ACHIEVING THE PROMISE OF A DIVERSE STEM WORKFORCE

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

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C O N T E N T S

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Appendix II: Additional Material for the Record

ACHIEVING THE PROMISE OF A DIVERSE STEM WORKFORCE

THURSDAY, MAY 9, 2019

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to notice, at 10 a.m., in room 2318, Rayburn House Office Building, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

Achieving the Promise of a Diverse STEM Workforce

Thursday, May 9, 2019
10:00 am – 12:00 pm
2318 Rayburn House Office Building

PURPOSE

On Thursday, May 9, 2019 at 10:00 am, the Committee on Science, Space, and Technology will hold a hearing to explore the need for a diverse STEM workforce and assess the lessons learned, model programs, enduring challenges, and future opportunities for expanding access to STEM studies and careers. The Committee will also receive testimony on the *STEM Opportunities Act*.

WITNESSES

- **Dr. Mae Jemison**, Principal, 100 Year Starship
- **Dr. Shirley Malcom**, Senior Advisor and Director of SEA Change, American Association for the Advancement of Science
- **Dr. Lorelle Espinosa**, Vice President for Research, American Council on Education
- **Dr. James L. Moore III**, Vice Provost for Diversity and Inclusion and Chief Diversity Officer, The Ohio State University
- **Ms. Barbara Whye**, Chief Diversity and Inclusion Officer, Vice President of Human Resources, Intel

KEY QUESTIONS

- Why should we strive for a STEM workforce that reflects the diversity of the country?
- What major barriers persist to increasing diversity in STEM studies and careers?
- What are some promising practices for recruitment, retention, and advancement of women and other groups historically underrepresented in STEM?
- Where should future efforts be focused?
- How might the *STEM Opportunities Act* be improved to address some of the challenges to broadening participation in STEM careers?

BACKGROUND

The U.S. science and engineering enterprise is essential to national defense, the public welfare, economic competitiveness, and the capacity to address national challenges.[1,2] While the U.S. continues to lead the world in spending on science research, advanced STEM degrees, high-quality research publications, and Nobel laureates, the nation's long-standing dominance in science and innovation is eroding.[3,4] Other nations are investing heavily in their STEM workforce. In 2014, almost half of all STEM bachelor's degrees were conferred in India (25 percent) and China (22 percent), compared with 10 percent conferred in the U.S. China increased spending on research and development by 18 percent per year between 2000 and 2015, compared with 4 percent in the U.S.[5] China has accelerated its research output in recent years, surpassing the U.S. in the number of research articles published for the first time in 2016.[6] One of the key challenges facing the U.S. science and engineering enterprise is a lack of diversity in the STEM workforce.

THE STEM WORKFORCE

It is difficult to measure the size of the STEM workforce because there is no standard definition of STEM workers. When defined by occupation only, the STEM workforce totals nearly 6.8 million people. By far, the largest STEM occupations are computer and information scientist (46 percent) and engineer (26 percent). While most STEM occupations (64 percent) are in industry, 13 percent are in 4-year colleges and universities and 6 percent are in the Federal government.[7]

Growth of the STEM workforce has historically outpaced growth of the overall workforce. The Bureau of Labor Statistics (BLS) predicts that future growth in STEM employment will be dominated by growth in math and computing jobs. Employment in math occupations will grow by 28 percent (59,400 new jobs) and computing jobs by 13 percent (557,100 new jobs) between 2016 and 2026. According to BLS, growth in these occupations will be driven by "greater emphasis on cloud computing, the collection and storage of big data, and information security."[8]

STEM Skills Gap: The widespread adoption of advanced technologies by the private sector has resulted in a growing demand for STEM skills. While demand is high in sectors traditionally

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[1] Vannevar Bush, "Science, The Endless Frontier," https://www.nsf.gov/about/history/nsf50/vbush1945.jsp
[2] NAS, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future," https://www.nap.edu/catalog/11463/rising-above-the-gathering-storm-energizing-and-employing-america-for
[3] Nature Index, "Not so fast. Who really leads the world in science?," https://www.natureindex.com/news-blog/not-so-fast-who-really-leads-the-world-in-science
[4] The Economist, "The hierarchy of countries winning Nobels in the sciences is shifting," https://www.economist.com/graphic-detail/2018/05/10/the-hierarchy-of-countries-winning-nobels-in-the-sciences-is-shifting
[5] NSB, "The Rise of China in Science and Engineering," https://nsf.gov/nsb/sei/one-pagers/China-2018.pdf
[6] NSF, "Overview of the State of the U.S. S&E Enterprise in a Global Context," https://www.nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications
[7] NSF, "Women, Minorities, and Persons with Disabilities in Science and Engineering 2019," https://ncses.nsf.gov/pubs/nsf19304/
[8] BLS, "Occupational Outlook Handbook," https://www.bls.gov/ooh/

reliant on STEM skills, such as information technology and software development, industries such as manufacturing, transportation, and financial services also need additional STEM talent as they incorporate new technologies into their business models.

High schools, community colleges, and universities have been slow to respond, struggling to adapt their curriculum to keep pace with the rapidly evolving needs of employers. Many companies are having difficulty recruiting and retaining workers with adequate STEM skills for their needs. A 2014 report by The Brookings Institution found that STEM jobs take more than twice as long to fill as job openings in other fields.[9] An analysis conducted by the World Economic Forum found that the skills gap is a significant barrier to the adoption of new technologies by companies in industries spanning a range of sectors.[10]

CHANGING DEMOGRAPHICS

Demographic shifts in the U.S. population are approaching an inflection point. The U.S. Census Bureau projects that by 2045, white Americans will no longer comprise the majority of the population. During that year, non-Hispanic whites will comprise 49.7 percent of the population, while Hispanics will comprise 24.6 percent, African Americans 13.1 percent, Asians 7.9 percent, and multiracial populations 3.8 percent. Although the nation as a whole is diversifying, the STEM workforce has been slow to respond.

Women: Despite accounting for one-half of the college-educated workforce, in 2015 women represented 28 percent of people working in STEM occupations. Women's participation in the STEM workforce varies across STEM fields. While women have made significant gains in fields like biological, agricultural, and environmental sciences (47.9 percent), their proportions are low in engineering (14.5 percent) and computer and mathematical science (26.4).

Low rates of women in the STEM workforce is driven, in part, by their underrepresentation in STEM degree programs. Women's share of bachelor's degrees fell between 2006 and 2016 in computer science (from 20.7 to 18.7 percent) and physics (from 20.7 to 19.3 percent) and women earned only 20.9 percent of bachelor's degrees in engineering.[11]

For women of color, the disparity is more pronounced. In 2016, Hispanic women comprised 10.6 percent of the college-age population[12], yet earned just 1.9 percent of bachelor's degrees in computer science and 2.3 percent of bachelor's degrees in engineering. The share of STEM bachelor's degrees awarded to Hispanic women increased across all fields between 2006 and 2016.

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[9] The Brookings Institution, "Still Searching: Job Vacancies and STEM Skills," https://www.brookings.edu/interactives/still-searching-job-vacancies-and-stem-skills/

[10] World Economic Forum, "The Future of Jobs Report 2018," https://www.weforum.org/reports/the-future-of-jobs-report-2018

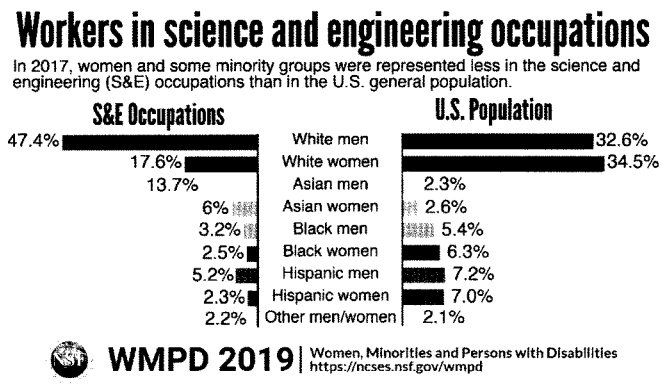
[11] NSF, "Women, Minorities, and Persons with Disabilities in Science and Engineering 2019," https://ncses.nsf.gov/pubs/nsf19304/

[12] U.S Census Bureau, "National Population by Characteristics: 2010-2017," https://www.census.gov/data/tables/2017/demo/popest/nation-detail.html

While the share of bachelor's degrees earned by black women (7.6 percent of the college-age population) increased slowly in psychology and social science, their share of bachelor's degrees in all other STEM fields stayed constant or declined. Black women earned just 1 percent of engineering bachelor's degrees in 2016, down from 1.5 percent in 2006. The sharpest decline was in computer science, which fell from 4.4 percent to 2.2 percent.

The women who do succeed in obtaining STEM degrees earn less than men. According to data collected by NSF, full-time employed women with a doctorate degree in a STEM field earn 20 percent less than men with STEM doctorates.[13] In addition to the STEM education pipeline and pay disparities, women in STEM occupations face a number of barriers to access and advancement in STEM careers. These barriers include discrimination, implicit bias, arbitrary and subjective career evaluation criteria, and organizational structure and rules that lead to differential treatment when compared with men.[14]

The National Academies of Science has a study underway to examine "the evidence behind the most successful policies, practices, and strategies that have demonstrated effectiveness in opening doors to women's participation and success" in STEM.[15] Dr. Mae Jemison, the first African American woman in space, is a panelist for the hearing. She is serving as Chair of the committee conducting this study and can discuss the motivation for and scope of the project.



Racial and Ethnic Minorities: Compared with their proportions in the U.S. population, members of racial and ethnic minority groups are significantly underrepresented in the STEM workforce. Asians and whites are overrepresented. While the representation of American Indians in STEM

[13] NSF, "Science and Engineering Indicators 2018," https://nsf.gov/statistics/2018/nsb20181/
[14] NAS, "Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering," https://www.nap.edu/catalog/11741/beyond-bias-and-barriers-fulfilling-the-potential-of-women-in
[15] NAS, "Addressing the Underrepresentation of Women in Science, Engineering, and Medicine," https://www8.nationalacademies.org/pa/projectview.aspx?key=51113

occupations increased from 1993 (0.2 percent) to 2006 (0.4 percent), that progress was reversed and only 0.2 percent of STEM occupations were held by American Indians in 2015. While Hispanic employment in STEM occupations has steadily increased (from 2.9 to 6 percent) from 1993 to 2015, progress for African Americans has been much slower (from 3.6 to 4.8 percent).[16]

Similar to women, the low rate of underrepresented minorities[17] in the STEM workforce is due, in part, to the pipeline of minority STEM graduates. Almost a quarter of all bachelor's degrees in STEM were earned by underrepresented minority students in 2016. At all degree levels, underrepresented minority men earned lower shares of STEM degrees than underrepresented minority women.[18]

Representation of Hispanics and black students varies across STEM fields. The share of STEM bachelor's degrees earned by Hispanic students has increased in all fields over time. Hispanics earn bachelor's degrees in psychology (17.1 percent) and social science (15.3) at rates similar to their proportion of the population but are significantly underrepresented among graduates in mathematics (8.9 percent) and physics (9.3 percent).[19]

The picture is more discouraging for black students. In nearly all STEM fields, the proportion of STEM bachelor's degrees earned by black students has either stagnated or declined since 1996. Black students earned only 4.8 percent of bachelor's degrees in engineering in 1996. Today, that share is 3.9 percent. In the past two decades, representation of black students among bachelor's degree earners in computer science has fallen from 9.9 percent to 8.7 percent.[20]

Black and Hispanic STEM degree earners are paid less than whites and Asians with STEM degrees – 14.3 percent less for doctorate degree earners and 24 percent less for those with a STEM bachelor's degree.[21] Many of the barriers facing women in STEM also affect underrepresented minority students. In addition, minority students are more likely to come from low-income families and have less access to academic resources to prepare them for STEM degree programs.

