

REDUCING THE IMPACT OF BIAS IN THE STEM WORKFORCE: STRENGTHENING EXCELLENCE AND INNOVATION

A REPORT OF THE
Interagency Policy Group on Increasing Diversity in the
STEM Workforce by Reducing the Impact of Bias



November 2016

OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
AND
OFFICE OF PERSONNEL MANAGEMENT
WASHINGTON, D.C. 20502

November 29, 2016

Dear Colleagues:

We are pleased to transmit to you the report, *“Reducing the Impact of Bias in the STEM Workforce: Strengthening Excellence and Innovation.”* The corresponding study was initiated in response to President Obama’s goal of broadening participation in science, technology, engineering, and mathematics (STEM) to meet workforce needs, draw on the best talent at all levels, and diversify the workforce.

It was conducted by the Interagency Policy Group on Increasing Diversity in the STEM Workforce by Reducing the Impact of Bias, which is led by the Office of Personnel Management (OPM) and the White Office of Science and Technology Policy.

The Interagency Policy Group comprises leaders from the Executive Office of the President (EOP) and Federal agencies, and is charged with addressing bias in the Federal workforce and in institutions of higher education that receive Federal funding for STEM. In the new report, the Group provides an inventory of the agencies’ current policies and practices to reduce the impact of bias; identifies the best policies and practices; offers recommendations for additional policies and practices to address bias in the agencies and at Federally funded institutions of higher education; and suggests actions to implement change.

This report comes at a time when other Federal agencies, such as those in the national-security domain, are increasing their own exploration of best practices and creating new bodies of knowledge to draw upon in the collective quest to engage all Americans in solving the most pressing challenges of our time. Further, the private sector, particularly companies with large technical workforces, is also taking more deliberate and regular action around these issues. As knowledge of best practices around implementing solutions to mitigate bias expands, it is critical that those striving to craft a workforce drawn from all of America continue to share and improve on lessons from diversity and inclusion policies and practices.

Building on the many commendable efforts by the Federal Government, institutions of higher education, industry, professional societies, and others to broaden participation among groups historically underrepresented in STEM, the Nation must continue to increase its efforts to strive toward a STEM workforce that draws from the full diversity of the United States, including groups historically underrepresented—women and girls, many ethnic and racial groups, and people with disabilities. As noted in the October 2016 Presidential Memorandum on Promoting Diversity and Inclusion in the National Security Workforce, “research has shown that diverse groups are more effective at problem solving than homogeneous groups, and policies that promote diversity and inclusion will enhance our ability to draw from the broadest possible

pool of talent, solve our toughest challenges, maximize employee engagement and innovation, and lead by example by setting a high standard for providing access to opportunity to all segments of our society.” To achieve fuller participation, the STEM enterprise must remain vigilant in mitigating explicit and implicit bias in order to provide opportunity to all.

The recommendations in the new report provide guidance for educating, enlarging, advancing, and diversifying a world-class STEM workforce in the Federal Government and Federally funded institutions of higher education, and for sharing lessons learned in the process.

Sincerely,



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ABOUT THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976. OSTP's responsibilities include advising the President in policy formulation and budget development on questions in which science and technology (S&T) are important elements; articulating the President's S&T policy and programs; and fostering strong partnerships among Federal, state, and local governments, and the scientific communities in industry and academia. The Director of OSTP also serves as Assistant to the President for Science and Technology and manages the National Science and Technology Council (NSTC). More information is available at: www.whitehouse.gov/ostp.

ABOUT THE OFFICE OF PERSONNEL MANAGEMENT

The Office of Personnel Management (OPM) was established in 1978 as one of three organizations of the former Civil Service Commission. OPM oversees all policy created to support Federal human resources departments – from classification and qualifications systems to hiring authorities and from performance management to pay, leave, and benefits. Along with making those policies, OPM is responsible for ensuring they are properly implemented and continue to be adequately carried out.

ABOUT THE INTERAGENCY POLICY GROUP ON INCREASING DIVERSITY IN THE STEM WORKFORCE BY REDUCING THE IMPACT OF BIAS

In October 2015, OSTP and OPM established the Interagency Policy Group on Increasing Diversity in the STEM Workforce by Reducing the Impact of Bias and charged the Group to identify existing and propose new policies aimed at reducing the impact of explicit and implicit biases in the Federal and Federally funded STEM workforce, produce a report recommending Government-wide policy options, and submit the report and recommendations for leadership approval.

ABOUT THIS DOCUMENT

This document was developed by the Interagency Policy Group on Increasing Diversity in the STEM Workforce by Reducing the Impact of Bias. The document was published by OSTP.

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We would like to thank the interagency group that worked over the past several months to produce this report. Key to the group's work was the identification of agency efforts to reduce the impact of bias on the science, technology, engineering, and technology (STEM) workforce; identification of evidence-based best and promising practices; generation of government-wide recommendations to mitigate the impact of bias; and development of a government-wide tool on bias mitigation. The report was developed under the direction of Wanda E. Ward, Assistant Director for Broadening Participation, OSTP. Contributors that provided significant support to the activities of the Interagency Policy Group include those who served on the report writing team, the best practices development sub-group, and the government-wide recommendations sub-group, and the dashboard development sub-group.

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EXECUTIVE SUMMARY

There is enormous opportunity to enrich the science, engineering, technology, and mathematics (STEM) enterprise—and the innovations and solutions it produces—by increasing diversity of the human resources on which STEM relies at all levels of participation and leadership. Recognizing the potential contributions of people from all backgrounds in STEM is imperative on scientific, workforce, economic, and moral grounds.

America’s role as a global leader in innovation and equity will be fortified by tapping into the unparalleled diversity of the American people. Efforts to draw on a diverse community in STEM, however, have been undermined, at least in part, by systemic barriers. Prominent among these are both implicit and explicit biases¹ generated by stereotypes and expectations of how a STEM professional should look and act, which can lead to lack of opportunities and access to a better education and careers. The United States must continue to address the biases that act to constrain the diversity of the STEM workforce; there is a “fierce urgency of now”² to do so in order to maintain the Nation’s competitiveness in science, technology, and innovation.

Evidence shows that it is very difficult to change implicit or unconscious biases, but it is possible to change behaviors that are shaped by biases. Most people want to be fair, and, if they are made aware of their biases, many will use cognitive processes to prevent biases from shaping their decisions and behaviors.^{3, 4} Over the last decade, nationwide efforts to enhance diversity have been predicated on the hypothesis that implicit biases are ubiquitous and unlikely to change, but training and awareness can and has reduced the impact of these biases. Accordingly, this report focuses on actions to raise awareness about bias and reduce its impact in Federal agencies and the institutions of higher education that they fund. Similarly, the metrics used to assess progress will focus on outcomes—increased diversity in hiring, retention, and promotion in the STEM workforce—not on reduction of biases themselves.

In addressing the national imperative for diversity in the STEM workforce, in October 2015, the White House Office of Science and Technology Policy (OSTP) and the Office of Personnel Management (OPM) established an Interagency Policy Group to identify policies and practices to

¹ Use of the terms “bias” or “mitigating or reducing the impact of bias” should be understood to mean “where such bias exists” throughout this report.

² Martin Luther King, Jr., *Why We Can’t Wait*, (New York: Harper & Row, 1963); Martin Luther King Jr., “I Have a Dream,” (Washington DC, 1963).

³ Lai, C.K., Marini, M., Lehr, S.A., Cerruti, C., Shin, E.L., Joy-Gaba, J., Ho, A.K., Teachman, B.A., Wojcik, S.P., Koleva, S., Frazier, R.S., Heiphetz, L., Chen, E., Turner, R.N. Haidt, J., Kesebir, S., Hawkins, C.B., Sartori, G., Schaefer, H.S., Rubichi, S., Dial, C.M., Sriram, N., Banaji, M.R., Nosek, B.A. (2014) Reducing implicit racial preferences: I. A comparative investigation of 17 interventions. *Journal of Experimental Psychology* 143: 1765-1785.

⁴ Carnes, M., Devine, P. G., Manwell, L. B., Byars-Winston, A., Fine, E., Ford, C. E. & Sheridan, J. (2015) The effect of an intervention to break the gender bias habit for faculty at one institution: a cluster randomized, controlled trial. *Academic Medicine* 90:221-230.

increase diversity in the STEM workforce by reducing the impact of bias, both in the Federal Government and in Federally funded institutions of higher education. The interagency group developed a vision, a goal, objectives, and basic principles to guide its efforts to: inventory current policies and practices; identify best and promising practices; develop recommendations for Government-wide policies and practices; and suggest strategies and next steps. The recommendations and implementation strategy follow here. The rest of the findings are presented in the main report.

In the Federal STEM Workforce

Recommendation 1. Each Federal agency should exercise leadership at all levels, including senior officials, STEM-program and administrative managers, human-capital officials, and diversity and inclusion officials (or their equivalent), to reduce the impact of bias in their internal operations through:

- Incorporation of the agency’s diversity and inclusion objectives in its strategic plan;
- Visible participation, deep engagement, and demonstrated accountability by agency and department leaders in the dialogue and activities to increase diversity;
- Implementation of an organizational cycle of recruiting, hiring, and promotion practices that encourages diversity and inclusion, in part by reducing the impact of bias;
- Engagement and empowerment of employees through policies, practices, and programmatic activities across all groups, including managers;
- Expanded research-based education and training on implicit- and explicit-bias mitigation; and
- Establishment of bias-mitigation goals, techniques, and accountability mechanisms.

In Federally Funded Institutions of Higher Education

Recommendation 2. Each Federal agency should incorporate bias-mitigation strategies into its proposal-review process and offer technical assistance to grantee institutions to implement bias-mitigation strategies. Such strategies and activities should include:

- Emphasizing to the academic community the importance of using bias-mitigation strategies to achieve fairness and quality in the STEM endeavor;
- Ensuring diversity in membership of grant-review panels to include representation of all, including women, underrepresented racial and ethnic groups, and people with disabilities;
- Establishing a systematic means of collecting and analyzing data on the entire cycle of the grant-making process to analyze success rates in getting grants across groups;

- Providing grantees with information about methods to reduce the impact of bias and enhance diversity and inclusion in their research groups and institutions; and
- Collecting best practices from grantee institutions and sharing them among agencies and other grantees, including by supporting communities of practice.

Cross-cutting Government Leadership—STEM Workforce and Federally Funded Institutions of Higher Education

Recommendation 3. OSTP, OPM, and the Department of Justice (DOJ), as appropriate, should exercise leadership to reduce the impact of bias in the Federal STEM workforce and Federally funded institutions of higher education by:

- Serving as focal points, clearinghouses, and distribution points for bias-reduction strategies and best practices for both Federal agencies and Federally funded institutions of higher education to reduce the impact of bias;
- Coordinating civil-rights-compliance efforts;
- Providing guidance to agencies related to performance and accountability in efforts to mitigate the impact of explicit and implicit bias (where it exists) by investigation of potential measurement tools;
- Promoting greater strategic coordination, sharing, and collaborating on successful programs aimed at reducing the impact of bias and increasing diversity in Federally funded institutions of higher education; and
- Strengthening university-community partnerships to mitigate the impact of bias and to increase access to Federal STEM employment.

Implementation and Next Steps

To implement the recommendations, the Interagency Policy Group proposes the following actions.

- An interagency body, acting as a community of practice and comprising staff drawn from OPM and Federal agencies, should coordinate and review the Government-wide implementation and scaling of best and promising practices; develop principles for appropriate local adaptation of practices; identify gaps; develop a tool, including a set of quantitative metrics and strategies, to track increased diversity in the Federal STEM workforce by the reduction of the impact of bias where it may exist; catalyze use of best-practices such as peer-to-peer learning and innovation methods through regular engagement with the community of practice; and develop a comprehensive, living inventory of policies and practices by the Federal Government and Federally funded

institutions of higher education that reduce the impact of bias in the STEM workforce. This body should develop targeted timelines for implementation and completion for each of these proposed actions, include those mentioned below.

- OPM and Federal agencies should implement a public-engagement campaign, strategically targeted to key stakeholders, to highlight the existence, challenges, and impacts of bias and ways to reduce it in the STEM workforce.
- Federal agencies should develop plans to implement and institutionalize policies and practices for reducing the impact of bias on the education, employment, and advancement of members of groups historically underrepresented or underserved in STEM fields. Such policies and practices should be designed to make careers in STEM more attractive and conducive to the success of all people, including women, members of underrepresented ethnic and racial groups, and people with disabilities. Agency plans should be best-practice driven, include measurable goals, and be published in easy-to-understand forms to be reviewed by OPM on an annual basis.
- Federal agencies, institutions of higher education, and the proposed interagency implementation body should develop accountability measures that can be used to assess progress and should review ongoing research to accelerate progress in the emerging fields of bias mitigation, diversity, and inclusion policies and practices; best practices emerging from research should also be brought back into agencies to accelerate implementation of new research-based tools and strategies.

CHAPTER I. THE BENEFITS OF DIVERSIFYING THE STEM WORKFORCE

A National Imperative

To confront the global challenges of the 21st century, the Nation requires a STEM workforce that is sufficiently large and innovative to meet the current and future needs of academia, government, and the private sector. The rapid pace of science and technology (S&T) discovery and innovation has created a sense of possibility—indeed, an expectation—within the research community and the general public that world-changing discoveries are almost in hand on many S&T fronts. At the same time, without further intentional action, the lack of human diversity in many S&T fields will likely constrain America’s role as a preeminent leader in the global economy. As noted in the October 2016 Presidential Memorandum on Promoting Diversity and Inclusion in the National Security Workforce, “research has shown that diverse groups are more effective at problem solving than homogeneous groups, and policies that promote diversity and inclusion will enhance our ability to draw from the broadest possible pool of talent, solve our toughest challenges, maximize employee engagement and innovation, and lead by example by setting a high standard for providing access to opportunity to all segments of our society.” The enormity of the opportunity for America to lead a new burst of discovery and invention is matched by a singular opportunity to achieve STEM workforce diversity.

In this report, diversity refers to representation of people who are members of gender and ethnic groups that historically have been underrepresented in STEM—including women, African Americans, Native Americans, Hispanics, Pacific Islanders, and Asian Americans—and people with disabilities. The intent, however, is to implement practices that benefit all groups, including groups who are underrepresented and may experience bias because of their sexual orientation, educational attainment, socioeconomic status, gender identity, and geographic location within the United States. Inclusion refers to the fostering of a work culture where uniqueness of beliefs, backgrounds, talents and capabilities, and ways of living is valued and leveraged for learning and informing decision making.

Explicit bias entails intentional and consciously held attitudes and beliefs that influence people’s evaluation of and behavior toward a particular group. This kind of bias is overt, deliberate, and can be self-reported. Implicit bias, on the other hand, is applied without consciousness or control, and is thus more challenging to detect and mitigate. Critically, implicit bias can occur both at an individual level, for example, reduced interpersonal warmth when interviewing a minority job candidate,⁵ as well as at an institutional level, for example, holding meetings at times that conflict with childcare pick-up times. There is substantial evidence that these types of biases

⁵ Carl O. Word, Mark P. Zanna, and Joel Cooper, “The Nonverbal Mediation of Self-Fulfilling Prophecies in Interracial Interaction,” *Journal of Experimental Social Psychology* 10 (1974): 109–12.

often operate without conscious intention and yet create sizeable hurdles for members of negatively stereotyped groups.

