light of the latest research findings. What does sex-difference research tell us about capability, achievement, and behavior? What are the effects of socialization and social roles on career development? What role do gender attitudes and stereotypes play in evaluation of people, their work, and their potential? What institutional features promote or deter the success of female scientists and engineers? What are the overlapping issues of sex, race and ethnicity? What else do we need to know, and what key research is needed? The convocation informed the thinking and research that underlie the committee's final report; the proceedings with invited papers and poster abstracts have been collected into a workshop report, *Biological, Social, and Organizational Components of Success for Women in Academic Science and Engineering*, will be published by the National Academies Press.

During the committee's February 2006 meeting, the committee heard presentations by nationally recognized experts on topics ranging from recent developments in employment discrimination law to programs and strategies used by universities and other employers to

advance the careers of women scientists and engineers. At its March meeting, the committee reviewed and refined the report's findings and recommendations. Throughout the spring, multiple meetings by teleconference permitted our committee to exchange views and information and to prepare our final findings and recommendations.

At all those sessions and throughout the months-long process of examining the evidence and developing this exhaustive report, in addition to data and opinions supplied by experts, committee members brought their own substantial expertise, insights, energy, and dedication to bear on this project and its goals. We have tried to carry out our task with great rigor, understanding the extraordinary impact that answering these questions and developing strategies can have on the next generation of women in science and engineering. It is our hope that in the future women in science and engineering will not face attitudes and institutional structures that denigrate their work and careers as "questionable" investments. Instead, our work will help ensure that women scientists and engineers take their unquestioned place as full, valued, and vital members of the nation's academic community.

We have no doubt that a combination of leadership, resources, peer pressure, law enforcement, and public outcry can fundamentally change the culture and opportunities at our research universities. We need look no further than our playing fields for evidence that the academy is capable of cultural and behavioral change when faced with a national imperative. It is time—our time—for a peaceful, thoughtful revolution.

Donna E. Shalala, Chair
Committee on Maximizing the Potential of Women
in Academic Science and Engineering

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MAHZARIN RUSTUM BANAJI, Department of Psychology, Harvard University, and
Radcliffe Institute for Advanced Study, Cambridge, Massachusetts

FRANK DOBBIN, Department of Sociology, Harvard University, Cambridge, Massachusetts

ROBERT DRAGO, Department of Labor Studies and Industrial Relations and Department of
Women's Studies, Pennsylvania State University, State College, Pennsylvania

SUSAN FISKE, Department of Psychology, Princeton University, Princeton, New Jersey

JAY GIEDD, National Institute of Mental Health, National Institutes of Health, Bethesda,
Maryland

DONNA GINTHER, Department of Economics, University of Kansas, Lawrence, Kansas

MARCIA GREENBERGER, Copresident, National Women's Law Center, Washington, DC

DIANE HALPERN, Berger Institute for Work, Family, and Children, Claremont McKenna
College, Claremont, California

ELIZABETH HIRSH, Department of Sociology, University of Washington, Seattle,
Washington

JANET HYDE, Department of Psychology, University of Wisconsin, Madison, Wisconsin

JOANNE MARTIN, Graduate School of Business, Stanford University, Stanford, California

BRUCE MCEWEN [NAS/IOM], Rockefeller University, New York, New York

KELLEE NOONAN, Diversity Program Manager, Technical Career Path, Hewlett Packard,
Sunnyvale, California

JOAN REEDE, Harvard Medical School, Cambridge, Massachusetts

SUE ROSSER, Ivan Allen College, Georgia Institute of Technology, Atlanta, Georgia

JOCELYN SAMUELS, Vice President for Education and Employment, National Women's
Law Center, Washington, DC

TONI SCHMADER, Department of Psychology, University of Arizona

ANGELICA STACY, Department of Chemistry, University of California, Berkeley, California

SARAH WARBELOW, Program Manager, American Association of University Women Legal
Advocacy Fund, Washington, DC

JOAN WILLIAMS, Center for WorkLife Law, University of California, Hastings College of
the Law, San Francisco, California

YU XIE, Department of Sociology, University of Michigan, Ann Arbor, Michigan

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assist the institution in making the published report as sound as possible and to ensure that the report meets institutional standards of 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 thank the following for their participation in the review of this report:

KENNETH ARROW [NAS/IOM], Professor of Economics and Operations Research, Emeritus, Stanford University

DAVID BALTIMORE [NAS/IOM], President, California Institute of Technology

SUZANNE BRAINARD, Director, Center for Women in Science and Engineering, University of Washington

ALICIA CARRIQUIRY, Associate Provost and Professor of Statistics, Iowa State University

FRANK DOBBIN, Professor of Sociology, Harvard University

RON EHRENBERG, Professor of Industrial and Labor Relations and Director, Cornell Higher Education Research Institute, Cornell University

CLAUDIA GOLDIN [NAS], Henry Lee Professor of Economics, Harvard University

MARC GOULDEN, Principal research analyst, graduate division, University of California, Berkeley

EVELYNN HAMMONDS, Senior Vice Provost for Faculty Development and Diversity, Harvard University

SOPHIA HUYER, Executive Director, Women and Global Science and Technology, Brighton, Ontario

MARC W. KIRSCHNER [NAS], Professor and Chairman, Department of Systems Biology, Harvard Medical School

MARIA KLAWE, President, Harvey Mudd College

WILLIAM MILLER [NAS], Distinguished Professor, Department of Chemistry, University of California, Berkeley

WILLIE PEARSON, JR., Chair, School of History, Technology, and Society, Ivan Allen College, Georgia Institute of Technology

ABIGAIL STEWART, Associate Dean for Academic Affairs, University of Michigan

SHIRLEY TILGHMAN [NAS/IOM], President, Princeton University

C. MEGAN URRY, Director, Center for Astronomy and Astrophysics, Yale University

SHELDON WEINBAUM [NAS/NAE/IOM], CUNY Distinguished Professor of Biomedical and Mechanical Engineering, City College of the City University of New York

RICHARD ZARE [NAS], Marguerite Blake Wilbur Professor in Natural Science and Chair, Chemistry Department, Stanford University

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NANCY HOPKINS [NAS/IOM] (*Guidance Group Chair*), Amgen Professor of Biology, Massachusetts Institute of Technology, Cambridge, Massachusetts

ELSA GARMIRE [NAE], Sydney E. Junkins Professor of Engineering, Dartmouth College, Hanover, New Hampshire

W. CARL LINEBERGER [NAS], Professor of Chemistry, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado

ANNE PETERSEN [IOM], President, Global Philanthropic Alliance, Kalamazoo, Michigan

MAXINE SINGER [NAS/IOM], President Emerita, Carnegie Institution of Washington, Washington, DC

HUGO SONNENSCHNEIN [NAS], Charles L. Hutchinson Distinguished Service Professor, Department of Economics, University of Chicago, Chicago, Illinois

LILLIAN SHIAO-YEN WU, Director of University Relations, International Business Machines, New York, New York

MARY LOU ZOBACK [NAS], Senior Research Scientist, Earthquake Hazards Team, US Geological Survey, Menlo Park, California

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