The National Academy of Sciences released a report in 2018 highlighting the outsized contributions to the STEM workforce made by minority serving institutions (MSIs). MSIs include Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), and Tribal Colleges and Universities (TCUs). For instance, HBCUs make up only 3 percent of the nation's colleges and universities, but graduate 28 percent of African American students earning bachelor's degrees in the physical sciences, 26 percent in mathematics, and 25

[16] NSF, "Science and Engineering Indicators 2018," https://nsf.gov/statistics/2018/nsb20181/

[17] Underrepresented minorities, as used in this charter, refers to African Americans, Hispanic or Latino Americans, Native Americans and Alaska Natives, and Native Hawaiians and Pacific Islanders. Asians, while a minority group in the U.S. population, are typically overrepresented in STEM fields.

[18] NSF, "Women, Minorities, and Persons with Disabilities in Science and Engineering 2019," https://ncses.nsf.gov/pubs/nsf19304/

[19] Ibid.

[20] Ibid.

[21] NSF, "Science and Engineering Indicators 2018," https://nsf.gov/statistics/2018/nsb20181/

percent in the biological sciences.[22] Included in the Committee's recommendations was a call for funding agencies to "continue to develop and expand grant competition programs that serve the nation's MSIs."[23] One of the committee Co-Chairs, Dr. Lorelle Espinosa, is a panelists at the hearing. She can discuss the committee's findings and recommendations in more detail.

BROADENING PARTICIPATION

In light of the STEM skills shortage, women and racial and ethnic minorities represent a much needed, but underutilized, pool of talent. In addition to helping narrow the skills gap, research indicates that diversity produces better results. A 2015 McKinsey & Company study found that "companies in the top quartile for gender or racial and ethnic diversity are more likely to have financial returns above their national industry medians."[24] A 2011 National Academies study compiled diverse views among researchers, economists, and others about the costs and benefits of racial and ethnic diversity and found, "a preponderance of research suggests that benefits outweigh the various objections to diversity raised in the literature."[25]

Promising efforts are underway in the Federal government, at universities, and in the private sector to identify and lower barriers to access, retention, and success in STEM studies and careers for women and other underrepresented groups.

Federal Government: A key initiative focused on increasing diversity in STEM is the NSF INCLUDES program. Launched in 2016, the goal of the program is "to achieve significant impact at the national scale within the next ten years in transforming STEM so that it is fully and widely inclusive."[26] NSF Director, Dr. France Córdova, has said the agency is interested in expanding INCLUDES into a government-wide effort.[27]

Universities: The American Association for the Advancement of Science (AAAS) made the first round of awards as part of its STEM Equity Achievement (SEA) Change initiative in February 2019.[28] Under the initiative, "educational institutions commit to removing barriers to STEM achievement for women, minorities and people with disabilities through participating in a

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[22] NSF, "Women, Minorities, and Persons with Disabilities in Science and Engineering," https://ncses.nsf.gov/pubs/nsf19304/

[23] NAS, "Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce," https://www.nap.edu/catalog/25257/minority-serving-institutions-americas-underutilized-resource-for-strengthening-the-stem

[24] McKinsey & Company, "Why Diversity Matters," https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters

[25] NAS, "Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads," https://www.nap.edu/catalog/12984/expanding-underrepresented-minority-participation-americas-science-and-technology-talent-at

[26] NSF, "Dear Colleague Letter: NSF INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science)," https://www.nsf.gov/pubs/2016/nsf16048/nsf16048.jsp

[27] AIP, "NSF Scaling Up STEM Diversity Efforts with INCLUDES Network," https://www.aip.org/fyi/2018/nsf-scaling-stem-diversity-efforts-includes-network

[28] https://seachange.aaas.org/

program of voluntary self-assessment."[29,30] Dr. Shirley Malcom, a life-long researcher and advocate for STEM diversity, is a panelist for the hearing. Dr. Malcom is the Director of SEA Change and she can describe this initiative and other AAAS activities in support of increasing diversity in STEM.

Dr. James Moore, Vice Provost for Diversity and Inclusion and Chief Diversity Officer at The Ohio State University, is also a panelist at the hearing. He can discuss ongoing efforts at his institution to address the issue of diversity and the role that public and land-grant universities play in broadening participation in STEM.

Private Sector: Over the last several years, technology companies have faced increasing criticism about the lack of diversity of their workforces, which are dominated by white and Asian men. Some tech companies are making strides to improve the diversity of their workforce. In an effort to be more transparent, Silicon Valley giants including Facebook[31], Google[32], Microsoft[33], Apple[34], and Intel[35] have started releasing annual diversity reports.

A growing number of employers have begun taking a hard look at their recruitment and hiring practices and investing in partnerships with institutions that serve underrepresented minority students. In 2015, Intel announced a $300 million effort to diversify its workforce by 2020.[36] Since then, the company launched a $4.5 million program to support STEM students at HBCUs.[37] Ms. Barbara Whye, Chief Diversity and Inclusion Officer at Intel, is a panelist at the hearing. She can discuss the efforts underway at Intel to increase the diversity of its workforce.

STEM OPPORTUNITIES ACT

The *STEM Opportunities Act* directs (1) OSTP to develop policy guidance on best practices for supporting caregivers, reducing the impact of implicit bias, and identifying cultural and institutional barriers at science agencies and Federal labs, (2) science agencies to collect demographic data on grant proposals and awards and research faculty, (3) NSF to support research, development, and implementation of reforms for increasing the recruitment, retention, and advancement of women and other underrepresented groups in STEM degree programs and research careers, and (4) NSF to support computer science education through the existing Tribal Colleges and Universities program.

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[29] AAAS, "SEA Change Program Aims to Transform Diversity Efforts in STEM," https://www.aaas.org/news/sea-change-program-aims-transform-diversity-efforts-stem

[30] The awardees were Boston University, the University of California, Davis and the University of Massachusetts Lowell.

[31] https://newsroom.fb.com/news/2018/07/diversity-report/

[32] https://diversity.google/annual-report/

[33] https://www.microsoft.com/en-us/diversity/default.aspx

[34] https://www.apple.com/diversity/

[35] https://www.intel.com/content/www/us/en/diversity/diversity-at-intel.html

[36] Intel, "Intel Allocates $300 Million for Workplace Diversity," https://www.nytimes.com/2015/01/07/technology/intel-budgets-300-million-for-diversity.html

[37] Intel, "New Intel Grant Program Invests $4.5 Million to Support STEM Pathways for HBCU Students," https://blogs.intel.com/csr/2017/06/new-intel-grant-program-for-hbcu-students/#gs.90l2o2

Chairwoman JOHNSON. The hearing will come to order. Without objection, the Chair is authorized to declare recess at any time.

Let me welcome all of you to today's hearing, and I'm eager to hear from today's distinguished panel of witnesses, each of whom is a leader in overcoming obstacles to bring more people into STEM (science, technology, engineering, and mathematics) studies and careers. So I thank you for the work that you do and for being with us today.

There is no denying the fact that our success as a Nation is closely tied to our capacity to build and sustain a highly skilled workforce, one that is equipped to take on the pressing challenges of the 21st century and to maintain our leadership in the global economy.

Right now, we are facing grave challenges on many fronts. We are battling an opioid crisis and seeking cures for diseases like cancer. We are losing lives every day to gun violence and suicide. We are rooting out terrorists and fighting back against attempts to hack our democracy. We are racing to find sustainable sources of energy and working to mitigate the destructive effects of climate change.

Meanwhile, our economic competitiveness is threatened as competitors like China invest heavily in science and make advances in critical technologies like quantum computing and artificial intelligence.

To solve these problems, we need a cadre of trained scientists and engineers pushing the boundaries of what we know and what we can achieve. We need computer scientists and economists, biologists and mathematicians, engineers, chemists, and social scientists. So far, we have gotten by with a STEM (science, technology, engineering, and mathematics) workforce that does not come close to representing the diversity of our Nation. However, if we continue to leave behind so much of our Nation's brainpower, we cannot succeed.

The Census Bureau predicts that by 2045, over half of all Americans will be non-white. Over half of all children under 18 will be non-white by 2020. As the rest of the country becomes more diverse, the STEM workforce has been slow to respond. In addition, I have watched with dismay for decades as women have also made too few gains in the STEM workforce. Discrimination, harassment, bias, and cultural and institutional barriers are preventing many of our brightest minds from realizing their greatest potential.

Today's discussion is long overdue. The last time the Science Committee held a hearing focused on the issue of broadening participation in STEM was in March 2010. Dr. Malcom can confirm that because she was here testifying about the challenges facing women, minorities, and persons with disabilities at all levels of education and career development.

I'm sorry to say that in the years since this Committee last addressed this issue, progress has been very slow. Some fields have seen no gains at all. In 2010, women earned 20 percent of physics bachelor's degrees; today, they earn 19 percent. The share of engineering degrees earned by black men is the same today as it was in 2010, just 3 percent. Hispanic women are still earning less than 2 percent of bachelor's degrees in computer science.

We have a lot of work to do. As Chairwoman of the Science Committee I am determined to do what I can to move the needle. I was very glad to be joined by my good friend and Ranking Member, Mr. Lucas, in introducing H.R. 2528, the *STEM Opportunities Act of 2019*, earlier this week. This bill supports policy reforms and research and data collection to understand and lower barriers faced by women and minority researchers in academia and Federal laboratories.

The way I see it, we have two possible futures: One in which we embrace the changing face of our Nation, and one in which our leadership continues to erode. The choice is an easy one, but the work required to get us there is not.