America must accelerate efforts to engage, inspire, develop, and advance diverse talent in STEM fields, especially by reducing the impact of bias where it exists. Several imperatives in particular converge to create a national imperative to make the STEM workforce diverse:

- **Science and Innovation Imperative.** A robust body of scientific studies, demonstrating both correlation and causation, shows that cognitive diversity within groups enables them to be more creative and generate higher quality or more defensible decisions, particularly in uncertain and novel situations, such as the pursuit of science and innovation.^{6,7} The wider range of expertise, ideas, experiences, and perspectives provided by diverse groups is particularly beneficial in innovation, problem-solving, and prediction. This is made evident through studies in various settings. For example, a recent analysis of 2.5 million papers from U.S. research groups found that publications generated by more ethnically diverse research teams were more likely to be published in higher-impact journals and cited 5 to 10 percent more than those produced by more homogeneous teams.⁸
- **Workforce Imperative.** The U.S. workforce needs the best STEM talent and more STEM college graduates. The demand for STEM workers is expected to outpace STEM college degree production by about 1 million by 2022.⁹ Several national studies and reports¹⁰ have argued that students need to be attracted to and retained in STEM pathways and should be drawn from all demographic groups to ensure utilization of the best talent. As the proportion of women and underrepresented ethnic and racial groups in the U.S. college population increases—currently approaching 70 percent—there is an increasing cost to not recruiting more members of these communities to the STEM workforce. The United States cannot afford to “leave much of the best talent on the bench.”¹¹
- **Economic Imperative.** Research shows that diverse teams outperform homogeneous teams when it comes to financial returns.¹² While neither government nor nonprofit institutions of higher education are pursuing profits, the same contributing factors to

⁶ Laurel Smith-Doerr, Sharla Alegria, and Timothy Sacco describe “cognitive diversity” as involving “training, ideas, and skills relevant to completing the task” in Laurel Smith-Doerr, Sharla Alegria, and Timothy Sacco, “How Diversity Matters in the U.S. Science and Engineering Workforce: A Critical Review Considering Teams, Fields, and Organizational Contexts.” Under review for publication by *Engaging Science, Technology, and Society*, (2016).

⁷ Aparna Joshi and Hyuntak Roh, “The Role of Context in Work Team Diversity Research: A Meta-Analytic Review.” *Academy of Management Journal* 52 (2009): 599–627; Scott E. Page, *Diversity and Complexity*, (Princeton, NJ: Princeton University Press, 2010).

⁸ Richard B. Freeman and Wei Huang, “Collaboration: Strength in Diversity,” *Nature* 513 (2014): 305.

⁹ Executive Office of the President, President’s Council of Advisors on Science and Technology, “Report to the President, Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.” (2012);

¹⁰ Ibid; National Academies of Science, “Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads,” (2011).

¹¹ Remarks by the President at the White House Science Fair, 2016.

¹² Vivian Hunt, Dennis Layton, and Sara Prince, “Why Diversity Matters,” *Our Insights*, McKinsey & Company, (2015), <http://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters>

these success metrics, such as the ability to attract and retain top talent, and improved customer or constituent orientation, suggest that many private-sector benefits of diversity would accrue to these stakeholders as well.

- **First Principles Imperative.** The Federal-merit-system principles, which are a foundation for the civil service, provide that agencies should recruit, for their workforce, qualified individuals drawn from all segments of society.
- **Moral Imperative.** Drawing the workforce from a diverse cross-section of Americans is the right thing to do. To advance the most fundamental American value of fairness, it is essential to provide equal opportunities for all members of society, including women, ethnic and racial groups, and people with disabilities to enter STEM fields, realize their potential, and experience the personal and financial rewards that accompany STEM careers.

In sum, the evidence demonstrates that diversity strengthens group and organization performance,¹³ and is itself a force for innovation.¹⁴ Furthermore, research also shows that diversity and inclusion increase people's performance in achieving organizational goals, retention rates, and emotional commitment to colleagues. Diversity and inclusion also provide multiple perspectives that improve problem-solving and creativity, reduce conformity, and raise team intelligence by increasing social intelligence.¹⁵

There is also a statistically significant positive relationship among gender, racial, and ethnic diversity and company financial performance.¹⁶ This finding extended to company leadership as well. Based on financial data and leadership demographics from hundreds of organizations and thousands of executives in Canada, Latin America, the United Kingdom, and the United States, researchers found that companies in the top quartile of gender diversity were 15 percent more likely to have financial returns above the national industry mean, and those that were in the top quartile of racial and ethnic diversity were 35 percent more likely.¹⁷ Comparison across countries revealed that in the United States efforts to increase racial and ethnic diversity have a stronger impact on financial performance than those addressing gender diversity, possibly, because of the already accumulated positive results for gender. No industry or company studied was found to be in the top quartile for both race and ethnic diversity and gender diversity. Researchers also assert that achieving organizational transformation along diversity considerations is difficult because of barriers like unconscious bias, making it all the more important that companies

¹³ Scott E. Page, *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*, (Princeton, NJ: Princeton University Press, 2007).

¹⁴ Scott E. Page, "Diversity Powers Innovation," *Center for American Progress* (2007),

<http://www.americanprogressorg/issues/economy/news/2007/01/26/2523/diversity-powers-innovations/>

¹⁵ David Rock and Heidi Grant Halvorson, "Breaking Workplace Bias at Its Source," *NeuroLeadership Institute*, (2015),

https://neuroleadership.com/wp-content/uploads/2015/03/Breaking-Workplace-Bias-at-its-Source_Rock_17Mar15.pdf

¹⁶ Company financial performance measured as average earnings before interest and taxes.

¹⁷ Vivian Hunt, Dennis Layton, and Sara Prince, "Diversity Matters," *McKinsey & Company* (2015).

implement programs that explicitly address unconscious bias with visible commitment from leadership.

Additional research delineates further the conditions under which diversity promotes innovation, creative problem-solving, and greater productivity. New research has summarized studies that indicate the mechanisms and boundary conditions by which diversity affects the performance of teams. These studies found that when conditions are right for diversity to be beneficial, that is, in equitable and integrated work environments, it leads to improved creativity, innovation, productivity, and reputation.¹⁸

The need for greater diversity, fuller inclusion, and bias mitigation in STEM extends to the international level.¹⁹ Many countries expect the United States to be a model from which they can learn how to promote and manage diversity. At the 2016 G7 Summit in Japan, President Obama and other G-7 leaders committed to advancing women’s empowerment and gender equality.²⁰ At the meeting of the G7 Science Ministers, Japan initiated discussion—and looked to the United States as a source of experience and knowledge—about policies that eliminate gender disparities and reduce stereotypes, biases, and other barriers to education and careers for women in STEM fields.²¹ These barriers will be discussed further in Chapter II.

The National Demographic Landscape

Profiles of the U.S. population and the STEM workforce reveal a disconnect: the general U.S. population is becoming more diverse far more rapidly than the STEM workforce. Reversing this trend is a national imperative. In 2012, a significant proportion of the U.S. population between the ages of 18 and 64 comprises groups that are not well-represented in STEM fields. This population includes women (approximately 51 percent) and a number of ethnic and racial groups, including Hispanics (approximately 16 percent), African Americans (approximately 13 percent), resident Asians (approximately 6 percent), and other non-white racial and ethnic groups combined (approximately 2 percent).²² Collectively, these ethnic and racial groups, currently 37 percent of the U.S. population, are projected to reach 57 percent of the U.S. population by 2060.²³

¹⁸ Laurel Smith–Doerr, Sharia Alegria, and Timothy Sacco, “How Diversity Matters in the U.S. Science and Engineering Workforce: A Critical Review Considering Teams, Fields, and Organizational Contexts.” Under review for publication by *Engaging Science, Technology, and Society*, (2016).

¹⁹ “Diversity Fueling Excellence in Research and Innovation: A Roadmap for Action for North America,” (Gender Summit 3: North America, 2013).

²⁰ FACT SHEET: The G-7 Summit at Ise-Shima Japan, <https://www.whitehouse.gov/the-press-office/2016/05/27/fact-sheet-g-7-summit-ise-shima-japan>.

²¹ “Tsukuba Communique: G7 Science and Technology Ministers’ Meeting in Tsukuba, Ibaraki,” May 2016, <http://www8.cao.go.jp/cstp/english/others/20160517communique.pdf>.

²² National Science Foundation, “Women, Minorities and Persons with Disabilities in Science and Engineering,” *National Center for Science and Engineering Statistics*, www.nsf.gov/statistics/2015/nsf15311/.

²³ U.S. Department of Commerce Census Bureau 2014 National Projections.

Yet participation and advancement of groups historically underrepresented in STEM continue to lag behind their representation in the overall population. Consider the following statistics about the collegiate, STEM degree, and STEM workforce populations: ²⁴

- Underrepresented groups, especially Hispanics/Latinos, are an increasing fraction of undergraduate students while whites are a decreasing fraction, and more women than men across all groups are enrolling in college.
- Although women earn 57 percent of all bachelor's degrees and approximately 50 percent of all science and engineering (S&E) degrees, their participation varies across S&E fields. Women's participation is lowest in engineering, at approximately 22 percent at the doctor-of-philosophy (Ph.D.) level and 19 percent at the bachelor-of-science (BS) level in 2012, and computer science, at approximately 21 percent at the Ph.D. level and 18 percent at the B.S. level in 2012, with their participation in computer-science majors decreasing in recent years.
- The gap in educational attainment that separates underrepresented ethnic minorities from whites and Asians remains wide, despite considerable progress in closing this gap over the past two decades, with underrepresented groups generally being less likely than whites and Asians to graduate from high school, enroll in college, and earn college STEM degrees.
- Women and other historically underrepresented groups are a smaller proportion of the overall S&E workforce than of degree recipients who recently joined the workforce (because older cohorts of S&E workers are disproportionately male and white or Asian); and people with disabilities are also underrepresented in this workforce compared with the overall college-educated population.
- Women's participation in the academic doctoral workforce has increased considerably over the past 20 years, while advancement for underrepresented minorities has been slower, with the rates for both women and underrepresented minorities in the academic workforce continuing to differ from those of their male and white or Asian counterparts in rank, tenure, salary, and Federal support.

[The Federal Workforce Demographic Landscape](#)

While certain groups continue to be underrepresented in the U.S. Federal workforce, it is more diverse than at any time in U.S. history. Hispanics, women, and persons with disabilities were underrepresented across the Federal workforce compared to the Civilian Labor Force (CLF) in

²⁴ National Science Foundation, "Women, Minorities and Persons with Disabilities in Science and Engineering," *National Center for Science and Engineering Statistics*, www.nsf.gov/statistics/2015/nsf15311/.

fiscal year (FY) 2015—8 percent versus 15 percent of the CLF for Hispanics²⁵, 43 percent versus 46 percent for women, and people with disabilities remaining underrepresented overall.²⁶

The Federal STEM permanent workforce has seen some gains in racial and ethnicity diversity over the last 5 years. From FY 2011 to FY 2015, African Americans increased from 9.0 percent to 9.5 percent, Asian Americans from 8.7 percent to 9.2 percent, Native Hawaiians or Pacific Islanders from 0.2 percent to 0.3 percent, Hispanics from 5.0 percent to 5.5 percent, and those with more than one race increased from 0.8 percent to 1.3 percent. American Indians or Alaska Natives had a slight decrease from 1.0 percent to 0.9 percent with women also showing a slight decrease from 25.8 percent of the Federal STEM occupations to 25.6 percent.²⁷

Recent Congressional Concerns

A compelling demonstration of the urgent need to address barriers such as bias in STEM fields is revealed in a recent report on women in STEM research positions by the Government Accountability Office (GAO), a fact-finding arm of Congress.²⁸ The December 2015 GAO report examined differences in Federal funding received by women and men in STEM fields, and the extent to which Federal agencies enforce Title IX at the educational institutions at which they fund STEM research.²⁹

GAO reported the following:

- Among the six Federal agencies examined for research awards made between FY 2009 and FY 2013, no disparities in success rates in receiving awards between women and men were found at the National Institutes of Health (NIH), Department of Health and Human Services (HHS); National Science Foundation (NSF); or National Institute of Food and Agriculture (NIFA), United States Department of Agriculture (USDA).
- Limitations of available data narrowed insights into success rates at the remaining three agencies that the GAO considered, including: the Department of Defense (DOD), Department of Energy (DOE), and National Aeronautics and Space Administration (NASA).

²⁵ Although Hispanics, taken as a whole, make up approximately 14 percent of the CLF, that number drops to approximately 11 percent of the CLF when only U.S. citizens (including those in Puerto Rico) are counted. Citizenship is a requirement for most Federal positions. Citizenship-based CLF calculations are based on the Equal Employment Opportunity (EEO) Tabulation of 5-year ACS data.

²⁶ United States Office of Personnel Management Office of Diversity and Inclusion, “The Current State of Diversity and Inclusion in the Federal Workforce,” (2014).

²⁷ United States Office of Personnel Management’s Enterprise Human Resources Integration Statistical Data Mart (EHRI-SDM).

²⁸ Government Accountability Office, “WOMEN IN STEM RESEARCH: Better Data and Information Sharing Could Improve Oversight of Federal Grant-making and Title IX Compliance,” GAO-16-14, December 2015, <http://www.gao.gov/products/GAO-16-14>.

²⁹ Title IX of the Education Amendments Act of 1972 states: “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.”

- Inadequate data limited the evaluation of STEM program performance against stated goals of funding the best scientists independent of gender. Such limitations obscure bias, where it may exist, in the grant-making system.
- Of the six departments and agencies reviewed, DOD and HHS were found to be noncompliant in conducting Federally required Title IX reviews. Officials in many DOD grant-making components reported that they were unaware of the requirement to conduct compliance reviews, lacked departmental guidance on this responsibility, and were not aware of any DOD-wide directive to conduct such periodic reviews. The second agency found non-compliant, HHS, reported that it focused its civil-rights enforcement on its primary or sole jurisdiction of civil-rights protections in healthcare settings rather than Title IX compliance reviews of NIH grantees.
- Five of the six departments and agencies suggested that the Department of Justice (DOJ) should facilitate interagency sharing of best practices for Title IX compliance to increase coordination, improve compliance reviews across agencies, and reduce the impact of any bias in the STEM enterprise.

CHAPTER II. BIAS: IMPACTS, METRICS, AND MITIGATION

Impacts of Bias

Biases, whether explicit or implicit, are prejudices that can create barriers for members of negatively stereotyped groups. Explicit biases are conscious and acknowledged by the person applying them, for example, “We shouldn’t hire her because she’s a woman, and women just go off and have babies,” or “We shouldn’t make him an offer because he’s from the South, and he’ll never want to live in a cold environment like ours.” Implicit biases are usually unintended and unconscious, but nonetheless are powerful influences on human behavior. In situations such as hiring decisions, these biases are frequently accompanied by a pretextual justification for the choice, which may seem legitimate but, in fact, masks the preference for a member of a particular demographic group. For example, in one study in which evaluators were asked to choose between candidates, evaluators more often chose the male candidate and justified their choice by pointing to a strong trait reflected in his resume. When the resumes were reversed, however, evaluators were still more likely to choose the male candidate and identified a different criterion as the basis of their decision.³⁰ Across a range of different occupations, research shows that the racial, ethnic, or gender group that traditionally has been affiliated with that profession will be favored—e.g., men in STEM fields or women in nursing. In academic settings, randomized controlled experiments show that STEM faculty are less likely to hire, mentor, or even respond to emails from women and minorities.³¹

Implicit biases are even held and applied by well-meaning people who are consciously supportive of the targets of their bias. For example, studies find that parents underestimate their daughters’ math abilities compared to that of sons with the same performance scores;³² and teachers often assume that white boys are better at computer science than girls or students of color.³³ In addition to distorting evaluations by strangers, family members, teachers, and employers, implicit biases are also powerful influences on children’s and adults’ evaluations of themselves. Many studies show that people are much less likely to aspire to a professional role that they have never seen filled by someone of their own demographic group.³⁴ An individual’s estimation of

³⁰ Eric Luis Uhlmann and Geoffrey L. Cohen, “Constructed Criteria: Redefining Merit to Justify Discrimination,” *Psychological Science* 16 (2005): 474-480.