I look forward to hearing the recommendations and insight from this wise panel on how we get there.

[The prepared statement of Chairwoman Johnson follows:]

Good morning and thank you, Chairman Lamb, for holding this timely hearing on two of our most valuable renewable energy resources, solar energy and wind energy.

Over the past ten years, costs of both wind and solar energy have decreased dramatically, making them a vital part of the energy mix of the U.S. According to a recent report from Austin-based analysis firm TXP, solar and wind energy saved Texans $5.7 billion in electricity costs from 2010 to 2017, compared to what they would have paid if these renewable energy sources were not part of the energy portfolio.

I'm proud to say that Texas now leads the U.S. in installed wind energy capacity, with over 24 gigawatts of wind energy. That's enough energy to power over 7 million homes. The wind energy industry also brings tens of thousands of jobs to the state, including jobs at several manufacturing facilities that support the wind industry by making products like blades, towers, and turbine housings.

All that being said, we still have significant investments we need to make to continue to innovate on these technologies, further bringing down their costs and making these technologies even more beneficial for Americans.

In the wind industry, for example, we are exploring new technologies like offshore wind, which has significant potential for leveraging untapped energy resources near our coastal communities, and needs important R&D investments to help bring down costs. In the solar industry, we are continuing to explore new types of solar cells made of advanced materials with record-setting efficiencies, at affordable prices.

We really can make investments that are both good for the environment, and for the economy. That's why I am looking forward to hearing from the distinguished witnesses assembled here today to learn about how we can support innovation in the solar and wind industries, ensuring that these important energy resources can play an even larger role in our clean energy future.

With that, I yield back.

Chairwoman JOHNSON. Before I recognize Mr. Lucas for this opening statement, I ask for the Business Roundtable principles of "Investing in People and a STEM Workforce" and principles on "Pursuing Inclusive Innovation" be placed in the record. Without objection, so ordered.

Chairwoman JOHNSON. The Chair now recognizes Mr. Lucas for an opening statement.

Mr. LUCAS. Thank you, Chairwoman Johnson, for holding this hearing today to discuss how we can achieve the promise of a more diverse STEM workforce in the United States. This Committee has a long bipartisan history of supporting STEM education for all, and I look forward to continuing that today.

When women and minorities face cultural and institutional barriers to access and advancement in STEM careers, our Nation's technological competitiveness suffers. The only way we'll achieve our potential is by utilizing America's most valuable resource: Our

people. That means developing a diverse STEM-capable workforce from every education level and from every background.

STEM employment in the U.S. continues to grow faster than any other sector, and we are struggling to meet that demand. In order to meet it, the development of talent from all groups is essential. More graduates with STEM degrees means more advanced technologies and a more robust economy. But it's not just about the economy. STEM graduates have the potential to develop technologies that could save thousands of lives, jumpstart a new industry, or even discover new worlds.

Women and the underrepresented minorities constitute a substantial proportion of the U.S. population. However, our STEM workforce fails to reflect this diversity. While women make up half of the U.S. workforce, they comprise less than 30 percent of the STEM workforce. Similarly, underrepresented racial and ethnic groups make up only 11 percent of the STEM workforce.

This week, I joined Chairwoman Johnson in cosponsoring the *STEM Opportunities Act of 2019* to help address this disparity. This bill requires more comprehensive data collection on students, researchers, and faculty receiving Federal science grants. This data will help us identify and reduce the barriers that prevent underrepresented groups from entering and advancing in STEM. It will also help us measure the success of Federal STEM programs.

As many of the Members of this Committee know, I am a proud graduate of a land-grant institution, the OSU, as we say, at Oklahoma State University, not to be confused with Dr. Moore's institution, the other OSU. The land-grant mission is to serve students of all backgrounds and influence people's lives beyond the boundaries of the classroom in service to the community.

In my home district, I have seen this mission brought to life at both OSU and at Langston University, which is a historically black college and a land-grant institution. Minority-serving institutions like Langston are successfully making strides in increasing the number of minority students graduating with STEM degrees.

It is important that we also increase STEM opportunities for American Indian and Alaska Native students, who are also unfortunately overlooked in this discussion. The *STEM Opportunities Act of 2019* will bolster the NSF's Tribal Colleges and Universities Program by providing grants to enhance computer science education at these institutions. Access to computer science resources and the development of computing skills is critical for underrepresented students in both rural and urban communities.

I'd like to thank our witnesses for being here. This entire panel not only brings a wealth of leadership and expertise in STEM education and workforce development, but they also provide inspiration to students of all backgrounds who are pursuing STEM careers. I look forward to hearing more from each of you about how we can support, encourage, and develop the next generation of STEM students.

Last, I again want to thank Chairwoman Johnson for her leadership on this important issue. I know it's a subject near and dear to her heart, and I look forward to working with her on the *STEM Opportunities Act* and additional STEM legislation focused on rural students in the coming year.

Thank you, witnesses, for being here, and I yield back the balance of my time, Madam Chair.

[The prepared statement of Mr. Lucas follows:]

Thank you, Chairwoman Johnson for holding this hearing today to discuss how we can achieve the promise of a more diverse STEM workforce in the United States.

This Committee has a long bi-partisan history of supporting STEM education for all and I look forward to continuing that today.

When women and minorities face cultural and institutional barriers to access and advancement in STEM careers, our nation's technological competitiveness suffers. The only way we'll achieve our potential is by utilizing America's most valuable resource: Our people. That means developing a diverse STEM-capable workforce from every education level and from every background.

STEM employment in the U.S. continues to grow faster than any other sector and we are struggling to meet that demand.

In order to meet it, the development of talent from all groups is essential. More graduates with STEM degrees means more advanced technologies and a more robust economy.

But it is not just about the economy. STEM graduates have the potential to develop technologies that could save thousands of lives, jump-start a new industry, or even discover new worlds.

Women and underrepresented minorities constitute a substantial proportion of the U.S. population; however our STEM workforce fails to reflect this diversity. While women make up half of the U.S. workforce, they comprise less than 30 percent of the STEM workforce. Similarly, underrepresented racial and ethnic groups make up only 11 percent of the STEM workforce.

This week I joined Chairwoman Johnson in co-sponsoring the "STEM Opportunities Act of 2019" to help address this disparity.

This bill requires more comprehensive data collection on the students, researchers, and faculty receiving federal science grants. This data will help us identify and reduce the barriers that prevent underrepresented groups from entering and advancing in STEM. It will also help us measure the success of federal STEM programs.

As many of the Members of this Committee know, I am a proud graduate of a land-grant institution - The OSU, Oklahoma State University. Not to be confused with Dr. Moore's institution, the other OSU. The land-grant mission is to serve students of all backgrounds, and influence people's lives beyond the boundaries of the classroom in service to the community.

In my home district, I have seen this mission brought to life at both OSU and Langston University, which is a historically black college and a land-grant institution. Minority-serving institutions like Langston are successfully making strides in increasing the number of minority students graduating with STEM degrees.

It is important that we also increase STEM opportunities for American Indian and Alaska Native students, who are often overlooked in this discussion. The "STEM Opportunities Act of 2019" will bolster the NSF's Tribal Colleges and Universities Program (TCUP) by providing grants to enhance computer science education at these institutions.

Access to computer science resources and the development of computing skills is critical for underrepresented students in both rural and urban communities.

I'd like to thank our witnesses for being here. This entire panel not only brings a wealth of leadership and expertise in STEM education and workforce development, but they also provide inspiration to students of all backgrounds who are pursuing STEM careers. I look forward to hearing more from each of you about how we can support, encourage and develop the next generation of STEM students.

Lastly, I want to again thank Chairwomen Johnson for her leadership on this important issue. I know it is a subject near and dear to her heart, and I look forward to working with her on the STEM Opportunities Act and additional STEM legislation focused on rural students in the coming year.

Thank you witnesses for being here and I yield back the balance of my time.

Chairwoman JOHNSON. Thank you, Mr. Lucas.

Are there other Members who wish to submit additional opening statements to the record?

At this time, I'd like to introduce our witnesses. Our first witness is Dr. Mae Jemison. Dr. Jemison leads 100 Year Starship, a global initiative seed funded through a competitive grant from DARPA

(Defense Advanced Research Projects Agency) to ensure capabilities for human travel to another star within the next 100 years while transforming life on Earth. Dr. Jemison served 6 years as a NASA astronaut and was the first woman of color in the world to go into space. She is also Chair of the National Academies' study on "Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine." I welcome Dr. Jemison.

Our next witness is Dr. Shirley Malcom. Dr. Malcom is a Senior Advisor and Director of SEA (STEM Equality Achievement) Change at the American Association for the Advancement of Science (AAAS). She works to support research and practice to improve the quality and increase access to education and careers in STEM fields. She served on the National Science Board, on President Clinton's Committee of Advisors on Science and Technology. Dr. Malcom also serves as Co-Chair of the Gender Advisory Board of the U.N. Commission on Science and Technology for Development and Gender Insight.

After Dr. Malcom is Dr. Lorelle Espinosa. Dr. Espinosa is the Vice President for Research at the American Council on Education (ACE). She is responsible for developing and managing the organization's thought leadership portfolio and for ensuring a strong evidence base across ACE's programs and services. Prior to ACE, she held senior roles at the Institution of Higher Education Policy, IHEP, Associates. Dr. Espinosa is Co-Chair of the National Academies Study Committee, "Closing the Equity Gap: Revitalizing STEM Education and Workforce Readiness Programs in the Nation's Minority-Serving Institutions."

Our fourth witness, Dr. James Moore. Dr. Moore is Vice Provost for Diversity and Inclusion and Chief Diversity Officer of The Ohio State University. He's also the Distinguished Professor of Urban Education in the College of Education and Human Ecology, Inaugural Executive Director of the Todd Anthony Bell National Resource Center on the African-American Male. From 2015 to 2017, Dr. Moore served as Program Director for Broadening Participation in Engineering at the National Science Foundation. His research focuses on school counseling, gifted urban multicultural higher education, and STEM education.

And finally, Dr. Barbara Whye. Ms. Whye is Intel's Chief Diversity Inclusion Officer and Chief Human Resources Officer for Technology, Systems Architecture, and Client Group. She also leads Intel's Diversity and Technology Initiative to reach full representation of women and underrepresented minorities in Intel's workforce. She has led the investment strategy for Intel's global STEM education portfolio with a focus on girls and other underrepresented populations. She joined Intel more than 20 years ago as an engineer.

As our witnesses should know, you will have 5 minutes for your spoken testimony. Your written testimony will be included in the record for the hearing. And so when you—when all of you have completed your spoken testimony, we will begin the round of questions. Each Member will have 5 minutes to question the panel.

So now we will start with Dr. Jemison.