³¹ Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman, “Science Faculty’s Subtle Gender Biases Favor Male Students,” *Proceedings of the National Academy of Sciences* 109, no. 41 (2012): 16474-16479; Katherine L. Milkman, Modupe Akinola, and Dolly Chugh, “What Happens Before? A Field Experiment Exploring How Pay and Representation Differentially Shape Bias on the Pathway into Organizations,” *Journal of Applied Psychology* 23 (2014): 710-717.

³² Doris K. Yee and Jacquelynne S. Eccles, “Parent Perceptions and Attributions for Children’s Math Achievement,” *Sex Roles* 19 (1988): 317-333.

³³ Victor Lavy and Edith Sand, “On The Origins of Gender Human Capital Gaps: Short and Long Term Consequences of Teachers’ Stereotypical Biases,” *National Bureau of Economic Research*, <http://www.nber.org/papers/w20909>.

³⁴ Albert Bandura, *Social Learning Theory*, (Englewood Cliffs, N.J.: Prentice Hall, 2007).

his or her own abilities, moreover, is shaped by feedback from others—particularly teachers, mentors, and supervisors—and by the people he or she sees designated as experts in that pursuit, both in life and via entertainment media.

Institutional or structural bias is usually a manifestation of either explicit or implicit biases held in the past. Both tradition and lack of awareness have often led to perpetuation of these biases, such as denying admission to a particular group, scheduling that is inconvenient for one group within the community, images of leaders that do not include women or minorities, and facilities that do not accommodate wheelchairs. Even where inadvertent, these vestigial institutional behaviors can continue to exert powerful pressures against members of certain groups in the present.

Explicit, implicit, and structural biases do not operate independently, and all need to be addressed. Often these biases interact in an iterative manner with implicit biases determining an initial, spontaneous reaction that either may be altered with deliberate effort or reinforced by explicit or structural biases.³⁵

Individuals can be made aware of their implicit biases and guard against their influence, but doing so requires effort, time, and motivation.³⁶ Studies show that individuals are particularly vulnerable to the influence of their own biases when they are tired or cognitively stressed.³⁷ Yet the effort required to address biases is a worthwhile endeavor because of the positive impact diversity has on increasing economic outcomes for individuals and organizations alike.

Experimental evidence from STEM disciplines shows a causal relationship between bias and diminished opportunities for some groups, and shows that addressing bias can increase hiring of and improve the environment for underrepresented groups.³⁸ If the effects of bias are not reduced, they will act as counterweights to other diversity efforts. Actions to reduce bias will amplify the impact of investments in STEM teachers, schools, and communities. Without these actions, countervailing forces will include students' lack of confidence and aspirations in STEM; unfair biases in hiring, mentoring, and promotion; and lower persistence of diverse people in STEM education and careers.³⁹

³⁵ Russell H. Fazio, and Tamara Towles-Schwen, "The MODE Model of Attitude-Behavior Processes," in *Dual Process Theories in Social Psychology*, ed. Shelley Chaiken and Yaacov Trope, (New York: Guilford, 1999), 97-116.

³⁶ Adam Hahn, Charles M. Judd, Holen K. Hirsh, and Irene V. Blair, "Awareness of Implicit Attitudes," *Journal of Experimental Psychology: General* 143, no. 3 (2014): 1369.

³⁷ Galen V. Bodenhausen, "Stereotypes as Judgmental Heuristics: Evidence of Circadian Variations in Discrimination," *Psychological Science* 1, no. 5 (1990): 319-322.

³⁸ Eve Fine, Jennifer Sheridan, Molly Carnes, Jo Handelsman, Christine Pribbenow, Julia Savoy, and Amy Wendt, "Minimizing the Influence of Gender Bias on the Faculty Search Process," in *Gender Transformation in the Academy*, (2014): 267-289; Molly Carnes, Patricia G. Devine, Linda Baier Manwell, Angela Byars-Winston, Eve Fine, Cecilia E. Ford, Patrick Forscher et al., "Effect of an Intervention to Break the Gender Bias Habit for Faculty at One Institution: A Cluster Randomized, Controlled Trial," *Academic Medicine: Journal of the Association of American Medical Colleges* 90, no. 2 (2015): 221.

³⁹ Mark J. Graham, Jennifer Frederick, Angela Byars-Winston, Anne-Barrie Hunter, and Jo Handelsman, "Increasing Persistence of College Students in STEM," *Science* 341 (2013): 1455-6.

Metrics for Assessing Bias

Bias is traditionally assessed using three methods: self-reports, implicit measures such as the Implicit Association Test (IAT), and randomized experiments on populations of people. Self-reporting is an ineffective measure of implicit bias since the bias itself is unconsciously held. The IAT is used to assess the degree to which two words (e.g., black and white) are associated in memory with positive and negative evaluations and to measure associations that people may be unable or unwilling to report. For example, the rate at which people can link concepts like “black” people or “white” people with characteristics like “good” or “bad” reveals implicit bias. In randomized experiments on populations of people, study participants are asked to evaluate an item such as a resume or job-performance description, one aspect of which is varied (i.e., male vs. female names; stereotypically black vs. white names). Findings from such randomized controlled experiments indicate that people are more likely to hire a male candidate for a science position, rate an African-American candidate as having higher athletic ability than a white candidate, and rate the verbal skills of the person higher if they think that writer is a woman rather a man. Research also indicates that biases can be detrimental to employers as well as to those against whom biases are held. For example, some science faculty are proven to be less likely to hire a female candidate even if she has equal or superior qualifications than her male counterpart, which may result in not hiring a better candidate.⁴⁰

Practices that Mitigate the Effects of Implicit Bias

There is no single solution to eliminate implicit bias, and despite many organizations’ endorsements of equal opportunity principles, the struggle continues to increase workforce diversity and minimize the effects of bias in employment decisions.⁴¹ Yet the impact of explicit and implicit biases can be reduced by making people aware of their own biases and providing strategies for bias mitigation,⁴² applying objective evaluation criteria,⁴³ and exposing people to counter-stereotypic images.⁴⁴ Institutional biases can be replaced with inclusive policies, such as

⁴⁰ Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman, "Science Faculty's Subtle Gender Biases Favor Male Students," *Proceedings of the National Academy of Sciences* 109, no. 41 (2012): 16474-16479.

⁴¹ Donald D. Tomaskovic-Devey, Written Testimony, Meeting of July 1, 2015 – EEOC at 50: Progress and Continuing Challenges in Eradicating Employment Discrimination, *U.S. Equal Employment Opportunity Commission* (2015), <http://www.1.eeoc.gov/eeoc/meetings/7-1-15/devey.cfm?renderforprint=1>.

⁴² Sarah M. Jackson, Amy L. Hillard, and Tamera R. Schneider, "Using Implicit Bias Training to Improve Attitudes Toward Women in STEM," *Social Psychology of Education* 17, no. 3 (2014): 419-438; Matthew J. Zawadzki, Cinnamon L. Danube, and Stephanie A. Shields, "How to Talk About Gender Inequity in the Workplace: Using WAGES as an Experiential Learning Tool to Reduce Reactance and Promote Self-Efficacy," *Sex Roles* 67, no. 11-12(2012): 605-616; Eve Fine, Jennifer Sheridan, Molly Carnes, Jo Handelsman, Christine Pribbenow, Julia Savoy, and Amy Wendt, "Minimizing the Influence of Gender Bias on the Faculty Search Process," in *Gender Transformation in the Academy*, (2014): 267-289; Molly Carnes, Patricia G. Devine, Linda Baier Manwell, Angela Byars-Winston, Eve Fine, Cecilia E. Ford, Patrick Forscher et al., "Effect of an Intervention to Break the Gender Bias Habit for Faculty at One Institution: A Cluster Randomized, Controlled Trial," *Academic Medicine: Journal of the Association of American Medical Colleges* 90, no. 2 (2015): 221.

⁴³ Eric Luis Uhlmann and Geoffrey L. Cohen, "Constructed Criteria: Redefining Merit to Justify Discrimination," *Psychological Science* 16 (2005): 474-480.

⁴⁴ Nilanjana Dasgupta and Shaki Asgari, "Seeing is Believing: Exposure to Counterstereotypic Women leaders and Its Effect On

access to childcare, dependent care, flexible length of academic tenure clocks, hiring and promotion practices, and evaluation criteria.⁴⁵

Efforts to control managers tend to lead to resistance, whereas human resource practices that engage managers tend to be more effective.⁴⁶ In attempts to prevent managers from acting on biases, equal-opportunity experts have long espoused managerial discretion-control reforms, such as diversity training, diversity-performance evaluations, and discrimination-grievance mechanisms. There is no universal place to introduce these interventions, but “responsible conduct of research” (RCR) courses for junior scientists provide one venue in which it would be practical to implement proven practices.⁴⁷

A review of research in the area of unconscious biases reveals few documented strategies that have been shown to effectively organize and simplify the over 150 documented unconscious biases. Subsequently, efforts by a small number of researchers have been undertaken to organize the most frequent unconscious biases into a taxonomy of biases to more easily identify, discuss, and develop strategies to minimize their impact.

After a review of the literature by the Interagency Policy Group, two unconscious bias taxonomies appear to provide a valid foundation to effectively address the organization and simplification of unconscious biases.

The first taxonomy, a proprietary model developed by the NeuroLeadership Institute, is known as the SEEDS Model™ of unconscious bias. According to the NeuroLeadership Institute, the SEEDS Model™ simplifies the roughly 150 identified cognitive biases and recognizes five categories of bias, each category responsive to a different set of actions that will help mitigate them.⁴⁸ It identifies processes that are claimed to potentially interrupt and redirect unconsciously biased thinking.

the Malleability of Automatic Gender Stereotyping," *Journal of Experimental Social Psychology* 40, no. 5 (2004): 642-658; Irene V. Blair, Jennifer E. Ma, and Alison P. Lenton, "Imagining Stereotypes Away: The Moderation of Implicit Stereotypes Through Mental Imagery," *Journal of Personality and Social Psychology* 81, no. 5 (2001): 828.

⁴⁵ Committee on Maximizing the Potential of Women in Academic Science and Engineering (US), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, National Academies Press (2007); Karin Matchett, ed., *Seeking Solutions: Maximizing American Talent by Advancing Women of Color in Academia: Summary of a Conference*, National Academies Press (2013).

⁴⁶ Donald D. Tomaskovic-Devey, Written Testimony, Meeting of July 1, 2015 – EEOC at 50: Progress and Continuing Challenges in Eradicating Employment Discrimination, U.S. Equal Employment Opportunity Commission (2015), <http://www.eeoc.gov/eeoc/meetings/7-1-15/devey.cfm>; Alexandra Kalev, Frank Dobbin, and Erin Kelly. "Best Practices or Best Guesses? Assessing the Efficacy of Corporate Affirmative Action and Diversity Policies." *American Sociological Review* (2006), 71: 589-617.

⁴⁷ Scholars Offer Scientific Solution to 'Persistent Bias' In Academia," (2014), <http://www.sciencedaily.com/releases/2014/02/140206164500.html>, in Corinne A. Moss-Racusin, Jojanneke van der Toorn, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman, "Scientific Diversity Interventions," *Science* 343, no. 6171 (2014): 615.

⁴⁸ David Rock and Heidi Grant Halvorson, "Breaking Workplace Bias at Its Source," *NeuroLeadership Institute*, (2015), https://neuroleadership.com/wp-content/uploads/2015/03/Breaking-Workplace-Bias-at-its-Source_Rock_17Mar15.pdf

The SEEDS Model™ is organized around the following dimensions:

- **Similarity:** biases that favor those who are similar to us;
- **Expediency:** biases that favor speed and familiarity;
- **Experience:** biases that favor past experiences or knowledge;
- **Distance:** biases that favor things that are close (e.g., time, space, ownership); and
- **Safety:** biases that favor perceived safety (e.g., status, loss aversion).

One training program from the NeuroLeadership Institute uses the SEEDS Model™ to simplify categories that address implicit bias proposes different mitigation strategies for each of these (See Table 1).⁴⁹

Element	Associated Belief	Mitigation Strategy
similarity	"people like me are better than others"	focusing on shared goals
expediency	"if it feels familiar and easy, it must be true"	creating processes to consider all information
experience	"my perceptions are accurate"	by providing multiple independent opinions
distance	"closer is better than distant"	acting as if people are closer in space and time
safety	"bad is stronger than good"	acting as if you are deciding for others

The second taxonomy is one built upon the research of Lovallo, et al.⁵⁰ These authors identified a similar set of biases to that of the SEEDS Model™. They also organize biases into a family of five dimensions or clusters that form the acronym "PASSS". The PASSS model highlights the view that unconscious biases "pass" under the awareness of the conscious mind and impact processes, policies, and systems in ineffective ways. This model also posits that certain biases interacting together can create unique types of organizational cultures that normalize everyday organizational decisions, actions, and ways of thinking.

⁴⁹ David Rock and Heidi Grant Halvorson, "Breaking Workplace Bias at Its Source," *NeuroLeadership Institute*, (2015), https://neuroleadership.com/wp-content/uploads/2015/03/Breaking-Workplace-Bias-at-its-Source_Rock_17Mar15.pdf

⁵⁰ Dan Lovallo and Olivier Sibony, "The Case for Behavioral Strategy", *McKinsey Quarterly*, McKinsey&Company, (2010) <http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-case-for-behavioral-strategy>.

The following are the five dimensions of the PASSS model:

- **Pattern-recognition:** biases that lead people to recognize patterns even where there are none;
- **Action-oriented:** biases that drive people to take action less thoughtfully than they should;
- **Self-interest:** biases that arise in the presence of conflicting incentives, including nonmonetary and even purely emotional ones;
- **Stability:** biases that create a tendency toward inertia in the presence of uncertainty; and
- **Social:** biases that arise from the preference for harmony over conflict.

The PASSS model seems to be a good first step in organizing unconscious biases in a way that can mitigate unconscious biases through various strategies and serve as a common language to discuss biases at various levels of the organization or institution. But, even more important, the research by Lovallo and collaborators has identified two of what they consider to be the most important unconscious biases: optimism bias and confirmation bias. The focus on these two unconscious biases in particular provides organizations and institutions the ability to provide a more simplistic model for bias mitigation.⁵¹

Implicit-bias training for employees and managers should be based on empirical evidence and theories, utilize active learning and engagement techniques, and highlight the assertion that everyone has biases in order to avoid the appearance of assigning blame.⁵² It should also contain the following components to achieve behavioral change:

- Raising awareness and motivation by acknowledging the need to change and desire to take action;
- Providing individuals with strategies and tools to change behavior and reduce the impact of bias;
- Giving a sense of empowerment and expectation of positive outcome (that it is similar to habit breaking and is worth it); and
- Increasing commitment to reducing bias and practice.⁵³

Trainings should also include an evaluation of training effectiveness by measuring changes in awareness, biases, and self-reported behavior before and after the training.

⁵¹ Ibid.

⁵² Corinne A. Moss-Racusin, Jozanneke van der Toorn, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman, "Scientific Diversity Interventions," *Science* 343, no. 6171 (2014): 615.

⁵³ Molly Carnes, Patricia G. Devine, Carol Isaac, Linda Baier Manwell, Cecelia E. Ford, Angela Byars-Winston, Eve Fine, and Jennifer Sheridan, "Promoting Institutional Change Through Bias Literacy," *Journal of Diversity in Higher Education* 5, no. 2 (2012): 63.