TESTIMONY OF DR. MAE JEMISON, PRINCIPAL, 100 YEAR STARSHIP

Dr. JEMISON. Thank you for inviting me here today.

And I want to start off by talking about 100 Year Starship, which is about trying to make sure we have the capabilities for human interstellar travel within 100 years that was seed-funded by DARPA. And the reason why we're doing that is because I believe that pursuing an extraordinary tomorrow creates a better world today. It's by pushing ourselves today that we have the ability to incorporate all of this incredible technology that we're looking at.

I am an individual who has been exposed to the most advanced technologies and bountiful economic resources and at the same time a woeful pittance of human compassion. I am an individual who has lived with people who have meager resources and who've persevered in conditions that would try us all. They relied on technologies that have been around for thousands of years but they would share what they have with a stranger.

This is where I'm coming from because over the course of my career and training as a doctor, as an engineer, I have attended and taught in schools and programs and universities which have been classified at different times as the best and the worst in our Nation, Cambodian refugee camps, Chicago public schools, Los Angeles Unified School District, Sierra Leone, Dartmouth, Cornell, Stanford, and it's from that perspective that I bring my comments.

When I left NASA, the first thing I did was start an international science camp called The Earth We Share. Because my mother had been a schoolteacher for over 25 years in Chicago public schools. I recognized how important it was to do active work around science literacy, that is the ability to read an article in the newspaper about a subject, whether it be the environment or health, and be able to understand it. And we work with kids around the world.

It is important that we have greater representation because, right now, STEM fields—science, technology, engineering, and mathematics—are slashing a path to the future, right? And that future is not necessarily one that we can be assured is going to be beneficial. But the scientists, the engineers, and those who fund and support them get to do a couple of things. They get to choose the problems to be worked on and researched. They get to choose the methodologies with which that problem will be approached. They get to choose to keep data sets or to throw them out as irrelevant or flawed. The scientists and engineers and those who fund and support them also have an opportunity to decide the priority with which problems are addressed. They get an opportunity to decide and evaluate whether a solution was effective or not.

So when you think about that, it requires that we have full representation. It's not a nicety; it's a necessity because we're losing so much of that perspective that we have to bear.

And when we look at what was really a difficult situation, women and people of color in this country have contributed over the years in countless ways despite being left out. So if you look from Rosalind Franklin, whether you look at the women who coded

for NASA and did all the kinds of work in mathematics, we know that they've done an incredible job. We see every day that women have done an incredible job. We see every day from Dr. Daniel Hale Williams and you can go on and on. African Americans have contributed; people of color contributed. So what we have to do is to make sure that we use all the talent.

I'm really excited about this bill. I want to throw in a couple things. What child doesn't deserve an excellent teacher? This really starts with education. With me today is Dr. Peggy Brookins, who is the head of the National Board of Professional Teaching Standards because we need to have education and standards. I've been excited to work with Bayer Corporation over the years. Solutions exist where we've been able to change the curriculum so that we do hands-on science education, which is the most effective way to do it. And the ASSET program has lifted not only science scores but reading and mathematics scores even more. The Earth We Share, which I talked about, brought and trained teachers from around the world.

And then finally, if I look at what can I offer for the bill, it ranges from making sure we think about skilled technicians and labor who really make up most of the tech workforce, to making sure that we hold organizations accountable.

[The prepared statement of Dr. Jemison follows:]

Testimony of

Mae Jemison, M.D.
Principal
100 Year Starship[1]
Chair, Committee on Addressing the Underrepresentation of Women in Science, Technology, Engineering, Mathematics, and Medicine
National Academies of Sciences, Engineering, and Medicine

Before the U.S. House of Representatives
Committee on Science, Space, and Technology

On

ACHIEVING THE PROMISE OF A DIVERSE STEM WORKFORCE
May 9, 2019

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for inviting me to testify today on the critical issue of achieving a truly diverse STEMM workforce (Science, Technology, Engineering, Mathematics, and Medicine).

I am an individual who has been exposed to both the most advanced technologies and bountiful economic resources and the woeful pittance of human compassion.

And, I have lived with people having meager resources who persevered in conditions that would try all of us mentally, relying on technologies that have served outstandingly for a thousand years, yet who would share all they have with a stranger.

Over the course of my training and career I have attended and taught in schools, programs and universities that may have been classified at different times as the best and worst in our nation and the world – Cambodian refugee camps, Chicago Public

[1] The **100 Year Starship** (**100YSS**) is a private non-profit, non-governmental global initiative seed-funded via a competitive joint U.S. Defense Advanced Research Projects Agency (DARPA) and National Aeronautics and Space Administration (NASA) grant. The objective is to ensure that the capabilities for human interstellar flight exist within the next 100 years while triggering and applying the radical research and innovations required to meet such a challenge here on Earth every step of the way.

Schools and Los Angeles Unified School District, Stanford, Cornell, Dartmouth, Freetown, Sierra Leone. As a former astronaut, Area Peace Corps Medical Officer, physician, chemical engineer, environmental studies professor, business owner and educator, I consider it part of my responsibility to help facilitate the promise of STEMM disciplines to build a beneficial future.

I come to this issue from multiple vantage points: I am the Principal for the 100 Year Starship initiative to ensure the capabilities for human interstellar flight in 100 years; a member of the board of the National Board of Professional Teaching Standards; Bayer's Science Literacy Ambassador; founder of The Earth We Share international science camp; and, I am privileged to currently serve as chair of the National Academies of Sciences, Engineering, and Medicine's Committee on the Underrepresentation of Women in Science, Technology, Engineering, Mathematics, and Medicine.[2]

It is through the range of my experiences in STEMM fields and in life that I offer my testimony today.

STEMM Diversity: A Necessity, Not a Nicety

Today, we are at a critical point in world and US history— we are struggling to meet the demand, the imperative to improve human quality of life while not overburdening this planet. The best paths forward are not clear. Whether one expresses this drive for enhanced quality of life in terms of economics, life expectancy, or fast cars and fast food, it is at the center of all our activities and ambitions. And the "solutions" born from the output of STEMM fields are leading the way, cutting a wide swath in our daily lives, through our consumption and production of energy, toys, health care, food, transportation, news, defense, entertainment—you name it.

The way being slashed is not necessarily a good path. Yet we are defining and building that path with less than a third of the intellectual capacity, experience, ambitions, vision and perspectives available to us.

[2] More than 150 years ago, the National Academy of Sciences was created through a congressional charter signed by Abraham Lincoln to serve as an independent, authoritative body outside the government that could advise the nation on matters pertaining to science and technology. Under that original charter, the National Academy of Engineering (NAE) was founded in 1964 and the National Academy of Medicine (NAM, formerly the Institute of Medicine, IOM) in 1970. Every year, approximately 6,000 Academies members and volunteers serve pro bono on our consensus study committees or convening activities. Our consensus study process is considered the gold standard of independent, nonpartisan, evidence-based advice. We do not advocate for specific policy positions. Rather, we enlist the best available expertise across disciplines to examine the evidence, reach consensus, and identify a path forward on some of society's most pressing challenges.

Women and most US ethnic and racial minorities, who make up two-thirds of our population, are underrepresented in all levels of the STEM workforce. The 'Findings' of H.R. 2653, the "STEM Opportunities Act of 2017," provide an excellent overview of the current status of women and underrepresented minorities in STEMM While improving, the numbers remain poor and progress is too slow.

The importance of diversity in STEMM for me is not just about improving US competitiveness by having more folks who can 'fill seats' to 'create' more things, technology or 'stuff'.

The scientists, engineers and those who fund and support them steer the impact – rewards and benefits—accruing from STEMM fields. The scientists, engineers and those who fund and support them get to choose:

- Topics and phenomena to be researched;
- Methodologies used in studies;
- Data sets to be analyzed, shelved for later, disregarded or thrown out as irrelevant or flawed;
- Problems to be solved and the priority in which the problems are addressed;
- Solutions and technologies targeted for development and the populations for which they are relevant; as well as
- The means, methods and standards used to assess the effectiveness of therapies, solutions, technologies and implementations.

Regardless if one assumes that a scientist or engineer will arrive at the same answer or interpretation of a natural phenomenon once a topic is chosen for analysis, clearly the decision to use a certain combination of minerals to propel a bullet or create a beautiful fireworks display is a choice heavily dependent upon personal experiences, values, ambitions and world view.

"The future never just happened; it was created"
Will and Ariel Durant.

The unprecedented advancements of physical, digital, and biological technologies are poised to fundamentally alter the way we live, what we value, and how we interact with each other. We have an opportunity and the responsibility to exercise foresight and mitigate unintended consequences. The shifts in technology and economic landscapes

will generate new jobs and occupations, while displacing others. If the inequities that exist today persist, they will likely only worsen during this shift. However, if we conscientiously address the inequities in STEMM education and careers, we may harness the power of what has been called this Fourth Industrial Revolution to create a better world for all.

To do so requires that the people guiding, developing, and implementing the technological underpinnings of this revolution reflect the diverse makeup of our citizenry. Right now, it does not. Today, the STEMM workforce that is researching, developing, and designing the powerful digital technologies that influence almost every aspect of our lives is dominated by a single demographic group. In 2014, Google released demographic data on its employees: 83% of employees were male and only 3% and 2% of those employees were Hispanic or African American, respectively. I commend Google for openly sharing these data because it is only through seriously confronting a problem that we can work to understand the problem and address it.

There are real opportunity costs attendant to the homogeneity of our STEMM workforce. Research highlights that greater diversity can yield many benefits in business and academia, including, but not limited to:

- More innovation
- Improved financial performance
- More effective and efficient problem solving
- Reduced conflict in the workplace
- Increased creativity
- Lower employment turnover
- Higher publication rates with greater impact.

Surely this is all very logical and unsurprising. Does it not make sense that when the thinkers, developers, and implementers at the table better reflect the makeup of the population, the output will be more robust, innovative and effective?

Supporting a diverse STEMM workforce reduces the likelihood of developing products and services that are skewed to advantage only a single group. Unfortunately, we have many examples of technological innovations with crucial design faults because they were developed by a homogeneous group. For instance, issues related to car crash-test dummies are designed based on the "average" male, such that when a woman is involved in a car crash, she is 47% more likely to be seriously injured and 17% more likely to die, even when controlling for factors such as height, weight, seatbelt usage, and crash intensity. Another example is offered by a recent report that found that Black

individuals were the most likely to be scrutinized by facial recognition software. It also suggested that software was most likely to be incorrect when used on Black individuals--a finding corroborated by research by the FBI. Issues like this are born out of a lack of gender and racial diversity in the technology sector.

The relative homogeneity of the leadership of the STEMM workforce and industries has far reaching implications for the nation's broader research and innovation agenda. Many issues of national importance do not receive adequate attention because not all voices are given equal priority; certain subsets of the population drive the focus and priority of our STEMM. For example, why is it that maternal mortality is higher in the United States than in any other developed country?