The Corporate Experience

Government and academic efforts to develop bias interventions can be informed by previous and ongoing work in industry, which faces many of the same challenges. Some industry groups are rigorously assessing the impact of implicit bias interventions and their studies should provide data useful to all sectors. Although these studies do not reflect a consensus view among researchers and are derived entirely from corporate environments, some general findings are nonetheless important indicators of the areas for consideration in addressing bias in other venues.⁵⁴ These findings suggest that:

- There is no evidence that corporate equal-opportunity statements by themselves, though important, are associated with increased employee diversity;
- In corporate settings, some approaches in diversity training often are not effective and even can reduce racial minorities' employment representation, and training that contains legal content focused on compliance and legal requirements can reduce representation of women and minorities in the company's workforce;
- Increased representation of protected groups in influential managerial roles typically leads to better implementation of equal-opportunity policies and higher rates of employment of minority groups;
- Accountability and transparency in managers' employment decisions often leads to increased representation and more equal pay for women and minorities;
- Identity-based networking groups are not on their own effective in advancing careers of minority groups in corporate settings, but combined with mentoring programs with senior managers often increase representation of protected groups; formalized hiring procedures, job postings, and job descriptions tend to increase hiring of women and minorities;
- Often formal evaluation systems are not on their own associated with improved outcomes for women and minorities in corporate settings;
- Human-resource practices can exacerbate inequalities, such as certain pay-for-performance systems or performance-based merit pay tend to increase disparities between majority and minority employees; and

⁵⁴ Donald D. Tomaskovic-Devey, Written testimony, Meeting of July 1, 2015 – EEOC at 50: Progress and Continuing Challenges in Eradicating Employment Discrimination, *U.S. Equal Employment Opportunity Commission* (2015), <http://www.eeoc.gov/eeoc/meetings/7-1-15/devey.cfm>; Alexandra Kalev, Frank Dobbin, and Erin Kelly. "Best Practices or Best Guesses? Assessing the Efficacy of Corporate Affirmative Action and Diversity Policies." *American Sociological Review* (2006), 71: 589-617.

- Using workers' tenure or position as formal layoff criteria when downsizing an organization often disproportionately harms black and female managers unless the consequences are analyzed before decisions are finalized.⁵⁵

Some of the outcomes of these corporate studies contradict conventional wisdom and some standard practices. They serve as a reminder that interventions to reduce the impact of bias must be experimentally evaluated to ensure that they achieve the desired outcomes, rather than designed and implemented based on intuition alone.

Businesses and industries are increasingly taking new approaches to reduce implicit bias in their organizations. For example, Microsoft CEO Satya Nadella identified diversity as a major focus for the company, and all Microsoft employees are now required to take a mandatory course evidence-based about overcoming unconscious bias.⁵⁶ In 2015, Google launched a website that provides tools and resources to help other companies learn from their practices, including a section on bias.⁵⁷

The Academic Experience

Academic institutions also provide evidence-based practices for reducing bias. Examples of these practices include a diversity-training session that reduced men's implicit bias;⁵⁸ a board game that generated discussion about bias;⁵⁹ a bias workshop during a search-and-hiring process that improved hiring outcomes;⁶⁰ and a bias workshop that improved department climate and attitudes of faculty toward women within 3 months of completion.⁶¹ Some lessons learned from research on reducing bias in academic settings are:

- Organizational leadership can create greater value for equitable behaviors;⁶²
- A multicultural approach to race reduces bias, whereas attempts at "color blindness" can increase expressions of bias;⁶³

⁵⁵ Ibid.

⁵⁶ "Satya Nadella Made Every Microsoft Employee Take a Class on 'Unconscious Bias'," last modified December 2, 2015, <http://finance.yahoo.com/news/satya-nadella-made-every-microsoft-171801352.html>.

⁵⁷ See www.rework.withgoogle.com.

⁵⁸ Sarah M. Jackson, Amy L. Hillard, and Tamera R. Schneider, "Using Implicit Bias Training to Improve Attitudes Toward Women in STEM," *Social Psychology of Education* 17, no. 3 (2014): 419-438.

⁵⁹ Matthew J. Zawadzki, Cinnamon L. Danube, and Stephanie A. Shields, "How to Talk About Gender Inequity in the Workplace: Using WAGES as an Experiential Learning Tool to Reduce Reactance and Promote Self-Efficacy," *Sex Roles* 67, no. 11-12(2012): 605-616.

⁶⁰ Eve Fine, Jennifer Sheridan, Molly Carnes, Jo Handelsman, Christine Pribbenow, Julia Savoy, and Amy Wendt, "Minimizing the Influence of Gender Bias on the Faculty Search Process," in *Gender Transformation in the Academy*, (2014): 267-289.

⁶¹ Molly Carnes, Patricia G. Devine, Linda Baier Manwell, Angela Byars-Winston, Eve Fine, Cecilia E. Ford, Patrick Forscher et al., "Effect of an Intervention to Break the Gender Bias Habit for Faculty at One Institution: A Cluster Randomized, Controlled Trial," *Academic Medicine: Journal of the Association of American Medical Colleges* 90, no. 2 (2015): 221.

⁶² Virginia Valian, *Why So Slow? The Advancement of Women*, (Cambridge, Mass.: MIT Press, 2000).

⁶³ Jennifer A. Richeson and Richard J. Nussbaum, "The Impact of Multiculturalism Versus Color-Blindness on Racial Bias," *Journal of Experimental Social Psychology* 40, no. 3 (2004): 417-423.

- Multifaceted, repeated training is more effective than unidimensional training;⁶⁴
- Bias in selection processes can be reduced by developing objective criteria before evaluating candidates, ensuring that reviewers adhere to the criteria, and discussing alignment of criteria with selections;⁶⁵ and
- Reviewers of application materials rely less on implicit biases when they focus their full attention on reviewing candidates than when they multitask or have cognitive distractions.⁶⁶

⁶⁴ Patricia G. Devine, Patrick S. Forscher, Anthony J. Austin, and William TL Cox, "Long-term Reduction in Implicit Race Bias: A Prejudice Habit-Breaking Intervention," *Journal of Experimental Social Psychology* 48, no. 6 (2012): 1267-1278.

⁶⁵ Eric Luis Uhlmann and Geoffrey L. Cohen, "Constructed Criteria: Redefining Merit to Justify Discrimination," *Psychological Science* 16 (2005): 474-480.

⁶⁶ Richard F. Martell, "Sex Bias at Work: The Effects of Attentional and Memory Demands on Performance Ratings of Men and Women," *Journal of Applied Social Psychology* 21, no. 23 (1991): 1939-1960.

CHAPTER III. FEDERAL LEADERSHIP ROLE

Federal Accomplishments to Date in Addressing Bias

Reducing the impact of bias (where it exists, especially unconscious bias, in the Federal STEM workforce is an important focus of OPM's efforts to increase the opportunity for diversity. Based on research that shows that recruiting with an emphasis on cultural, experiential, and cognitive diversity will improve agencies' workforce efficiency in addressing increasingly complex challenges, OPM has taken actions over the past few years to mitigate the negative impact of explicit and implicit bias (where it exists). These actions include: developing a course called "Micro-behaviors: Understanding the Power of the Unconscious Mind" and using it to train more than 10,000 Federal leaders, managers, and employees on the impact of implicit bias; developing a course around inclusion called the "New Intelligence Quotient" that has been completed by over 15,000 Federal employees and managers; providing implicit bias training to approximately 3,000 Senior Executive Service members; and using OPM's updated Inclusive Diversity Strategic Plan as a framework for bias mitigation by establishing new norms for OPM activities (such as managing meetings, gathering data, and discussing analogies) and stimulating debate that can diminish the impact of implicit biases on critical decisions.

Future Federal Priorities

Addressing bias is one of the priorities in the Administration's STEM for All Initiative to improve equity in and quality of STEM education.⁶⁷ Existing efforts include working with the media and entertainment industry to help raise awareness of opportunities to ensure that representation of people working in STEM more accurately represents the diversity of Americans in STEM fields, while offering the public a more realistic image of the broad range of STEM jobs to help inspire students to consider STEM degrees and careers.⁶⁸

The national-security community in the Federal Government also has identified workforce diversity within the intelligence community as a key priority directly impacting mission success.⁶⁹ The national-security community is working together to develop further and share research-

⁶⁷ The White House, "STEM for ALL: Ensuring High-Quality STEM Education Opportunities For All Students," https://www.whitehouse.gov/sites/default/files/microsites/ostp/stem_fact_sheet_2017_budget_final.pdf

⁶⁸ The White House, Office of Science and Technology Policy, "STEM Depiction Opportunities," https://www.whitehouse.gov/sites/default/files/microsites/ostp/imageofstemdepictiondoc_02102016_clean.pdf.

⁶⁹ Presidential Memorandum, Promoting Diversity and Inclusion in the National Security Workforce, (October 2016), <https://www.whitehouse.gov/the-press-office/2016/10/05/presidential-memorandum-promoting-diversity-and-inclusion-national>

based best practices that will support its goals around recruitment, retention, and advancement in both STEM and non-STEM jobs.

Additionally, a number of agencies are working with their private-sector constituents on inclusion in workforce and entrepreneurship across sectors; for example, the private sector has spearheaded a Tech Inclusion Pledge that encourages companies to draw from a broader segment of the workforce.⁷⁰

OSTP-OPM Charge and Interagency Policy Group Response

In October 2015, OSTP and OPM established an Interagency Policy Group (IPG) to engage Executive Office of the President offices and Federal agencies (including Federal laboratories)⁷¹ in designing efforts to broaden participation in STEM fields through reducing the impact of bias in the Federal workplace and in Federally funded institutions of higher education. The IPG focused on actions to mitigate the effects of bias, rather than attempt to eliminate it because research shows that whereas biases are recalcitrant to interventions, actions and behaviors are more readily modified.^{72, 73}

Recognizing the importance of this issue, the OSTP Director and OPM Acting Director charged the Interagency Policy Group to:

- Identify existing practices and develop proposed policies in their organizations aimed at reducing the impact of explicit and implicit biases;
- Produce a report recommending government-wide policy options; and
- Submit the report and recommendations for Agency approval.

In responding to the charge, the IPG developed a vision, goal, objectives, and guiding principles; inventoried agencies' current policies and practices; identified best and promising practices; developed recommendations for Government-wide policies; and suggested implementations and next steps. The remainder of this document reports the IPG's findings, recommendations, and suggested next steps.

⁷⁰ <https://www.whitehouse.gov/sites/whitehouse.gov/files/images/Blog/Tech-Inclusion-Pledge-Letter-6-22-16.pdf> or <http://www.tech-inclusion.org>

⁷¹ Participants include: United States Departments of Agriculture, Commerce (including National Oceanic and Atmospheric Administration and United States Patent and Trademark Office), Defense, Education, Energy, Health and Human Services, Homeland Security, Interior, Labor, and Transportation; Environmental Protection Agency; National Aeronautics and Space Administration; National Science Foundation; and the Smithsonian Institution.

⁷² Lai, C.K., Marini, M., Lehr, S.A., Cerruti, C., Shin, E.L., Joy-Gaba, J., Ho, A.K., Teachman, B.A., Wojcik, S.P., Koleva, S., Frazier, R.S., Heiphetz, L., Chen, E., Turner, R.N. Haidt, J., Kesebir, S., Hawkins, C.B., Sartori, G., Schaefer, H.S., Rubichi, S., Dial, C.M., Sriram, N., Banaji, M.R., Nosek, B.A. (2014) Reducing implicit racial preferences: I. A comparative investigation of 17 interventions. *Journal of Experimental Psychology* 143: 1765-1785.

⁷³ Carnes, M., Devine, P. G., Manwell, L. B., Byars-Winston, A., Fine, E., Ford, C. E. & Sheridan, J. (2015) The effect of an intervention to break the gender bias habit for faculty at one institution: a cluster randomized, controlled trial. *Academic Medicine* 90:221-230.

In presenting its vision, goals, and guiding principles, the IPG set out to capture the need to address barriers to inclusive participation and advancement in the STEM enterprise. The IPG drew upon the context described in this section, including the national demographic landscape, Congressional concerns, corporate environments, and the evidence supporting bias mitigation strategies in remediating diversity- and inclusion-related challenges in the STEM workforce. The vision, goals, objectives, and guiding principles are designed to provide a foundation for the promising practices and government-wide recommendations identified.

Vision, Goal, and Objectives

Vision: A robust and inclusive world-class U.S. STEM enterprise characterized by institutions of higher learning and Federal-workplace environments free from bias and other barriers that can impede creativity, productivity, entrepreneurial vitality, and quality of life.

Goal: To enable the progress of science, innovation, and society through greater participation and advancement of all Americans in STEM, including those from historically underrepresented and underserved racial and ethnic groups, women and girls, and people with disabilities.

Objectives:

- To enhance existing and to establish new policies and practices across the Federal Government that mitigate the impact of explicit and implicit bias (where it exists) in STEM workplaces.
- To spur collaboration among Federally funded institutions of higher learning in the exchange of best policies and practices and other resources to mitigate bias.

Guiding Principles

- Intellectual diversity strengthens the STEM enterprise;
- Preparation and advancement of all available U.S. talent is essential to the Nation's STEM leadership globally;
- Diversity and inclusion are central to meeting agencies' missions and the business case for success; and,
- Groups traditionally underrepresented and underserved in STEM workplaces provide a reservoir of untapped creativity, diversity of thought, and engines of innovation that must be woven into the fabric of the STEM enterprise, both in Federal agencies and institutions of higher education funded by these agencies.

CHAPTER IV. BEST, PROMISING, AND EMERGING PRACTICES

The IPG Best Practices Subgroup identified a range of best and promising practices that 14 Federal agencies are using to raise awareness about bias and minimize its impact (see visualization of agency efforts in Figure 1 and links to agency websites for summaries in Appendix A). This chapter highlights selected successful practices that the Federal science and engineering agencies have used to: (1) reduce the impact of bias within their own workforce; or (2) generate basic research, development, and tested interventions on bias in academia.

KEY WORD VISUALIZATION OF AGENCY EFFORTS

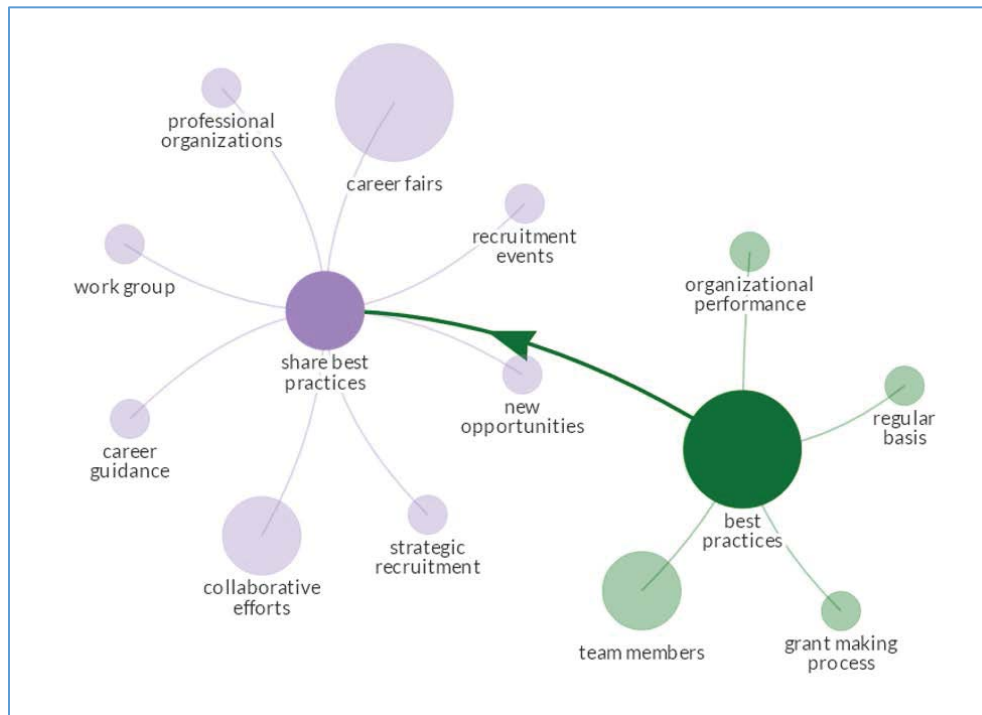


Figure 1. Visualization Summary: In general, best practices for mitigating the impact of bias are related to organizational performance and the grant-making process. The participating agencies identified the following best practices for sharing information: participation in career fairs, collaborative efforts, strategic recruitment, work with professional organizations, regular participation in recruitment events, the use of inclusive work teams, career-guidance resources, and sharing new opportunities to reduce the impact of bias and promote diversity and inclusion. This graphic was created specifically for this report using data collected from the IPG agencies.

Practices for Reducing the Impact of Bias in the Federal STEM Workforce

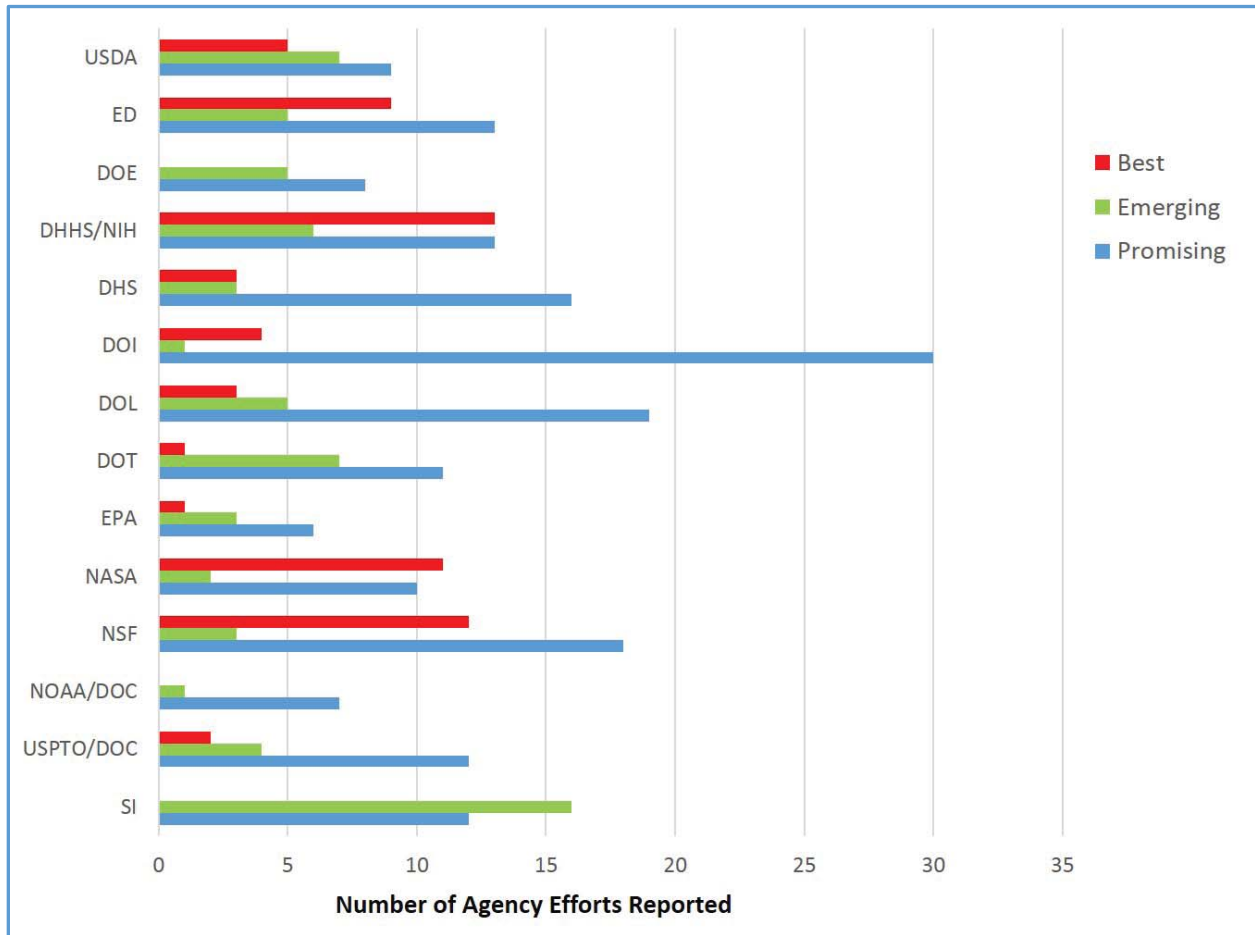


Figure 2. The number of efforts from each agency, characterized by level of progress. This graph was created for this report using data collected from the IPG agencies.

Best Practices

Best practices were defined as those that consistently mitigated explicit or implicit bias as indicated by the agencies’ metrics or indicators, which included replicability. Best practices identified are:

- Analyses of mandated workforce data sets;
- Implicit bias training;
- Conflict resolution; and
- Promoting work flexibility.

Analyses of Mandated Workforce Data Sets. Collecting data is, in itself, an effective intervention, and also provides a means to assess progress and a tool to dispel myths about advantages experienced by women and minorities in hiring and promotion. Quantitative assessment of hiring and retention, and qualitative assessment of workplace climate and worker satisfaction, are fundamental tools for diversifying the workforce and may point to manifestations of bias that can be addressed. Agencies consider annual data collection, reporting employee-work satisfaction, and analysis of workforce demographics for mandated Federal reports to constitute a best practice. These data are used to examine trends for potential workplace challenges and provide a vehicle for focusing on biases and barriers. Reports in which relevant data are provided include the Federal Equal Opportunity Recruitment Plan (FEORP),⁷⁴ the Annual Equal Employment Opportunity (EEO) Program Status report known as MD-715,⁷⁵ the Federal Employee Viewpoint Survey (FEVS) Trend Data and Action Planning,⁷⁶ and the Annual Federal Equal Opportunity Statistical Report of Discrimination Complaints (EEOC 462 Report).⁷⁷

Based on analyses of workforce demographics, **USDA** has implemented annual hiring goals for disabled veterans (10 percent) and other disabled employees (10 percent). USDA also prepares a Cultural Transformation Milestones and Metrics Report. This monthly report addresses areas such as diversity of employees and new hires, work-life balance and wellness, leadership, employee development, training, talent management, hiring reform and equal-opportunity accountability. Results are generated using self-reported data as well as data from the National Finance Center's Time and Attendance databases. The results are compared over time to highlight improvements or areas in need of attention.

Agencies also use the FEVS results to conduct workplace climate assessments, and a few agencies have developed their own surveys. In addition to using FEVS results to evaluate progress, **NASA** deploys its own comprehensive Diversity and Inclusion (D&I) Assessment Survey to all employees for a more in-depth measurement of its D&I efforts and to discover potential areas of bias or perceptions of exclusion that might exist in the workplace. NASA first deployed the survey in 2010 and repeated it in 2014. NASA used the initial survey as a baseline assessment, with plans to measure progress by repeating the survey approximately every 3 years. The D&I Survey measures respondents' perceptions about the meaning and culture of diversity and inclusion at NASA. It indicates strengths as well as areas and opportunities for improvement. Survey questions address whether employees believe that managers address bias (where it exists) or whether employees have felt marginalized or excluded, enabling NASA to measure perceptions around the presence of bias and to shape means of addressing bias, such as voluntary education and awareness opportunities that explore methods of bias mitigation. NASA compared the 2014

⁷⁴ United States Office of Personnel Management/Office of Diversity and Inclusion, "Federal Equal Opportunity Recruitment Program (FEORP) Report to Congress: Fiscal Year 2014" (ODI-02364-FEORP 2/2016), <https://www.opm.gov/policy-data-oversight/diversity-and-inclusion/reports/feorp-2014.pdf>

⁷⁵ United States Equal Employment Opportunities Commission, "Annual Report on the Federal Work Force Part II: Work Force Statistics Fiscal Year 2011," (2014), https://www.eeoc.gov/federal/reports/fsp2011_2/upload/fsp2011_2.pdf

⁷⁶ United States Office of Personnel Management, "Federal Employee Viewpoint Survey Results: Employees Influencing Change," (2016), https://www.fedview.opm.gov/2015FILES/2015_FEVS_Gwide_Final_Report.PDF

⁷⁷ United States Equal Employment Opportunities Commission, "Annual Report on the Federal Work Force Part I: EEO Complaints Processing Fiscal Year 2014," (2016), <https://www.eeoc.gov/federal/reports/fsp2014/>

survey results with the baseline survey and saw small improvement in employee perceptions on the presence of bias. The progress indicated by the survey results was presented to senior leadership and used to inform the Agency's D&I Strategic Plan and Agency-wide D&I training. The results were also disaggregated for each of NASA's field centers and shared with them to inform their D&I Plans.

Implicit Bias Training. Most agencies include implicit bias content in mandatory EEO and D&I training for supervisors and managers. Other opportunities for implicit-bias training include online-training modules, informational briefings, agency-wide workshops, and in-class training. **USDA** provides Department-wide online and instructor-led training opportunities through its AgLearn system. Examples of these trainings include: "Avoiding Discrimination and Bias; Training and Tips for Leaders/Managers" and related opportunities such as "Veteran Employment Training for Federal Hiring Manager/Human Resource Professionals" and "A Roadmap to Success: Hiring, Retaining and Including People with Disabilities." **United States Patent and Trademark Office's (USPTO)** New Inclusion Quotient Training (IQT) provided training to over 85 percent of its managers in the last 24 months. The New IQT empowers managers with tools designed to: (1) transform inclusive practices into habits, and (2) measure inclusion through the inclusion quotient, which is derived from 20 FEVS questions.

Conflict Resolution. Research shows that fair, effective, and accessible means for conflict resolution are essential for a healthy workplace, but unintended bias can corrupt the fairness of the process. It is therefore imperative to ensure that managers are cognizant of their own biases when managing conflict. Agencies reported that alternative dispute-resolution programs are lowering the number of employees filing formal complaints about harassment, indicating that disputes are being resolved at an early stage. For example, over a 5-year period starting in 2006, **NASA** averaged 23 formal complaints about harassment. For the next 5 years following implementation of the Anti-Harassment Program (AHP), instituted in FY 2010, NASA averaged 16 formal complaints about harassment, a 28 percent decline.⁷⁸ Programs like AHP often promote understanding of diverse perspectives and unconscious assumptions about communication, people's behavior, and high-quality performance.

NASA's Conflict Management Program (CMP) consists of basic conflict-management training as well as web-based refresher training, team training, executive sessions, webinars, and individual conflict consultations. CMP provides managers and employees with the communication and mitigation skills to explore sources of conflict, including implicit and structural biases, and to identify hidden sources of bias. In 2015, 70 percent of NASA survey respondents responded

⁷⁸ NASA EEO complaints data posted pursuant to the No FEAR Act, <http://odeo.hq.nasa.gov/nofear.html>.

positively on items evaluating the fairness of Agency leadership, including the fair resolution of disputes. NASA ranked number one among large Federal agencies on these questions.⁷⁹

Work Flexibility. Institutional bias includes policies that unintentionally discriminate against certain groups, creating unintended barriers to their participation in a workforce. Many historical structures and rules were created in times when the vast majority of employees were men, had wives who carried the majority of childcare duties, and whose first language was English. Today, institutional bias must be examined and mitigated because organizational structures still do not accommodate certain groups of modern workers who experience significant hardships that others do not. This section addresses practices intended to reduce structural biases in the workplace.

Work-life balance is a key determinant of employee contentment, and work flexibility contributes to one's ability to attain that balance. Even when providing work flexibilities, leadership has to be proactive in collecting employee input concerning unconscious attitudes about flexibility options, conditions for their use, and potential impacts on performance assessments. Several agencies cited flexibility as a best practice for the Federal STEM workforce and have measured positive outcomes from implementing telework and alternative work schedules that enable employees to reduce commuting time and adjust their time at work to accommodate other life obligations.

USDA encourages eligible employees to participate in the telework program through a variety of methods including "Telework Week" when eligible employees pledge to telework at least 1 day during the week of April 6-10 in order to promote the policy's many benefits. Specifically, at the National Institute of Food and Agriculture (NIFA), participation increased from year to year up to 53 percent (172 participants). The Department has an established goal that 60 percent of all Core eligible employees participate in Core Telework. NIFA was at 91 percent at the end of FY 2014. Additionally, in a cost-savings analysis, USDA reported that the number of employees currently teleworking in both Core and Ad-hoc remains steady at approximately 21,000 employees.

⁷⁹ Agency Rankings by Category, Effective Leadership: Fairness," *The Best Places to Work in the Federal Government*, http://bestplacestowork.org/BPTW/rankings/categories/large/leadership_sub_fairness

At the **USPTO**, the telework program supports one of the agency's core missions—examination of often highly complex patent applications—by bolstering its ability to recruit and retain a highly skilled, diverse workforce. The telework program began in 1997 with 18 employees and now engages 10,601, with 84 percent of them teleworking between 1 and 5 days per week. Employees value the flexibility it offers to balance work and family and reduce the time and environmental footprint associated with commuting; the practice also contributes to uniting a geographically dispersed workforce.

Reducing Bias in Peer Review

NIH's Center for Scientific Review (CSR) is playing a key role in understanding the role of implicit bias in unexplained racial disparities in R01 grant awards. With the input from a team of experts in implicit bias, stereotyping, decision-making, and research training, CSR completed two challenges (under the prize authority provided by the American COMPETES Reauthorization Act of 2010) that engaged the scientific community in finding new methods to detect possible bias in peer review given the unavailability of valid metrics for evaluating implicit bias in the review process. This subcommittee on Peer Review discouraged over-reliance on the Implicit Associations Test and cautioned possible resistance associated with mandatory implicit bias training for reviewers. CSR surveyed and conducted focus groups with a diverse sample of new investigators to garner their insights on the fairness of NIH peer review and the challenges they face in seeking NIH funding. The value of anonymization of grant applications in reducing bias will be tested in an upcoming project that examines the effect of altering PI race, gender, and university affiliation on reviewer scores of R01 applications.

Promising Practices

Promising practices are defined as those that are consistent with principles established by research but have not been the subject of evaluation. Every agency contributed examples of their own practices, including the following:

- Diversity change agents;
- Diversity toolkits;
- Technical qualifications boards; and
- Proposal review experiments.

Diversity Change Agents. The Change Agent strategy at **Department of Education (ED)** involves robust training that helps Diversity Change Agents (DCAs) confront their own biases and to learn the principles and practices of effecting organizational change. The DCAs then provide diversity training, which includes a module on implicit bias, to others in the Department.

Diversity Toolkits. **Department of Labor (DOL)** has an online library of policy guidance to inform employees of their rights and responsibilities. **NASA's** Promising Practices Guide⁸⁰ is a catalogue that showcases innovative EEO and D&I efforts of the Agency and its field centers. The promising practices are grouped around six themes: leadership commitment, attracting top talent, cultivating excellence, teamwork and innovation, serving the American people, and advancing the STEM pipeline.