Frequently when the STEMM workforce equity and diversity is contemplated, the focus is on the academy and jobs requiring four year or advanced degrees. The reality is that the majority of STEMM jobs are for skilled technicians requiring high school, community college or two year degree programs. And these jobs pay substantially more than other jobs with the same years of education. Yet women and underrepresented minorities are frequently unaware of and left out of pathways to these careers.

National Academies Study on Addressing the Underrepresentation of Women in STEMM

I am pleased to be the Chair of the National Academies study on the topic of women and STEMM, which will offer a detailed overview of the research and a set of actionable recommendations on how to improve the education, recruitment, retention, and advancement of women in STEMM. My hope is that the study report will help to guide action on the part of a diverse array of stakeholders--educational institutions, policymakers, funders, media and employers-- that we so desperately need. With the support of the National Institutes of Health, the National Science Foundation, and L'Oréal USA corporation, the National Academies assembled an expert committee comprised of distinguished scientists, engineers, and medical professionals from industry and academia and leading researchers on women's underrepresentation in STEMM disciplines and the intersectionality of race and gender in STEMM Our task as a committee focuses on understanding the basis for effective solutions, the barriers and opportunities for the scaling and adoption of such solutions, and with particular exploration on the intersectional experiences of women of color. When the report is released in November 2019, I will arrange for every member of this Committee to receive a hard copy, and I would welcome an opportunity to return before you to brief

you on the report's findings and recommendation. For now, let me give you some of the background that provides the context for our approach to this study.

Women Remain Underrepresented in STEMM

The number of women in science is growing, yet women—especially women of color--remain underrepresented in STEMM relative to their representation in the U.S. population. This representation varies by discipline and field. For example, though women are at parity at the undergraduate and graduate levels in the life sciences, women make up fewer than 25% of bachelor's and doctoral degree recipients in engineering and computer science. The numbers are even lower for women of color, who in 2014 earned fewer than 12% of STEM degrees.

Even in fields in which women are at parity—such as in biology and certain medical specialties--women are underrepresented among the senior ranks in these fields. For example, women doctors comprise 51% of medical instructors, but their representation steadily declines from the Assistant Professor level (43%) to Associate Professors level (33%) to Full Professor level (20%) (Association of American Medical Colleges, 2016).

The underrepresentation of women in STEMM is driven by a range of well-researched biases and structural inequities that we will be reporting on in great detail in the forthcoming National Academies report. But from what the committee has heard thus far in its public meetings, and from our consultation of previously published National Academies reports on this topic[3][4][5][6], it is clear that women in STEMM experience the following barriers:

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[3] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2007. *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*. Washington, DC: The National Academies Press. https://doi.org/10.17226/11741.

[4] National Research Council. 2013. *Seeking Solutions: Maximizing American Talent by Advancing Women of Color in Academia: Summary of a Conference*. Washington, DC: The National Academies Press. https://doi.org/10.17226/18556.

[5] National Research Council. 2006. *To Recruit and Advance: Women Students and Faculty in Science and Engineering*. Washington, DC: The National Academies Press. https://doi.org/10.17226/11624.

[6] National Research Council. 2001. *From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers*. Washington, DC: The National Academies Press. https://doi.org/10.17226/5363

- Bias in recruitment
- Unequal allocation of resources and pay
- Less access to mentoring
- Higher teaching loads
- Bias in teaching evaluations
- Bias in authorship credit
- Bias in peer review
- Fewer speaking invitations
- Higher service expectations
- Uncivil treatment
- Assault

For women of color, the experiences of gender discrimination are compounded by racial and ethnic discrimination. Such experiences contribute to a "double bind" in which women of color experience increased bias at key career junctures and often hostile environments.

Despite the many barriers that hold women back, reduce their productivity and success, or force them to leave STEMM, we should not lose sight of the fact that many women persist in these fields, making significant contributions to STEMM and to society. Sadly, too often these contributions are omitted from history books and are not valued in the same way as the contributions of men. For instance, research shows that women are less likely to be called "geniuses" or "brilliant" than men and that their contributions are often attributed to hard work and luck rather than to innate talent. Nevertheless, if we reflect on the subset of women whose contributions our society does celebrate, we are reminded of how much would be lost without their efforts.

Where would we be without Rosalind Franklin and her discovery of the structure of DNA; or Katherine Johnson's calculation of lunar trajectories; or Frances Kelsey's fight to keep thalidomide off the drug market in the U.S.; or Ada Lovelace's foundational work in computer science; and so many other powerful and significant contributions from women in STEMM? We are lucky that many pioneering women have persisted, yet I urge you to consider: how many outstanding contributions to the fields of science, technology, engineering, mathematics, and medicine have we lost by pushing women out of these fields? What is the world going to be like in 10, 20, 100 years if we continue to exclude more than 50% of the world's population from full participation in helping to identify and solve the global challenges of our era?

We are still in the process of conducting the National Academies study, so today I offer comments based on my knowledge and experiences and from what I am learning through the information gathering activities of the National Academies study.

If you wait for tomorrow, tomorrow comes. If you don't wait for tomorrow, tomorrow comes.
African Proverb

I am pleased that the hearing today serves to raise awareness and understanding of the issue of women's and minorities' underrepresentation in science, technology, engineering, mathematics, and medicine (STEMM). However, I am disappointed that we are still having this conversation despite the fact that the many barriers facing these groups in science are very well researched and well understood, as are the strategies for improving the recruitment, retention, and advancement. And the strategies improve the achievement of all in STEMM.

Progress is stymied by ingrained bias—implicit and explicit, tolerance of the status quo, lack of accountability, markedly uneven distribution and access to educational and investment resources, gatekeepers blissfully unaware of the how the culture of the STEMM disciplines actually hinders the beneficial contributions it can make to society and lack of commitment by leadership. When these challenges are addressed, then practices are not just promising, they deliver remarkable results. Examples of some such practices and strategies follow.

Excellent Education Must Be Universal.

Education is fundamental to STEMM success. Its starts in childhood, first at home and then in school. Schools, curriculum and teachers, K-12, are key. Requirements: hands-on education, excellent teachers, national standards and access to quality education for every child regardless of their parent's economic wherewithal, educational attainment, knowledge or zip code.

Teachers

To quote Dr. Peggy Brookins, *"What child doesn't deserve an excellent teacher?"*

Accompanying me today is Dr. Brookins, the CEO of the National Board of Professional Teaching Standards and a Certified Teacher. The National Board Certification represents the gold standard in teaching. Teachers who achieve this distinction have earned the profession's highest mark of achievement through a rigorous, performance-

based, peer-review process, demonstrating their proven impact on student learning and achievement.

More than 122,000 teachers have earned Board Certification, including 61,039 in STEM-related fields. Board Certification is available in 25 subject and grade levels including math, science, and career and technical education. More than a decade of research from across the country confirms that students taught by National Board Certified Teachers (NBCTs) learn more than students taught by other teachers. In STEM fields the impact on student achievement is clear:

- According to the Harvard Strategic Data Project (2012), NBCTs produce an estimated 2 months of additional learning in Math for students in an academic year.
- For middle school mathematics, the effectiveness of NBCTs relative to non-NBCTs is about 50-75% of the return to the first five years of experience, according to Cowan & Goldhaber (2015).
- Goldhaber and Anthony (2007) further find that the positive impact of NBCTs is even greater for minority and low-income students
- Students of NBCTs demonstrate evidence of deeper learning nearly three times more frequently than their peers. Research by John Hattie and others finds student work samples that reflect deeper learning, in 74% of the classrooms of NBCTs compared to the 29% of the classrooms of non-NBCTs. (Smith, Baker, Hattie, & Bond, 2008).
- Research shows that policies that award financial incentives to National Board Certified Teachers in high need schools improve retention of these accomplished teachers at the schools that need them most. This is particularly relevant given the shortage of accomplished teachers in STEM fields. (Cowan and Goldhaber, 2018).
- There is evidence that on the whole NBCTs are retained longer, the South Carolina Center for Educator Recruitment, Retention, and Advancement found that NBCTs are retained at 4 times the rate of non-NBCTs, with a 1.9% turnover rate for NBCTs compared to 7.7% for other teachers (CERRA, 2017).

Effective Curriculum

For more than 50 years, Bayer has demonstrated a commitment to science literacy and has worked tirelessly to advocate for STEM (science, technology, engineering and math) education and careers. In 1995, Bayer formalized this commitment with creation of its national, Presidential-award-winning Making Science Make Sense® (MSMS) initiative. MSMS focuses on:

- Advocating for scientific literacy
- Promoting and providing hands-on, inquiry-based learning (learning by doing)
- Creating awareness about and access to careers in STEM
- Creating awareness of the importance of diversity in STEM

Bayer was an early trailblazer in science education reform, starting two organizations with seed money - ASSET STEM Education (Pittsburgh) and BioTech Partners (Berkeley) - both of which have sustained as independent education nonprofits since the early 90s.

ASSET STEM Education™ is a national education improvement nonprofit that provides educators, schools and educational organizations (serving Pre-K through career) with...

- proven professional development
- evidence-based, hands-on learning materials
- customized consulting services

Using a "teachers teaching teachers" model, ASSET supports systemic school wide and districtwide changes. ASSET's programs: (a) relate to standards-based curricula; (b)incorporate research-based classroom practices; (c) allow teachers to experience firsthand what students will experience; (d) model inquiry-based teaching and learning; (e) embed reflection/meaning making; and (f) support the development of educators into leaders.

Students learn by doing. For example they learn about insect metamorphosis by growing caterpillars and monitoring there growth into butterflies. Basics of electricity are learned through wiring flashlights and models of homes.

Students in the ASSET program improved science scores but saw even greater improvement in reading and math. ASSET serves more than 2,500 educators impacting more than 150,000 students annually. The organization is part of 100Kin10, Change the Equation and STEMx—national coalitions for developing excellent STEM teachers, sharing best practices and scaling effective practices in science, technology, engineering and math (STEM) education.

BioTech Partners

Established in 1993 as part of a development agreement between Bayer and the City of Berkeley, Biotech Partners is an now independent non-profit organization, collaboration of biotech companies in the Bay Area and that focuses on helping students underrepresented in the field of biotechnology attain personal, academic, and

professional development experiences through in-classroom instruction and paid internships within the biotech and health industries. BioTech partners works with 'at risk' students entering high school. These are students who ordinarily would be expected not to finish high school or graduate. Yet, Biotech students Partners has a graduation rate of 99% and most graduates are able to be certified as skilled biotechnicians immediately.

Informal Experiential Programs

Named after my mother, who was a school teacher in the Chicago Public Schools for over 25 years, the Dorothy Jemison Foundation for Excellence engages girls and boys in science through programs like our four-week residential summer camps specifically designed for middle school and secondary school students, ages 12-16. These camps successfully increase our students' science literacy, their problem-solving skills, their knowledge of the impact of science and technology on society, and their understanding of societal and environmental impact on science endeavors. Their learning occurs in an encouraging and exciting atmosphere where they are supported, while being challenged to reach their greatest potential. Interestingly, our The Earth We Share™ international science camp receives far more applications from girls than boys! Founded in 1994, teachers and their training in with experiential, open-ended curriculum are at the center of TEWS™.

TEWS: Space Race™ was a non-residential program developed with the Los Angeles Unified School District and the Compton School District training over 200 middle school teachers and three thousand students.

Research Reveals How Institutions Can Work to Improve the Recruitment, Retention, and Advancement of Women in STEMM

The persistent underrepresentation of women in STEMM is discouraging, but even more discouraging is the fact that this underrepresentation persists despite the existence of a body of research and practice on effective strategies and policies for improving the representation and experiences of women in STEMM fields. Some institutions have adopted such practices and seen marked improvements in women's representation. For example, at Carnegie Mellon, directed efforts to recruit women in computer science resulted in an increase of representation from 7% to 42% over 15 years from 1995-2000 (Fisher et al., 1997). At University of Michigan, sustained institutional support for a range of interventions developed through the NSF ADVANCE program led to an increase in the percentage of women hired (as a proportion of all new faculty

hired) from 13% in 2003 to 31% in 2016[7]. While these examples are encouraging, unfortunately, such success stories are relatively rare.

Gatekeepers, Accountability and Organizational Culture

The barriers faced by women and underrepresented minorities are insidious and pervasive compromising careers, contributions and economics of individuals and institutions. Often the culture of an institution, no matter how prestigious and accomplished can produce surprisingly dismal results. Regardless of the level of an individual's achievement and national visibility, gatekeepers often are not held accountable for acting, unconsciously or consciously upon ingrained biases. With full knowledge, those in positions of authority may decline to provide appropriate equipment and supplies or blatantly change standards after women and minorities have met criteria that should lead to promotion and leadership positions. Individuals are told they need to make the gatekeeper "feel more comfortable" with them and their capabilities.

This even happens in great organizations--including institutions that seem to have made exceptional progress. A case in point is NASA and the astronaut corps. We are all familiar with the seemingly inexplicable unavailability of medium sized EVA suits (spacesuits) on the International Space Station, which has delayed the deployment of two women simultaneously on a spacewalk. There was a conscious decision to limit the size of spacesuits over a decade ago, which disproportionately impacted women's opportunities to do space walks. And it pains me to highlight it here and to call out the consequences of the capricious intersection of race and gender.

First, I am honored to have had the opportunity to be the first woman of color in the world to have flown into space as a NASA astronaut. Dr. Peggy Whitson, a woman, has the most time of any US astronaut in space.

However, running a different set of numbers is instructive. There have been six African American women accepted into the NASA astronaut program out of over 338 astronauts total. As of today, May 9, 2019, one woman is still an ASCAN (in astronaut candidate training with her class that entered the corps in 2017). The remaining five African American women all completed their ASCAN training and passed all the qualifications for spaceflight; yet only three have flown. Further, only two U.S. astronauts have been

[7] https://advance.umich.edu/wp-content/uploads/2018/10/Handbook-for-Faculty-Searches-and-Hiring.pdf

denied or pulled from a spaceflight assignment not due to health, family issues or personal career choice.

Airforce Ret. Colonel Yvonne Cagle, M.D. was never assigned a mission despite being a member of the military (all military astronauts have had missions). Dr. Jeanette Epps was removed from her mission to the international space station without explanation less than 7 months prior to launch and after training for over two years with Russian crew. Dr. Epps would have been the first African American assigned to a space station crew. I bring this account to my testimony on Achieving the Promise of a Diverse STEMM Workforce, because if such career altering acts that lack gatekeeper transparency and accountability can happen to exceptionally qualified in the rarified air and public visibility of NASA and the astronaut corps, we can only surmise what happens in the trenches of STEMM workforce.

H.R. 2653 The STEM Opportunities Act of 2017

I applaud the Congress for bringing forward this bill. It is timely and needed.

I offer the following comments to the bill based on my personal experiences and programs.

Organizations and agencies receiving taxpayer money, whether directly or through granting agencies, should be transparent on the numbers of men and women employed, in what capacities and job assignments. This data should be annual and available publicly. In addition, each should be required to develop a strategy and implementation plan with measurable objectives to achieve a workforce representative of the country. And the leadership must be held accountable for progressing steadily and with all due speed toward equity.

Education initiatives in STEM disciplines, especially K-12, should be maintained in individual federal agencies. For example, NASA, DOE, NOAA, NIH, NSF each bring their own expertise, resources, content and perspectives to the bear educating, supporting and inspiring teachers, students and public outreach in ways that cannot be duplicated through a single Department of Education mechanism. The knowledge of the disciplines, challenges and rewards is invaluable in fostering the STEM workforce.

Awareness of skilled technicians and labor in the STEM workforce should be highlighted and supported. Filling these jobs with the best talent benefits the country and individual citizens.

The Challenge

The challenge before us is to appropriately identify, commit to and incentivize the kind of coordinated, sustained, evidence-based action to ensure that we, as a nation, have full and unfettered access to develop the talent, benefit from the experiences and perspectives, and foster the goodwill of all people in this country with respect to the STEMM enterprise. We live in a time of great challenges-- poverty, hunger, disease, climate change, environmental degradation-- and in a country fueled by an "innovation economy." STEMM has such a big impact on our shared prosperity and security, now more than ever, we need to take action, not only for the benefit of women and underrepresented minorities, but for the benefit of the nation and the world.

We must ask ourselves a simple question and be willing to act on the difficult answer.

"If we know that we need the full wealth and breadth of talent pool and there are effective policies and practices that institutions, organizations, and the country can adopt to improve the representation and experiences of women and underrepresented minorities in STEMM, why has the progress over the past decade been less than modest?"

Answer: Commitment and actions to effectively implement and sustain change means upsetting the status quo.Those comfortable, resourced, and well positioned in the existing culture- male and female, majority and minority—will be uncomfortable.

General Colin Powell reminds us in a lecture titled Great Lessons in Leadership, 1998 that ***"Being responsible sometimes means pissing people off."***

Dr. Mae Jemison
30 October 2018

Biography:

Astronaut, engineer, entrepreneur, physician and educator, Dr. Mae Jemison is at the forefront of integrating the physical and social sciences with art and culture to solve problems and foster innovation. Jemison leads 100 Year Starship®, a global initiative seed funded through a competitive grant from DARPA to ensure the capabilities for human travel to another star within the next 100 years while transforming life on Earth.

Jemison served six years as a NASA astronaut and was the first woman of color in the world to go into space aboard a joint space shuttle mission with the Japanese space agency. Trained as an engineer, social scientist and dancer, Jemison, a medical doctor, was the Area Peace Corps Medical Officer for Sierra Leone and Liberia. As a professor at Dartmouth College, Jemison focused on technologies designs for sustainability for both industrialized and developing nations. She founded two technology companies and the non-profit Dorothy Jemison Foundation for Excellence which designs and implements STEM education experiences impacting thousands of students and hundreds of teachers worldwide. She is member U.S. National Academy of Medicine, Fortune 500 companies' boards, and the National Women's Hall of Fame. She is Chair of the National Academies' Study on Promising Practices for Addressing the Underrepresentation of Women in Science Engineering and Medicine. In October 2018 Jemison spearheaded Look Up™ to connect people to space, Earth and each other. Jemison was the first actual astronaut to appear on the Star Trek TV series and is a LEGO figurine in the LEGO Women of NASA kit.

Chairwoman JOHNSON. Thank you.
Dr. Malcom.

TESTIMONY OF DR. SHIRLEY MALCOM,
SENIOR ADVISOR AND DIRECTOR OF SEA CHANGE,
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

Dr. MALCOM. Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for the opportunity to testify. I'm Shirley Malcom, Senior Advisor and Director of SEA Change at the American Association for the Advancement of Science, the largest general scientific society in the United States and publisher of the Science family of journals. Our mission is simple: To advance science, engineering, and innovation throughout the world for the benefit of all people.

I have spent my entire career working to address concerns around equity in STEM. I do this partly because of my own pathway from the Jim Crow South to years as the only in my class, my major, in my lab group, in my faculty, in my committees, on boards. I was drawn to science at the launch of Sputnik because of the compelling vision and opportunities, even for a little girl from Birmingham for understanding and making a difference in the world, for earning a living and making a life.

There are many more people out there from all backgrounds and experiences who are drawn to STEM and who need to see a pathway to turn interest into outcomes. STEM needs these people for the energy, dynamism, and diverse perspectives they bring. The U.S. research and education cannot be excellent unless they're inclusive. Diversity improves the inputs and the outcomes. The vibrancy and strength of the U.S. economy and the health, security, and quality of life of our citizens are all intertwined with the health of the scientific enterprise and are products of the investment that this country has made in STEM research and education. Our Nation has supported invention and innovation across diverse fields and partnered with the private sector producing the most powerful engine for economic growth in the world.

But that is not guaranteed. At the core of the economy are people, not just the scientists and the engineers and the mathematicians in our colleges and universities and industries, national labs and biomedical facilities but also the STEM teachers, technicians, managers, financiers, patent attorneys, and others whose collective efforts, grounded in science, fuel the innovation economy. STEM knowledge and skills are not just requirements for those of us in STEM but for all throughout the workforce and across our society, from farmers utilizing weather data and robotics to manage crops to those who care for us when we are sick using high-tech diagnostic tools.

We can only get to this point by expanding the pool of talent, tapping into the vast well of women and minorities and persons with disabilities who are currently underrepresented in STEM. We know that these groups don't participate in STEM at levels that are reflected in either the population or in higher education, and there are losses at each successive level.

This isn't just a reflection of interest or the impact of personal choices. Choice is not what it seems. Choices aren't always informed and may be driven by lack of opportunity or stereotyping. Minority students who come from high-needs K–12 schools may not have opportunities to participate in programs or classes that would enable them to explore their interest in STEM. Poor early-stage preparation and uninspired teaching compounded by low expectations can make it difficult to move forward. At later stages the absence of role models, institutional and classroom climate, a culture of weeding out, isolation and the lack of community, incivility, bias, and harassment can all prevent participation.