⁸⁰ "Promising Practices for Equal Opportunity, Diversity, and Inclusion," *National Aeronautics & Space Administration*, last modified July 2015, http://odeo.hq.nasa.gov/documents/PromPract_8-20-15_TAGGED.pdf.

Examples of promising practices cited in the Guide include: D&I training that focuses on implicit bias, is designed for executive leadership, managers, supervisors, and employees, and includes opportunities for practical application; making the Agency's websites more accessible to individuals with vision disabilities; increasing work-life flexibilities; and partnering effectively with local educational and business communities to engage and inspire young people from all backgrounds. One purpose of the Promising Practices Guide is to enhance cross-pollination among the NASA Centers. The Guide will be regularly updated.

Technical Qualifications Boards. The **Environmental Protection Agency (EPA)** has developed Technical Qualifications Boards based on a substantial body of research indicating that when evaluators establish criteria before review, they apply less bias to their evaluation of people or their accomplishments. These panels review and evaluate qualifications and contributions of all candidates for promotion to senior (GS14-15) levels for research positions against published guidelines, in an attempt to ensure consistent, fair, and equitable treatment of candidates for promotion throughout EPA's research organization.

Proposal Review Experiments. **DOE** is increasing the diversity of STEM professionals who review DOE proposals by opening up the reviewer pools to diverse faculty from both majority institutions and minority-serving institutions. The current reviewer database is being expanded to include demographic data about reviewers and at least one reviewer from an underrepresented minority group will participate in each review panel. A few agencies are planning to analyze the scientific review process, including **NSF**. See also DOE and **NIH** highlights on the proposal-review process that follow in this and the next section.

Strengthening the Scientific Review Process

NSF is continuously testing novel review approaches. One new and two recent pilots offer potential to strengthen the review process by: (1) attracting an untapped reviewer pool, (2) removing barriers to scientists serving as reviewers, and (3) reducing evaluation bias, if present.

Pilot 1: Virtual Panels. NSF has experimented with having reviewers participate virtually, using teleconferencing, videoconferencing, or virtual worlds. Motivations for using wholly virtual panels have included enhanced opportunities for reviewer training, greater flexibility in how panels are structured, and removing barriers for those who may not be able to travel due to physical limitations, family responsibilities, or other restrictions. In addition to completely virtual panels, many panels now provide the option for panelists to attend remotely, if they cannot attend in person. The option of attending such a hybrid panel virtually enhances the participation of women. For example, looking at those reviewers for whom gender information was available in FY 2013, 29 percent of the reviewers who participated in hybrid panels by traveling to NSF were women while a larger percent (34 percent) of those who participated virtually were women.

Pilot 2: Mechanism Design. The Mechanism Design pilot examined a review mechanism in which the investigators who submit proposals also review some of the competing proposals. The usual policy on avoiding conflict of interests was applied. In the pilot, each proposal received seven reviews and the average review ratings were used to determine a consensus ranking of all of the proposals. The rating of the PI's own proposal was then supplemented with "bonus points" depending upon the degree to which his or her ordering of the assigned seven proposals agrees with the consensus ranking. The awarding of bonus points is the step that game theory suggests should provide an incentive to each reviewer to give a fair and thorough rating and ranking of the proposals to which he or she is assigned. This encourages objectivity and promotes openness in the review process by requiring the individual to consider how other objective reviewers would assess each proposal. The NSF program officer then uses the reviewers' comments, ratings, and rankings as the primary input for his or her funding recommendations.

Pilot 3: Reviewer Orientation. Beginning in 2017, many research programs at NSF will provide an orientation, by webinar, to panel reviewers before they prepare their individual written reviews of proposals. The orientation will include tips on how to structure reviews, a reminder of the review criteria, and techniques for consciously mitigating the potential influence of unconscious, cognitive biases. This pilot will test whether such an orientation enhances the quality of written reviews. It will also examine whether providing information about strategies for mitigating unconscious biases leads to any changes in the distributions of review ratings received by proposals from investigators who belong to underrepresented minorities.

Emerging Practices

One exploratory practice is unconscious bias training for search committees. This type of unconscious-bias training at **NIH** is an institutional practice used with scientific directors and the search committees in charge of hiring their scientific workforce. This effort also will attempt to assess, with data, the effectiveness of implicit-bias training. In a similar effort, **DOE's** Argonne National Lab has launched a training initiative on implicit bias aimed at hiring committees. The training efforts are based on the general consensus reported by research that biases can be unlearned and replaced with new mental associations.

Other emerging practices include ED's work to facilitate a training series to discuss race and equity, including the impact of bias. These conversations address inequity across demographic groups and are expected to help mitigate bias and create a more inclusive environment for all employees. Additionally, **Department of Interior (DOI)** is using focus groups as well as climate surveys, **DOL** has special training for the entire DOL workforce entitled "Blindspot: Hidden Biases of Good People," and **EPA** has a Hiring and Promotions Safeguard Pilot Program. More recent efforts that are underway or planned are presented later in this section.

A significant impetus for work by the **U.S. Department of Transportation (DOT)** to reduce the impact of bias within the agency is the Ladders of Opportunity Agenda, a major DOT priority. The department-wide Ladders of Opportunity internal program focuses on the importance of harnessing the talents of each individual, embracing diversity and promoting self-advocacy, and considering how these priorities help ensure that equity considerations are part of all DOT decisions. Among the activities advancing this effort, DOT hosted a Diversity and Inclusion Forum to showcase the important role that diversity has played in the history of transportation, presented the first in series of planned diversity, self-advocacy, leadership events entitled "DOT Planting Seeds: Select Your Destination," and created a Diversity and Inclusion Council to identify innovative ways to engage and educate DOT employees on issues related to diversity and inclusion in workplace practices. The Departmental Director, and Deputy Director, of the Office of Human Resource Management, are members of the Office of Personnel Management's Diversity and Inclusion in Government (DIG) Council, attending monthly meetings and serve as liaisons to DOT leadership.

In addition, the **Department of Homeland Security (DHS)** has developed a new tool, the "Inclusive Behaviors Job Aid," to provide managers and supervisors concrete examples of how to be consciously inclusive in the workplace. In 2016, DHS also began developing a bank of interview questions that focus on the candidates' experience in managing diverse and inclusive workplaces. This effort is founded upon research that indicates that underrepresented groups are often excluded from key positions simply because they are not deliberately included, but that by learning about the power of implicit bias and ways to mitigate it, organizations can create more inclusive workplaces.⁸¹

⁸¹ Corporate Executive Board, "Beneath the Surface of Diversity Recruiting: Activating Inclusion Recruiting." 2011. <https://www.cebglobal.com/home.html/>

DOE Implicit-Bias Training

DOE aims to reflect in their training program the belief that implicit bias is not inherent in people, but rather it is a reaction to experiences, including words and actions over the lifetime of an individual. In order to mitigate this bias, there need to be experiential learning opportunities to change how employees are reviewed. It is through active, engaged learning that DOE hopes to reduce the impacts of bias. DOE will make the following recommendations for providing experiential learning related to implicit bias:

- *Individual Professional-Development Training:* DOE will encourage employees to take a series of courses made available through the online-learning center on topics related to bias mitigation and communicating across cultures. DOE will recommend making courses mandatory for managers and team leaders on an annual basis and optional for non-supervisory employees. Employees will receive a certificate in bias mitigation once all courses are completed.
- *Bias Interrupters:* DOE will develop and promote “bias interrupters” as a resource for managers and employees who complete training related to bias mitigation. The “bias interrupters” will be tips and practices that employees can use to improve the objectivity and quality of decisions about hiring, promotions, career development opportunities, and performance appraisals.
- *DOE Community:* DOE will leverage its workforce to challenge stereotypes in STEM fields by engaging underrepresented communities in hands-on technology demonstrations. By introducing learners to new technology applications like the Smartphone Microscope, which utilizes relatively familiar, non-intimidating technologies like a camera and microscope, DOE will tap into a learner’s conscious and unconscious experiences with STEM disciplines. By leveraging the Smartphone Microscope, developed by one of its National Labs, along with its eclectic Federal workforce, DOE can positively impact STEM education efforts in certain targeted communities.

[Federal-Academic Interface: Research, Development, and Interventions on Bias](#)

The Federal Government has had a vast impact on the academic STEM workforce by funding a substantial body of basic and applied research on bias. Basic research has produced a rich understanding of bias, while the applied research has built on this understanding to design evidence-based interventions that have been tested on campuses across the Nation. Several agencies have advanced both of these efforts.

Basic Research

NSF has supported basic research, development, and implementation activities. Through its Science of Broadening Participation portfolio, NSF has invested in research on the theories,

methods, and analytic techniques of the social, behavioral, economic, and learning sciences to better understand the barriers that hinder and factors that enhance the participation of women and underrepresented minorities in STEM. Some of the powerful findings that emerge from this type of research include:

- **Gender bias impacts hiring.** A male job applicant for an academic positions was rated as more competent and would be offered a higher salary than an identical female applicant.⁸²
- **Assertiveness training does not improve women's ability to negotiate.** Sometimes women did not know that they could ask for what they want, and sometimes they did not ask because they had learned that society reacts badly to women asserting their own needs and desires.⁸³
- **Letters of recommendation disadvantage women.** Female applicants were described in more communal (social or emotive) terms and male applicants were described in more agentic (active or assertive) terms.⁸⁴
- **Stereotype threat impacts performance.** If there are negative stereotypes about a specific group, its members are likely to become anxious about their performance if attention is called to their membership in that group, which may hinder their ability to perform at their maximum level in part due to diversion of blood away the cognitive centers of the brain following activation of stereotype threat.^{85,86}

NIH also supports basic research on bias, stereotypes, and interventions to combat the impact of bias. Some examples are research on causal factors and interventions that promote support careers of women in biomedical and behavioral sciences and engineering⁸⁷ and NIH Directors Pathfinder Award, designed to encourage exceptionally creative individual scientists to develop

⁸² Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman, "Science Faculty's Subtle Gender Biases Favor Male Students," *Proceedings of the National Academy of Sciences* 109, no. 41 (2012): 16474-16479.

⁸³ Hannah Riley Bowles, Linda Babcock, and Lei Lai, "Social Incentives For Gender Differences in the Propensity to Initiate Negotiations: Sometimes it Does Hurt to Ask," *Organizational Behavior and Human Decision Processes* 103, no. 1 (2007): 84-103.

⁸⁴ Juan M. Madera, Michelle R. Hebl, and Randi C. Martin, "Gender and Letters of Recommendation for Academia: Agentic and Communal Differences," *Journal of Applied Psychology* 94, no. 6 (2009): 1591.

⁸⁵ Claude M. Steele and Joshua Aronson, "Stereotype Threat and the Intellectual Test Performance of African Americans," *Journal of Personality and Social Psychology* 69, no. 5 (1995): 797; Jason W Osborne, "Linking Stereotype Threat and Anxiety," *Educational Psychology* 27, no. 1 (2007): 135-154; Anne Maass, Claudio D'Ettole, and Mara Cadinu, "Checkmate? The Role of Gender Stereotypes in the Ultimate Intellectual Sport," *European Journal of Social Psychology* 38, no. 2 (2008): 231-245.

⁸⁶ Wendy Berry Mendes and Jeremy Jamieson, "Embodied Stereotype Threat: Exploring Brain and Body Mechanisms Underlying Performance Impairments," *Stereotype Threat: Theory, Process, and Application* (2011): 51-68.

⁸⁷ Research on Causal Factors and Interventions that Promote and Support the Careers of Women in Biomedical and Behavioral Science and Engineering (R01), Program Announcement, RFA-GM-09-012.

highly innovative and possibly transforming approaches for promoting diversity within the biomedical research workforce.⁸⁸

Findings from these NIH-supported basic research include:

- **Gender bias in grant reviews.** Grant reviewers implicitly hold different standards for male versus female applicants, and were more critical of female applicants and gave lower priority, approach, and significance scores to females in renewal applications.⁸⁹
- **Race bias in grant reviews.** Black applicants are less likely to receive independent research grants compared to white applicants.⁹⁰
- **Reducing implicit gender-leadership bias in academic medicine with an educational Intervention.** Educational intervention on implicit bias reduced faculty members' implicit bias regarding women and leadership (as measured by the IAT).⁹¹
- **Stereotype threat gender differences in academia.** Female faculty report greater susceptibility to stereotype threat in academic sciences and lower confidence in the likelihood of advancement compared to males, despite similar career interest and identification.⁹²

Research, Development, and Intervention

Many programs have been initiated to transform the basic understanding of bias into practices that reduce its impact. Examples include the following:

- NSF's ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers program⁹³ since 2001 has generated training programs and curricula for reducing implicit bias. Several of these have been successful in extensive comparative studies and randomized controlled trials. The rigorously tested, successful programs provide a starting point for any agency or institution of higher education

⁸⁸ NIH Recovery Act Grants to Foster Scientific Workforce Diversity, *National Institutes of Health, Turning Discovery into Health*, (2010),

<https://www.nih.gov/news-events/news-releases/nih-recovery-act-grants-foster-scientific-workforce-diversity>

⁸⁹ Anna Kaatz, You-Geon Lee, Aaron F. Potvien, Wairimu Magua, ... Molly Carnes, "Analysis of NIH R01 Application Critiques, Impact and Criteria Scores: Does the Sex of the Principal Investigator Make a Difference?" *Academic Medicine: Journal of the Association of American Medical Colleges*, 91, no. 41 (2016): 1080–1088.

⁹⁰ Donna K. Ginther, Walter T. Schaffer, Joshua Schnell, Beth Masimore, Faye Liu, Laurel L. Haak, and Raynard Kington. "Race, ethnicity, and NIH research awards." *Science* 333, no. 6045 (2011): 1015-1019.

⁹¹ Sabine Girod, Magali Fassiotto, Daisy Grewal, Manwai Candy Ku, Natarajan Sriram, Brian A. Nosek, and Hannah Valantine. "Reducing Implicit Gender Leadership Bias in Academic Medicine With an Educational Intervention." *Academic Medicine: Journal of the Association of American Medical Colleges* (2016).

⁹² Magali Fassiotto, Elizabeth O. Hamel, Manwai Ku, Shelley Correll, Daisy Grewal, Philip Lavori, VJ Periyakoil, Allan Reiss, Christy Sandborg, Gregory Walton, Marilyn Winkleby, and Hannah Valantine. "Women in Academic Medicine: Measuring Stereotype Threat Among Junior Faculty." *Journal of Women's Health* 25, no. 3 (2016): 292-298.

⁹³ ADVANCE Program Solicitation NSF 14-573. Also, www.portal.advance.vt.edu/

interested in developing its own training program and advancing institutional transformation. Some are immediately transferable to any work environment and others need to be adapted to the Federal work environment.

- The National Center for Women & Information Technology, funded by NSF and other collaborators, has developed case studies that offer solutions to reduce the impact of bias.⁹⁴
- NSF's recently launched the Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES) Initiative, will support new research, models, networks, and partnerships that lead to measureable progress at the national level and support efforts to scale the concepts of diversity and inclusion in STEM.⁹⁵ A key tenet of INCLUDES is that the infusion of broadening participation research about biases and barriers can positively inform implementation strategies and practices.
- NIH's BUILD: Building Infrastructure Leading to Diversity Initiative is a set of grants issued to undergraduate institutions to implement and study innovative approaches to engaging and retaining students from diverse backgrounds in biomedical research. Through implementing a variety of innovative intervention approaches to research skill building and training, mentorship and institutional change, the BUILD-funded institutions address various challenges faced by students, faculty and institutions, including the impact of bias.⁹⁶
- NIH's National Institute for General Medical Sciences (NIGMS) has been supporting the Research to Understand and Inform Interventions that Promote the Research Careers of Students in Biomedical and Behavioral Sciences, a program that facilitates dissemination and exchange of hypothesis-based research on interventions and initiatives that broaden participation in science- and engineering-research careers, including those that focus on the impact of implicit bias. It is designed to create a dialogue among behavioral science, social science, and education researchers, evaluators, and faculty in STEM fields who participate in intervention programs.^{97,98} NIGMS intentionally supports research on implicit bias through all of its diversity-focused programs as well as a range of research studies on implicit-bias interventions.