At AAAS we're engaged in efforts to address the systemic problems that create barriers to success. Among these are efforts to address the culture change within STEM such as the Societies Consortium on Sexual Harassment in STEM with 100 society members; making role models more visible as in the AAAS IF/THEN and AAAS-Lemelson Invention Ambassadors programs, and building community for diversity, equity, and inclusion.

The most ambitious undertaking, however, is SEA Change. Based on a model from higher education in the U.K., SEA Change recognizes colleges and universities for work to improve gender and race ethnic equity in STEM. Participating institutions voluntarily develop a data-driven plan to address issues of diversity, equity, and inclusion, aligning their plan with specific context of the institutions. Institutional plans are developed by rigorous self-assessment and using data to try to understand where we have to go forward.

With funding from the Alfred P. Sloan Foundation, AAAS and Education Council are updating resources that assist colleges and universities to try to figure out how to do this in ways that are also consistent with judicial rulings and the legal aspects that may come into question.

We see much within the *STEM Opportunities Act* that is highly complementary with SEA Change, and we look forward to working together to figure out how to make those synergies happen. Thank you.

[The prepared statement of Dr. Malcom follows:]

Written Testimony of Dr. Shirley Malcom
American Association for the Advancement of Science
Before the Committee on Science, Space and Technology
U.S. House of Representatives
May 9, 2019

Chairwoman Johnson, Ranking Member Lucas and Members of the Committee on Science, Space and Technology, thank you very much for the opportunity to testify before the Committee. I am Shirley Malcom, Senior Advisor and Director of SEA Change at the American Association for the Advancement of Science. AAAS is the largest general scientific society in the United States and the world, and publisher of the *Science* family of journals. Our mission is simple: to advance science, engineering, and innovation throughout the world for the benefit of all people.

Attracting a Diverse STEM Workforce

I have personally spent my entire career in positions as well as in volunteer service working to address concerns around equity in STEM. I do this partly because of my own pathway, from the Jim Crow South to years as "the only," in my class or in my major or in my lab group or on faculty or on a board or committee. I was drawn to science after the launch of Sputnik because of the compelling vision and opportunities, even for a little girl from Birmingham, for understanding the world, making a difference in the world, for earning a living and making a life. There are many more people out there, from all backgrounds and experiences, who are drawn to and interested in STEM, who need to see the pathway to turn interest into outcomes.

Diversity is Key to Excellence in Research and Education

Science, technology, engineering, mathematics and medicine need these people for the energy, dynamism and diverse perspectives they bring! Many scholars are exploring the relationship of diversity and excellence, innovation and productivity. We are beginning to understand that our research and education cannot be excellent unless they are inclusive—that the lenses that diverse people bring to scientific research and discovery improve the inputs and the outcomes. *Science and Engineering Indicators 2018* raises this point after noting the lower rates of participation in STEM educational programs by women and minorities:

"The lower participation signals a lack of diversity in the workplace, negatively impacting productivity and innovation."

The report cites the research of Hewlett, Marshall, and Sherbin [2013] and Ellison and Mullin [2014], that tracks with the research of Scott Page [2017] and the observation of serial inventor and innovator Joseph DeSimone, who states: "There is no more fertile ground for innovation than a diversity of experience. And that diversity of experience arises from a difference of cultures, ethnicities, and life backgrounds. A successful scientific endeavor is one that attracts a diversity of experience, and cultivates those differences, acknowledging the creativity they spark."

We have numerous examples of problems that have emerged from our failures to include diverse perspectives, (e.g., from research on women's health and recent reports on artificial intelligence and facial recognition technology). But DeSimone and Farrell [2014] point to **opportunities** that come from diversity such as in convergent research: "Harnessing human diversity effectively can have major implications for the advancement of science and society," they say.

Why We Must Care

The vibrancy and strength of the U.S. economy, and the health, security and quality of life of our people, are all intertwined with the health of the science and technology enterprise. The abundance and safety of the food we eat, the quality of the water we drink, the adequacy of our public health structures and our ability to combat diseases, the ability to protect our nation's security at home and abroad, and the safety and robustness of our infrastructure are—at the most fundamental level—products of the investments that the country has made in science, technology, engineering, mathematics and biomedical research and education. We have supported invention and innovation related across diverse fields, partnered with the private sector, and in partnership produced the most powerful engine for economic growth in the world.

At the core of this knowledge economy are people; not just the scientists, engineers and mathematicians in our colleges, universities, industries, national labs and biomedical facilities, but also the STEM teachers, technicians, managers, financiers, patent attorneys, and more, whose collective efforts, grounded in science, fuel the innovation economy. STEM knowledge and skills are not just requirements for scientists and engineers but for people throughout the workforce and across the spectrum of our society—from farmers utilizing weather data and robotics to cultivate and manage crops, to those who care for us when we are sick using high-tech diagnostic tools.

STEM research has much to offer in informing national policy decisions around issues such as the 2020 Census, improved voting technology, and uses and abuses of big data. While noting the importance of STEM knowledge and skills and STEM driven innovation to addressing global and national problems, we need also to look at the opportunity to address regional and local issues. This argues for a strong and diversified base of support for STEM research and education across our country as a goal we can all share. Applying STEM knowledge and innovation around forensics, policing, "super bugs," addiction, aging, drought mitigation, protection of national parks, improved weather prediction, food safety, clean drinking water and energy solutions, as well as poverty alleviation and better education systems, can benefit all. Our citizens need to see that work in STEM and work using STEM knowledge and skills are done by people just like them.

If we are to build support for the value of STEM knowledge and skills we need to show how such knowledge and skills can apply to the lives of everyday people in the full range of challenges they face,

to carve out a space for our citizens to see the importance of these fields to our democracy and the need for continued investment in them.

Equity in STEM

How do we ensure a steady flow of talent for STEM while also responding to the larger need for a workforce and citizenry who have requisite STEM knowledge and skills to address the next generation challenges and opportunities? We can only do this by expanding the base of that pool of talent, tapping into the vast well of talent among women and minorities currently underrepresented in STEM. That fact is echoed by the National Science Board's *Science and Engineering Indicators 2018*:

"As researchers and policymakers increasingly emphasize the need for expanding S&E capabilities in the United States, demographic groups with lower rates of S&E participation represent an underutilized source of human capital for S&E work."

This statement draws upon some of the following demographic trends to illustrate the growing need to expand the talent pool for STEM. In 2015, women were about 50% of the resident adult population of the United States but less than 30% of the S&E workforce. In 2016-17, they were 57% of those enrolled in higher education, received 57% of all bachelor's degrees but only 38% of natural sciences and engineering bachelor's degrees; women received 50% of all PhDs but only 34% of PhDs in the natural sciences and engineering.

In 2015, African American, American Indian/Alaska Native and Hispanic/Latinx men and women represented over 30% of the resident population; in 2016 they made up more than 30% of U.S. undergrads. Yet, in 2016-17 these groups collectively received 21% of all bachelor's degrees and 17% of bachelor's degrees in natural sciences and engineering. They received 14% of all PhDs and only 6% of PhDs in natural sciences and engineering.

At each successive level there are losses from the talent pool for STEM for all women as well as for African American, American Indian/Alaska Native and Hispanic/Latinx men. This affects our national ability to compete in the global economy, our need to diversify our faculties and K-12 STEM educators, and to address global challenges such as climate change, health and national security.

In 2014, 49% of men and 38% of women freshmen expressed their intention to major in science and engineering. The differences between the intention of freshmen to major in STEM varied widely by racial/ethnic group and field. There was a difference of almost 14 percentage points between freshmen intention to major in STEM of Asian American men compared with Asian American women; by contrast African American men and women were virtually equal in their freshman intention to major in STEM (41% vs. 40%). Broad field differences are noted: Asian American men were much more likely to declare an intention to major in engineering and mathematics, statistics and computer science while Asian American women were more likely to declare intention to major in the biological and agricultural sciences. For every group except American Indian/Alaska Native, intention to major in engineering was much higher for men than for women. Women's intentions were higher than men's intentions as freshmen to major in the biological and agricultural sciences and social and behavioral sciences.

Some people look at these data and the participation and degree outcomes that flow from them and say that they reflect choices made by individuals—men and women of different racial and ethnic groups selecting the areas that interest them. But we know from other work that "choice" is not always what it seems; choices are not always informed, and they may be driven by lack of opportunity, stereotyping and circumstances surrounding the conditions and climate within fields. Minority students who come from high need K-12 schools may not have opportunities to participate in programs or classes that would enable them to explore their interests. Poor earlier preparation can make it more difficult to pursue study in many fields, but so too can uninspired teaching and low expectations.

The absence of role models or career information can be a deterrent to exploring an interest in a particular STEM field. So too can a lack of opportunity to practice behaviors characteristic of a field (e.g., having access to "maker spaces"). Campus and classroom climates can make fields unwelcoming even for those who enter with intention to major (e.g., attitudes, beliefs, behaviors and perceptions of faculty, students, administrators and staff; a culture of "weeding out"; isolation and the lack of community; incivility, bias, harassment and more).

We know these things can depress participation levels because we have seen what happens when programs and departments are transformed in ways that take these issues into account and that address these barriers. We have evidence of programs, such as computing at Harvey Mudd and Carnegie Mellon, that were transformed, resulting in high levels of participation by women. We have seen that many HBCUs (such as Morgan State University where I serve as a regent) are able, despite being under resourced, to emerge as leading baccalaureate origins institutions for African Americans who receive PhDs in STEM, even as they enroll students who may enter less well prepared and more needful of support. We have seen many Hispanic-serving institutions (HSIs) attract and nurture talent in STEM. We have seen institutions such as the University of Maryland Baltimore County produce a steady flow of talent from diverse student populations and share those lessons learned with other predominantly white institutions. The way programs are designed, the teaching strategies used, the opportunities for research and internships, institutional leadership, faculty support and encouragement, the climate of the institutions and departments, all make a difference.

Beyond recruitment to STEM, there are other issues that affect the retention in STEM of women and members of underrepresented minority populations, such as equitable treatment in terms of salaries, opportunities for advancement, and environments free of bias and harassment.

Over the years our work at AAAS has involved identifying and understanding the barriers at all levels (including policy and legal barriers) that prevent success by all. We have undertaken research, developed models to support success (such as STEM programming that linked school, community and home) and engaged with partners, both within and beyond the science community, involved in efforts to create initiatives to remove the barriers. But after more than 45 years of advocacy, studies, research and experiments in formal and informal/community-based STEM learning, AAAS is not satisfied with the impact of its own and others' efforts to level the playing field. We can and should do more. In order to drive the significant and lasting impacts needed to recruit and retain talented individuals from diverse groups into STEM, AAAS is moving forward with bold efforts for institutional transformation and

climate/cultural change in colleges and universities and, in partnership, with the science, engineering, mathematics and biomedical communities.