⁹⁴ See <https://www.ncwit.org/resources/how-can-reducing-unconscious-bias-increase-women%E2%80%99s-success-it/avoiding-unintended-gender-bias>;
<https://www.ncwit.org/resources/how-can-reducing-unconscious-bias-increase-women%E2%80%99s-success-it/avoiding-gender-bias>.

⁹⁵ INCLUDES Program Solicitation NSF 16-544. <http://www.nsf.gov/pubs/2016/nsf16544/nsf16544.htm>

⁹⁶ <https://diversityprogramconsortium.org/pages/build>

⁹⁷ Conference reports can be found at <http://understanding-interventions.org/reports/>

⁹⁸ <http://grants.nih.gov/grants/guide/rfa-files/RFA-GM-14-013.html>

Family-Friendly Policies and Programs

Recently, agencies have been addressing stereotypes and institutional barriers related to gender roles that can undermine performance due to parental status and family responsibilities. Family-friendly policies and practices for **NIH**-grant recipients include child-care support as part of conference grants, re-entry supplements, and up to 8 weeks of paid parental leave for National Research Service Award trainees. The Career-life Balance Initiative (CLB) at **NSF** is an agency-level approach to attract, retain, and advance graduate students, postdoctoral fellows, and early-career researchers in STEM fields, especially women. CLB aims to develop a coherent and consistent set of new and existing career-life policies and practices agency-wide to expand dependent care and dual-career support to improve the STEM work environment in higher education, as well as CLB partnership pilots with colleges and universities to promote the development and advancement of diverse STEM talent.

Compliance Reviews

Several agencies have tested the intervention of holding their grantees accountable for addressing implicit bias to encourage good practices. NIFA and NASA both conduct civil-rights and equal-employment-opportunity reviews in the institutions they fund. They attempt to ensure that their partners in research, education, and extension are in compliance with the rules and regulations pursuant to Federal civil-rights laws:

- Title VI of the Civil Rights Act of 1964 (prohibits discrimination on the basis of race, color, national origin, limited English proficiency);
- Title IX of the Education Amendments Act of 1972 (prohibits discrimination on the basis of gender);
- Age Discrimination Act of 1975 (prohibits discrimination on the basis of age); and
- The Rehabilitation Act of 1973 (prohibits discrimination on the basis of disability).

In assessing grantee compliance, NASA reviews methods of administration that can have unintentional adverse impacts, including policies and practices such as admission criteria, student advising, and classroom or research participation. Written reports with findings and recommendations that include identifying and addressing implicit bias are provided to university presidents or heads of museum and science centers. NASA's compliance reports have made recommendations to STEM programs to address the presence of unconscious bias in meaningful ways, such as training tailored to a particular audience. NASA has published a "Title IX and STEM" series that highlights promising grantee practices that assess the presence of bias and steps to address it.⁹⁹ Holding grantees accountable for reducing the impact of implicit bias is a strategic component for promoting diversity in STEM.

⁹⁹ "Title IX & STEM: Promising Practices for Science, Technology, engineering, & Mathematics," *National Aeronautics & Space Administration*, http://odeo.hq.nasa.gov/documents/71900_HI-RES.8-4-09.pdf; "Title IX & STEM: A Guide for Conducting Title IX Self-Evaluations in Science, Technology, Engineering, and Mathematics Programs," *National Aeronautics & Space Administration*, http://odeo.hq.nasa.gov/documents/TITLE_IX_STEM_Self-Evaluation_Fillable.pdf

Resources: Data Series Reports and Guides

Many past efforts to address bias in government, academia, professional societies, and industry have resulted in resources that can enable other institutions to launch initiatives to address implicit bias quickly and easily (see Appendix B). Some materials can be used as presented and others may need to be adapted to the organization or target audience, but the variety and abundance of the materials available provide many choices to address particular topics, use a preferred mode of presentation, or target an audience based on their role in an organization (e.g., leadership, managers, employees, or students).

Gaps and Scaling Questions

Promising practices are those that have been sustained and adopted or adapted in multiple places, but have not yet been studied or analyzed. For example, with monthly events, agencies collect participation counts but have not yet examined the impact of such practices. There is an opportunity here to address this question so that the agencies better understand if, how, and why these long-standing practices mitigate the impact of bias. If these agencies start to collect more evidence about the effectiveness and efficiency of promising practices and analyze those data, the activity might become a best practice. Data collection should focus on the ramifications of bias—hiring, retention, promotion, and cultural experiences of women, underrepresented minorities, and persons with disabilities—rather than on attempting to measure bias itself, which is neither easy to measure nor indicative of success in mitigating its effects.

The following scaling questions are relevant as agencies enhance their efforts to mitigate the impact of bias in the STEM workforce and learning environments:

- How are best practices adapted across the Federal agencies, including those from industry and professional societies?
- What evidence is needed to move from promising to best practices?
- What are the new features of longstanding practices that are appropriate for scale-up and what are incentives for more agencies to pilot new efforts, such as exploring creative approaches to prevent bias within the grant review process?
- Should the exploratory practice transition to a supportable practice?
- What are impactful strategies for collaborating with higher education to mitigate bias in a way that can be replicated?

CHAPTER V. RECOMMENDATIONS AND IMPLEMENTATION

The reduction of the impact of bias in STEM disciplines and the workforce is critical if America is to maintain its competitive edge in the global economy of the 21st century, and fully utilize the Nation's vast diversity of talent. Strategies for addressing the impact of bias in the STEM workforce, both internally and in Federally funded institutions of higher education, must start with a commitment from top leadership to advance equality and cultivate the best talent, independent of demographic affiliations. The practices that reduce the impact of bias must be integrated into each agency's core mission and at all levels of the organization. Predicated on these essential principles, the IPG developed the following policy recommendations to mitigate biases in: (1) the Federal STEM workforce, and (2) STEM programs in institutions of higher education that receive Federal funding.

Recommendation to Address Bias in the Federal Workforce

As research has shown, every Federal Agency and Department have a strategic interest in developing an infrastructure to address bias (where it exists) and increase opportunity for diversity within its own workforce. It is critical that each agency integrate mechanisms for addressing bias into its strategic plan. Mitigating bias (where it exists) in the workplace requires deliberate focus, including strong agency-wide communications strategies.

The following recommendation identifies key components that should be at the foundation of all agencies' and departments' strategies for addressing bias. Implementation steps will need to accommodate each agency's culture and work environment.

Recommendation 1: All Federal agencies and departments should exercise leadership at all levels, including senior officials, STEM program and administrative managers, human-capital officials and diversity and inclusion officials, to reduce the impact of bias in their internal operations.

- *Incorporation of diversity, inclusion, and bias mitigation into strategic plan.* Agency strategic plans must convey the value of diversity, inclusion, equality of opportunity, and the importance of explicit- and implicit-bias mitigation. The principles of promoting diversity must permeate the agency, across senior leadership and all employees.
- *Visible and regular participation, deep engagement, and demonstrated accountability by agency and department leaders in the dialogue and activities aimed at increasing diversity.* Agency leaders should be proactive, committed, and personally engaged in advancing the STEM workforce, reducing bias, and shifting cultures toward greater internalization of the principles of diversity and inclusion. Examples of actions include:

- Empowering staff with key responsibilities in improving diversity and inclusion by ensuring regular communications with the agency or departmental head who should regularly discuss with them policies and practices that reduce bias, and by ensuring this work is included in the staff's key performance goals and metrics and is not considered a voluntary activity; and
- Ensuring strong collaboration in bias-mitigation initiatives among key offices within the agency or department, such as the Office of the Secretary, Administrator, or Director; EEO; D&I; Human Resources, Education; Small Business; and with external stakeholders, such as program offices and professional and advocacy groups.
- Implementation of an organizational cycle of recruiting, hiring, and promotion practices that encourages diversity and reduce the impact of bias such as:
 - Enhancing opportunities to draw from a diverse pool of applicants;
 - Ensuring the use of objective and transparent criteria in hiring and promotion;
 - Evaluating employee perceptions of fairness in the workplace; and
 - Assessing demographics in hiring, promotion, performance ratings, and awards.
- Bias mitigation education and training. Each agency and department should develop or expand education and training on implicit- and explicit-bias mitigation.
- Employee empowerment and workforce engagement. Each agency and department should empower its employees at every level through support for attaining work-life balance (including flexible work schedules), advancing employee-education and professional-development opportunities, and maintaining good communication. Agencies and departments should ensure that these aspects of the workplace are distributed fairly, and they should strive to build inclusive, collaborative, and open work environments and fully engage employees in bias-reduction efforts. Bias reduction, like all matters pertaining to culture change, requires a sustained effort over time. Examples of good practices include:
 - Encouraging all employees to participate in opportunities for staff to be heard and receive feedback, have appropriate access to critical information, and making efforts to build or maintain an environment where diverse ideas and viewpoints are respected, valued, and encouraged;
 - Administering anonymous climate surveys agency-wide to reveal local manifestation of hidden bias and unfairness;
 - Conducting voluntary focus groups to assess whether alternative viewpoints are respected, valued, and encouraged, and whether employees are knowledgeable about critical developments in the Agency;
 - Maintaining a continuous program of learning opportunities, as resources permit, to ensure that all employees have basic skills to identify implicit bias (where it exists) and are expected to model behaviors that can mitigate the effects of such bias. These can

- include multilayered training opportunities for senior managers, supervisors, and employees to develop awareness of and a means of mitigating implicit bias, and customized training that includes examples of hidden bias, forms of unfairness that are hurtful and demotivating, and safe forums in which to discuss these issues; and,
- Developing and maintaining robust work-life-balance policies, advocating for and utilizing flexibilities to the maximum extent practicable, and equitable access to these programs.
- *Establishing bias-mitigation goals, techniques, and accountability mechanisms.* Each agency should establish bias-reduction goals and accountability mechanisms to determine whether goals are being met. Accountability mechanisms should include the creation of an implicit-bias-diagnostic tool to inform users and offer skill-development opportunities to aid individuals, teams, and organizations to better identify and, where it exists, better address unconscious biases. Examples include:
 - Establishing appropriate benchmarks and monitoring performance over time; and
 - Reporting on challenges and progress in bias mitigation in relevant reports.

Recommendation to Address Bias at Federally Funded Academic Institutions of Higher Education

Overarching policy recommendations designed to help increase participation in the STEM fields through bias-reduction efforts at Federally funded institutions must reflect the strategic foundation on which Federal agencies are engaging with these programs, whether higher education, research institutes, or laboratories. The recommendations in this section are therefore based on the premise that agencies will incorporate these initiatives into their own strategic planning. A commitment to culture change must flow from top leadership and permeate the agency at every level to exert influence in the academic environments that receive Agency support.

Recommendation 2: All Federal agencies should encourage the institutions they fund to implement bias-mitigation strategies by providing a model in the proposal-review process and by offering technical assistance and support for advancing inclusive STEM environments. Strategies and activities should include:

- Ensuring diversity in membership of grant-review panels;
- Establishing a systematic means of collecting and analyzing data on the entire life cycle of the grant-making process to analyze success rates in getting grants across groups;
- Offering training or conducting workshops with staff involved in the grant-selection process about the potential for bias to shape Federal-grant-making processes;
- Hosting workshops with grantees and institutional stakeholders to share research findings and develop bias interventions;

- Incorporating work-life-balance policies into grant-making processes and grant award agreements;
- Offering grantees resources on diversity and promising practices for mitigating the effects of bias undertaken by government, academia, and the private sector;
- Encouraging grant recipients to conduct evidence-based workshops on implicit bias for department chairs, professors, deans, and administrators at all levels of the STEM pipeline; and
- Encouraging institutional grantees to have strong family-friendly and work-life-balance policies in place (e.g., tenure-clock extensions, daycare, and lactation facilities).

Recommendation for Cross-cutting Government Leadership: STEM Workforce and Federally Funded Institutions of Higher Education

It is incumbent upon the Federal Government as a leading investor in STEM research and development to serve as an example of strong leadership for all efforts to ensure that all Americans are welcomed into the STEM workforce. Although each agency will implement diversity strategies that are tailored to its culture and needs, efforts will be most effective if they are coordinated across agencies. Accordingly, the agencies will need a renewed spirit of coordination that accommodates the variation among agencies.

Recommendation 3: OSTP, OPM, and DOJ—as the agency responsible for coordinating government-wide civil-rights efforts—should coordinate Federal agencies among themselves and with Federally funded institutions to reduce the impact of bias in the STEM workforce. Ways to accomplish this include:

- Serving as focal points, clearinghouses, and distribution points for bias-reduction strategies and best practices for both Federal agencies and Federally funded institutions.
- Coordinating civil-rights compliance efforts.
 - DOJ should continue to coordinate agencies' efforts to assess compliance among Federally funded institutions and assist them in their efforts to increase diversity through bias-reduction efforts. To address the goals presented in the GAO's December 2015 report on challenges facing women, which is relevant to all underrepresented groups, DOJ should also:
 - Facilitate interagency information-sharing on best practices in Title IX compliance; and
 - Improve and coordinate compliance reviews across agencies.
- Providing guidance to agencies related to performance and accountability in efforts to mitigate the impact of explicit and implicit bias (where it exists) by investigation of potential measurement tools;

- Spurring greater strategic coordination, sharing, and collaborating on successful programs aimed at reducing bias and increasing diversity at Federally funded institutions.
- Strengthening University-Community-Government collaborations to mitigate the impact of bias and expand pathways to Federal STEM employment. Examples include the following:
 - Providing outreach to local schools, colleges, and universities to provide diverse role models to inspire students and encourage students to study STEM by dispelling stereotypes about who can participate in STEM;
 - Working with community organizations, STEM-advocacy groups, and professional societies to encourage underrepresented populations to pursue STEM careers, provide bias-training opportunities, and share innovative practices to mitigate the impact of bias in STEM; and
 - Working with professional societies and other STEM organizations to expand recruitment efforts for the Federal workforce by providing role models for underrepresented populations to inspire and dispel stereotypes among junior members of the STEM community.

Implementation and Next Steps

To guide the implementation of these recommendations, the Interagency Policy Group further proposes the following actions.

- An interagency body, acting as a community of practice and drawn from the NSTC and OPM bodies should:
 - Coordinate, share, and review the Government-wide implementation and scaling of best and promising practices;
 - Develop design principles for adapting practices to specific environments;
 - Identify gaps in research, policy, and practice;
 - Develop a diagnostic tool, comprising a set of quantitative metrics and strategies, to track increased diversity in the Federal STEM workforce by the reduction of the impact of bias where it may exist; and
 - Develop a comprehensive, updated inventory of policies and practices by the Federal government and Federally funded institutions to reduce the impact of bias in the STEM workforce.
- OPM and Federal agencies should implement a public-engagement campaign, strategically targeted to key stakeholders, to highlight the existence, challenges, and impacts of bias and ways to reduce it in the STEM workforce.

- Each Federal agency and department should develop a 1-page plan of action to implement and institutionalize policies and practices for reducing the impact of bias on the education, employment, and advancement of members of groups historically underrepresented or underserved in STEM fields. Such policies and practices must be designed to make careers in STEM more welcoming and conducive to the success of all people, including women, members of underrepresented ethnic and racial groups, and people with disabilities. Agency plans should be best-practice driven, include measurable goals, and be published in easy-to-understand forms, such as dashboards, to be reviewed by OPM on an annual basis.
- Federal agencies, institutions of higher education, and the proposed interagency implementation body should develop accountability measures that can be used to assess progress on reducing bias (where it exists) in STEM education and the workforce. This work should entail the development of a system of measurements and strategies to measure progress that would include creation of an implicit-bias-diagnostic tool. These entities should also review research to accelerate progress in the emerging fields of bias-mitigation, diversity, and inclusion policies and practices. Best practices emerging from research should also be brought back in-house to accelerate use of new research-based tools and strategies in practice.

APPENDIX A

Summaries of Agency Reports on Efforts to Mitigate the Impact of Bias

As part of the IPG process to identify best and promising practices, agencies and departments provided reports on their efforts to raise awareness about bias and mitigate its impact using the format below.

- I. **Agency STEM Workforce** (including National and Federal Laboratories)
 - a. Implicit Individual Bias: Unintended and unconscious assumptions, often based on stereotypes about gender or ethnicity, which influence individuals' judgments about other people or their work.
 - b. Implicit Institutional Bias: Institution or agency policy and practices that make it more difficult for members of certain groups to succeed.
 - c. Explicit Bias: Intentional, consciously articulated beliefs that spur discriminatory attitudes and behaviors.

- II. **Federally Funded Institutions of Higher Education STEM Workforce**
(e.g., Graduate and Postdoctoral Students; Faculty; Staff; Administrators; or Institutional Climate)
 - a. Implicit Individual: Unintended and unconscious assumptions, often based on stereotypes about gender or ethnicity, which influence individuals' judgments about other people or their work.
 - b. Implicit Institutional: Institution or agency policy and practices that make it more difficult for members of certain groups to succeed.
 - c. Explicit: Intentional, consciously articulated beliefs that spur discriminatory attitudes and behaviors.

Agency and department websites for their respective one-page summaries on their efforts to raise awareness about bias and mitigate its impact can be found below:

- Department of Agriculture (USDA): <https://www.ascr.usda.gov/about-oascr>
- Department of Defense (DOD): <http://www.dodstem.us/blog-posts/2016/dod-agency-final-report-mitigating-bias-in-stem-workforce>
- Department of Education (ED): <http://innovation.ed.gov/what-we-do/stem/>
- Department of Energy (DOE): <http://www.energy.gov/diversity/bias-mitigation>
- Department of Health and Human Services (DHHS): www.hhs.gov/stem-bias-mitigation-report

- Department of Homeland Security (DHS): <https://www.dhs.gov/publication/stem-workforce-diversity>
- Department of Interior (DOI): <https://www.doi.gov/notices/stem-eo>
- Department of Labor (DOL): <https://blog.dol.gov/2016/07/20/strengthening-our-workforce-through-diversity-and-opportunity/>
- Department of Transportation (DOT): <https://www.transportation.gov/civil-rights/about-docr/reducing-impact-bias-stem-workforce>
- Environmental Protection Agency (EPA): <https://www.epa.gov/aboutepa/reducing-impact-bias-stem-workforce>
- National Aeronautics and Space Administration (NASA): http://odeo.hq.nasa.gov/documents/NASA_Mitigating_Bias_Agency_Progress_Rpt_6-23-16_tagged.pdf
- National Science Foundation (NSF): <http://www.nsf.gov/od/broadeningparticipation/bp.jsp>
- National Oceanic and Atmospheric Administration (NOAA), a Bureau of the Department of Commerce: <http://www.epp.noaa.gov/>
- United States Patent and Trademark Office (USPTO), a Bureau of the Department of Commerce: <http://www.uspto.gov/about-us/organizational-offices/office-equal-employment-opportunity-and-diversity/reducing-impact>
- Smithsonian Institution (SI): <http://www.si.edu/oeema/DivInitiatives.htm>

APPENDIX B

Resources for Reducing the Impact of Bias

Federal Agencies

ED published a practice guide, “Encouraging Girls in Math and Science”, to provide specific and coherent evidence-based recommendations that educators can use to encourage girls in the fields of math and science. The target audience is teachers and other school personnel with direct contact with students, such as coaches, counselors, and principals. The practice guide is available online at: <http://ies.ed.gov/ncee/wwc/PracticeGuide.aspx?sid=5>.

DOL’s Bureau of Labor Statistics produces several data series with detail by occupation, including specific STEM occupations. Available data include employment and wages by detailed occupation (from the Occupational Employment Statistics program), 10-year occupational employment projections (from the Employment Projections program), information on job characteristics and duties (from the Occupational Outlook Handbook), data on employee benefits (from the National Compensation Survey), and data on workplace safety (from the Survey of Occupational Injuries and Illnesses and the Census of Fatal Occupational Injuries). Taken together, these data series provide information to employers, employees, career counselors, students, researchers, and others on the current employment and working conditions of many detailed occupations, including STEM occupations.

NASA’s MissionSTEM website, <http://missionstem.nasa.gov/>, supplements the agency’s compliance review program and is the centerpiece of its civil-rights technical assistance to grantees. MissionSTEM is embedded in the core operations of NASA’s grantee civil-rights compliance efforts, and is deemed essential for making progress in this arena. The site provides a wide array of material on civil rights, including promising practices. NASA performs regular analytics on the site to measure its success. This includes monitoring “hits” and “views,” which consistently trend upward following email blasts to alert grantees of new content. Grantees have applauded NASA for technical-assistance efforts. In September 2014, NASA added a learning tool on implicit bias to its Mission STEM website.¹⁰⁰ The tool, “Unconscious Bias in STEM: Addressing the Challenges,” is designed to assist administrators, faculty, staff, and students of programs funded by NASA by providing them with a better understanding of bias and how it can impact STEM-educational environments.

¹⁰⁰ <http://missionstem.nasa.gov/eLearn.html>

NSF's ADVANCE provides a repository of information on bias that includes the following policies and practices being employed in higher education: leadership (e.g., Office of Institutional Equity), policy (e.g., career flexibility policies), training/education (e.g., training for college deans and department chairs, double blind survival strategies videos, research synthesis), recruitment (e.g., large and diverse pool of nominees/applicants, search committee strategies and guidelines such as STRIDE [Strategies and Tactics for Recruiting to Improve Diversity and Excellence]), retention (e.g., faculty retention toolkit), advancement (e.g., recognition for diversity contributions), and accountability (e.g., bias assessments, analysis of culture survey data).¹⁰¹

The **Smithsonian** Science Education Center (SSEC), (<https://ssec.si.edu/>) provides extensive training for teachers at the K-12 level across the country and has developed a comprehensive curriculum (Science and Technology ConceptsSTC™) that supports higher-order teaching strategies to improve student learning of STEM, integrated with history, art and culture in grades K-8. A five-year rigorous study of its “Leadership and Assistance for Science Education Reform (LASER)” model demonstrates that LASER leads to measurably higher student achievement for all students—especially those students who are economically disadvantaged, are English language learners, or have disabilities.¹⁰² Together with Shell Oil Foundation and the National Science Teachers’ Association, the SSEC has also embarked on a 3-year initiative to address the unintended assumptions, often based on stereotypes about gender or ethnicity, which have served as a possible barrier in the advancement of STEM teachers of color serving in leadership positions. Three distinct strategies have been prioritized for mitigating systemic biases and improving the engagement of minority teachers in STEM: (1) focusing on city- and district-level systems change; (2) starting a marketing campaign to rebrand the teaching profession to make it more attractive, including to people of color; and (3) increasing and improving mentorship and the intentional instruction of leadership competencies for STEM teachers.

Industry

Many large STEM related companies (e.g., chemicals, petroleum, engineering, etc.) have affinity groups, e.g., a group for women, Hispanics, LGBT, etc., but not implicit-bias training. There is considerable implicit bias training in Silicon Valley. A number of consulting firms and industry membership organizations provide implicit bias training or models of best practices. But the training is proprietary. Some of the consulting firms providing implicit-bias training include: Workplace Answers, Catalyst, Cook Ross, Nextions, Paradigm, Vaya, and Unitive.¹⁰³ Some companies that have addressed implicit bias include:

¹⁰¹ ADVANCE Program Solicitation NSF 14-573. Also, www.portal.advance.vt.edu/

¹⁰² <https://ssec.si.edu/laser-i3>

¹⁰³ <http://www.forbes.com/sites/ellenhuet/2015/11/02/rise-of-the-bias-busters-how-unconscious-bias-became-silicon-valleys-newest-target/>

- **Arla Foods** has a 2-day bias-training session for leadership teams. Among the results (local) are a 25 percent increase in the success rate of recruitment and the annual engagement survey (global) show a 19 percent increase in the employees experiencing that their differences are being used more. Leaders report that they are much more conscious about challenging “us” and “them” groups, and more actively seek out diverse perspectives.”¹⁰⁴
- **Google** developed a workshop,¹⁰⁵ in which employee participants reported positive impacts; participants were significantly more aware, had greater understanding, and were more motivated to overcome bias. In addition to partnering with organizations like the Clayman Institute and the Ada Initiative to further research and awareness, Google is taking action to ensure that decision-making—from promoting employees to marketing products—is objective and fair. Four practices are being utilized to reduce the influence of bias: gather facts, create a structure for making decision, be mindful of subtle cues, and foster awareness.¹⁰⁶ Google also has an implicit-bias training video up on YouTube.¹⁰⁷
- **Salesforce Inc.** is addressing unconscious bias through awareness training and competencies-based interviewing processes. Additionally, a process is in place where at least one female candidate or underrepresented minority is interviewed for executive positions. Over the last 12 months, nearly 40 percent of all new Salesforce hires in the United States were either women, African American, Hispanic, Native American, Hawaiian, or two or more races—an increase of approximately 5 percent over the 38 percent in the previous 12 months.¹⁰⁸

Professional Societies

A brief review of the websites of selected professional STEM organizations resulted in identifying several important resources related to bias mitigation. **Engineers Australia** has an Action Plan for Mitigating Gender Bias that can be found at this website.¹⁰⁹

¹⁰⁴ Source: Nudging the Unconscious Mind for Inclusiveness Tinna C. Nielsen & Lisa Kepinski, October 2014© Copyrights reserved Tinna C. Nielsen and Lisa Kepinski, 2014. Please request permission from the authors to share this Whitepaper with others beyond your own personal use.
http://weprinciples.org/files/attachments/WHITE_PAPER_Nudging_the_Unconscious_Mind_Nielsen_&_Kepinski_Oct_2014.pdf

¹⁰⁵ <https://library.gv.com/unconscious-bias-at-work-22e698e9b2d#.i614ebsqz>

¹⁰⁶ “Google’s Workplace Diversity Still has a Long Way to Go” Kia Kokalitcheva/Fortune, Time Magazine, June 1, 2015, <https://googleblog.blogspot.com/2014/09/you-dont-know-what-you-dont-know-how.html>

¹⁰⁷ <https://www.youtube.com/watch?v=nLjFHTgEVU>

¹⁰⁸ https://www.salesforce.com/blog/2015/08/working-toward-more-diverse-salesforce-future.html?utm_content=buffer4c30b&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer Cindy Robbins is the EVP, Global Employee Success, Salesforce.

¹⁰⁹ https://www.engineersaustralia.org.au/sites/default/files/wie_ind_ustryblueprint_p3_digital.pdf

The following three professional societies, in collaboration with AWIS, have developed best practices for selection of awardees that address implicit bias: the **American Chemical Society**,¹¹⁰ the **Mathematical Association of America**,¹¹¹ and the **American Geophysical Union**.¹¹²

The Society for Neuroscience has a video on implicit bias that is available only to members¹¹³ and also a Department Chair Training to Increase Women in Neuroscience (IWiN) project to tackle these issues within the neuroscience community. The website¹¹⁴ indicates progress has been made in some institutions for the project as a whole, but not clearly due to implicit-bias training.

¹¹⁰ http://www.acs.org/content/dam/acsorg/funding/awards/national/selection-committee-best-practices_percent20_2015.pdf

¹¹¹ http://www.maa.org/sites/default/files/pdf/sections_archived/Sections_ImplicitBiasStatement.pdf

¹¹² <http://honors.agu.org/files/2014/11/AWARDS-SUGGESTED-BEST-PRACTICES-MAY2011.pdf>

¹¹³ <http://neuronline.sfn.org/Articles/Diversity/2015/Questioning-Implicit-Bias>

¹¹⁴ <http://www.sfn.org/Careers-and-Training/Women-in-Neuroscience/Department-Chair-Training-to-Increase-Diversity/Promotion-and-Tenure/Leveling-the-Playing-Field>

ABBREVIATIONS

ADVANCE:	Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers
BUILD:	Building Infrastructure Leading to Diversity
CLF:	Civilian Labor Force
CSR:	Center for Scientific Review
DCA:	Diversity Change Agents
CEO:	Chief Executive Officer
CMP:	Conflict Management Program
CRD:	Civil Rights Division
D&I:	Diversity & Inclusion
DISP:	Diversity and Inclusion Strategic Plan
DOC:	Department of Commerce
DOD:	Department of Defense
DOE:	Department of Energy
DHHS:	Department of Health and Human Services
DHS:	Department of Homeland Security
DOL:	Department of Labor
DOI:	Department of Interior
DOJ:	Department of Justice
DOT:	Department of Transportation
DPC:	Domestic Policy Council
ED:	Department of Education
EEOC:	Equal Employment Opportunity Commission
EEO:	Equal Employment Opportunity
EPA:	Environmental Protection Agency
EO:	Equal Opportunity
EOP:	Executive Office of the President
EPP:	Educational Partnership Program
ERG:	Employee Resource Groups
ETA:	Employment and Training Administration
FEORP:	Federal Equal Opportunity Recruitment Plan
FEVS:	Federal Employee Viewpoint Survey
FY:	Fiscal Year
GAO:	Government Accountability Office
HHS:	U.S. Department of Health and Human Services
IAT:	Implicit Association Test
INCLUDES:	Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science
IPG:	Interagency Policy Group

IQT:	Inclusion Quotient Training
IWiN:	Increase Women in Neuroscience
LASER:	Leadership and Assistance for Science Education Reform
LGBT:	Lesbian, Gay, Bisexual, Transgender
NASA:	National Aeronautics and Space Administration
NCWIT:	National Center for Women & Information Technology
NIFA:	National Institutes for Food and Agriculture
NIH:	National Institutes of Health
NIGMS:	National Institute for General Medical Sciences
NOAA:	National Oceanic and Atmospheric Administration
NSF:	National Science Foundation
NSTC:	National Science and Technology Council
ODI:	Office of Diversity and Inclusion
OPM:	Office of Personnel Management
OSTP:	Office of Science and Technology Policy
PASSS:	Pattern-recognition, Action-oriented, Self-interest, Stability, Social
RCR:	Responsible Conduct of Research
R&D:	Research & Development
SBP:	Science of Broadening Participation
S&E:	Science and Engineering
S&T:	Science and Technology
SEEDS:	Similarity, Expedience, Experience, Distance, Safety
SES:	Senior Executive Service
STC:	Science and Technology Concepts
STEM:	Science, Technology, Engineering and Mathematics
STRIDE:	Strategies and Tactics for Recruiting to Improve Diversity and Excellence
US:	United States
USDA:	United States Department of Agriculture
USGS:	United States Geological Survey
USPTO:	United States Patent and Trademark Office