Changing the Culture of STEM

The STEM community has learned a great deal working over many decades to remove barriers to STEM participation for all women, African American, American Indian/Alaska Native, Hispanic/Latinx men, persons with disabilities and members of other groups marginalized within STEM, such as those in the LGBTQ+ communities. These efforts were aimed at "fixing the students," such as attempting to imbue students with qualities such as grit or persistence or engaging in out of school and afterschool STEM enrichment programming, aimed at compensating for what students were often not getting in school settings. Largely ignored were holistic solutions to address the root causes that lead many students to struggle in STEM courses.

AAAS IF/THEN Ambassadors. AAAS continues to recognize the importance of role models within the larger society, people who look like the students we are trying to attract and who also have interesting lives in STEM careers. We are pleased to note a recent partnership with Lyda Hill Philanthropies and others to make women in STEM more visible: If we support a woman in STEM, then she can change the world. The AAAS IF/THEN Ambassadors program advances women in science, technology, engineering and mathematics by empowering current innovators and inspiring the next generation of pioneers. The program provides AAAS IF/THEN Ambassadors with a national platform to share stories of their STEM journeys and the many ways in which they use science to solve problems and create new possibilities for the future.

Through this program, AAAS will bring together 100 women from a variety of science, technology, engineering, and mathematics careers to serve as high-profile role models for middle-school girls. STEM professionals use their skills in many fields – including research and development, sports and recreation, finance, fashion, gaming, engineering and manufacturing, entertainment, healthcare, retail, music, and more. The AAAS IF/THEN Ambassadors program highlights women in STEM who are contributing to these fields, showing girls the different career pathways they can pursue and how STEM impacts their lives every day.

AAAS IF/THEN Ambassadors will gather for in-person summits, be featured in original entertainment and media content, and engage with middle-school girls in formal and informal educational spaces. The AAAS IF/THEN Ambassadors program is supported by IF/THEN, an initiative of Lyda Hill Philanthropies.

AAAS-Lemelson Invention Ambassadors. AAAS is working with the Lemelson Foundation to expand the public's vision of who STEM professionals are and what they do to include invention and innovation. Invention and innovation have long been areas with low participation by women and individuals from minority groups. Economic analysis shows invention rates are best predicted by zip code, gender, and ethnicity rather than by early measures of aptitude or interests. In fact, kids born into the richest 1 percent of society are 10 times more likely to be inventors than those born into the bottom 50 percent. Women are so outnumbered by men when it comes to obtaining patents that, even with the current increased rate of patenting by women, it will take 118 years before the U.S. reaches gender

parity among inventors. These disparities are having significant impacts on our economy. One study estimates that innovation in the U.S. would quadruple if women, minorities, and children from low-income families became inventors at the same rate as men from high-income families. To address the barriers that are leading to these disparities, AAAS provides prominent inventors a platform (as AAAS-Lemelson Invention Ambassadors) and the resources needed to highlight the diverse faces and impacts of invention and innovation in the modern world. They serve as role models to inform, inspire, and influence the next generation of inventors and innovators, along with decision makers that can remove the barriers faced by underrepresented groups.

Societies Consortium on Sexual Harassment in STEMM. Professional societies recognize that sexual and gender-based harassment and other biases can drive women and underrepresented minority students and professionals out of science, technology, engineering, mathematics and medicine (STEMM). The National Academies' consensus report, *Sexual Harassment of Women: Climate, Culture and Consequences in Academic Sciences, Engineering and Medicine*, was a major wake-up call for the science, engineering and medical communities, and through its recommendations it provided guideposts as we came together as a community. In response, AAAS, the American Geophysical Union and the Association of American Medical Colleges, with EducationCounsel serving as policy and legal consultant, established the Societies Consortium on Sexual Harassment in STEMM. The work of the Consortium is to develop research- and evidence-based resources and guidance to support societies as we advance full participation and excellence in STEMM and prevent sexual and gender harassment in STEMM environments. Now over 100 society members strong, the Consortium provides leadership for a broad diversity of our societies' collective voices and actions to advance ethics, equity, inclusion and excellence in STEMM research, education and practice.

SEA Change. For many years colleges and universities have been challenged to increase the diversity of their STEM programs. Whether looking at enrollment, undergraduate and graduate degree production, or faculty demographics, institutions of higher education do not reflect the diversity of the talent pool for STEM. Intervention programs have been developed over the decades that address *some* aspects of the challenges or demonstrate effectiveness in removing *some* of the barriers, but there has not been widespread systematic adoption of the practices, policies, or processes which sustain and integrate the practices over time or across the institutions.

AAAS has long been interested in addressing diversity, equity, and inclusion (DEI) in STEM in our colleges and universities, having as one of its organizational goals that of "strengthening and diversifying the STEM workforce." The size of the problem is huge, with over 4,000 colleges and universities in the U.S. and tens of thousands of individual departments and programs, all making separate decisions that *collectively* affect diversity and inclusion in STEM. Small-scale intervention programs, no matter how promising, cannot address these challenges alone. The search for large-scale solutions has led us to look beyond the U.S. and beyond education for models that can be adapted to U.S. conditions, challenges and circumstances.

A model from higher education in the U.K. is that of Athena SWAN, which recognizes colleges and universities (and the schools and departments within them) for work to improve gender equity in STEM.

This 13-year old initiative has been able to demonstrate positive change in the movement of women onto the faculty and into leadership roles. Evaluation has also shown the growing influence of Athena SWAN in decision-making related to enrollment and interest in faculty positions across highly rated institutions/departments. A separate U.K. Race Equality Charter (REC), established in 2015, currently has 10 institutions holding Bronze Awards. In awarding research grants, the U.K. Medical Research Council requires evidence of action to address equality and diversity at the departmental level and recommends Athena SWAN as part of this evidence. Interest in adopting aspects of the Equality Charters process underlying Athena SWAN and REC is spreading to other countries such as Australia (SAGE), Canada, and the U.S. (SEA Change).

The circumstances of STEM participation in the United States led AAAS to focus on an initiative that includes gender and race/ethnicity as well as their intersection for women of color in STEM. AAAS has interests in promoting policies, programs, processes and practices that support participation by other marginalized populations (e.g., persons with disabilities, first-generation students, LGBTQ+ students), yet the general absence of data makes it impossible to consider these additional areas at this time. It is with this in mind that AAAS launched SEA (STEM Equity Achievement) Change, using the Equality Charters process from the U.K. as a model.

SEA Change is designed to provide the positive incentive and support needed to motivate institutions to commit to the difficult work of systemic change required for meaningful and long-lasting improvements to DEI in STEM disciplines. The initiative provides institutions with an opportunity to publicly state the value they place on DEI and receive commendation for efforts to make positive changes. More importantly, SEA Change is data driven. Participating institutions voluntarily develop a data-driven plan to address issues of DEI, aligning the plan within the specific context of the institution. The plan is to be derived from a rigorous self-assessment of qualitative and quantitative data and evidence, along with consideration of institutional and departmental climate to drive holistic and sustained change. All applications are subject to peer review.

Participating institutions will be publicly celebrated for their commitment to and progress made toward addressing issues of DEI in STEM. SEA Change will provide access to training modules, evidence-based strategies, and case studies to ground the system reform efforts of participating institutions in best practices and lessons learned from the field. The vision of SEA Change is for the institutions themselves to be the primary beneficiary of self-assessment and the data (and information) being collected. Thus, each step of the process has been designed to avoid the development of a 'check the box' mentality or an auditing culture; the process will be continually and iteratively improved so that the program spurs and supports continuous improvement and true change and allows institutions to track new behaviors and unanticipated outcomes. To that end, SEA Change requires awardees to reapply for an award after five years, at which time institutions can apply to retain their current SEA Change Bronze Award or to advance to a higher level, based on progress made in their action plans.

The landscape of diversity and inclusion in higher education in the U.S. is challenging because of the judicial rulings and laws, at the national and state levels, which provide guiderails for the structures of interventions that can be undertaken. In addition to being effective and research-based, interventions

need also to adhere to federal, state, and local laws. Building on the original AAAS Diversity and the Law project's success in 2009-2011, with funding from the Alfred P. Sloan Foundation, AAAS and EducationCounsel are updating resources that assist colleges and universities in developing mission-aligned, effective and legally sustainable diversity strategies. We intend to create practical tools and professional development resources that will enable colleges and universities to continue and better operationalize their institutional commitments to student and faculty diversity, at a time when new court, administrative agency and federal policy challenges make wise, strategic and collaborative action particularly important for success.

We are developing SEA Change to address STEM diversity, equity, and inclusion efforts *at scale*—evidence- based (with a reasonable expectation of effectiveness), and relevant to the context and circumstances of each institution. We want to take advantage of the educational value of diversity in promoting excellence and innovation, using the lens of legal policy and best practices, to ensure that institutions are supported as they do this critical work. We have been supported by a number of funders, including the Heising-Simons Foundation, Carnegie Corporation of New York, Alfred P. Sloan Foundation, Kavli Foundation, National Science Foundation and others, to launch a pilot of SEA Change and were able to award our first SEA Change bronze awards in February 2019. We appreciate Chairwoman Johnson presenting the keynote address for the inaugural SEA Change awards celebration. Our second group of pilot institutions will begin this spring.

AAAS is also working with our affiliated societies in creating the structure for SEA Change departmental level awards, capturing the power of "top down-bottom up" strategies to change climate and culture in STEM.

There are three aspects of the SEA Change initiative: the SEA Change Community; the SEA Change Institute; and the SEA Change Award/Recognition System. We expect that working in concert we will be able to see change.

NSF INCLUDES Open Forum. While research, experience and the wisdom of practice can inform persons interested in improving student and faculty diversity and inclusion in STEM, these are not generally known to administrators and faculty. Funding by the National Science Foundation supports AAAS in bringing together persons actively engaged in the STEM diversity, equity and inclusion (DEI) community and those seeking to learn more: about the history of STEM diversity and inclusion; about promising practices and lessons learned; as well as about specific challenges for which individuals seek advice. We aim to enable promising STEM DEI policies, programs and practices by those who have not yet had an opportunity to become conversant with these issues.

STEM Opportunities Act

Thank you for providing an opportunity to comment on the *STEM Opportunities Act*. It is interesting to note the degree of overlap between the issues addressed in the *Act* from a federal "lens" and the issues we have engaged through an institutional lens in SEA Change: noting and attempting to address talent losses at successive educational levels; hiring processes, including recruiting a diverse pool of candidates; work-life integration; faculty diversity; culture and climate; institutional and departmental

level improvements; identifying and promulgating best practices; preventing harassment and bias; addressing outmoded institutional structures; assessment and promoting continuous improvement strategies; and sustainability. Given the overlap in the issues being addressed, it is important to point out how the *Act* and SEA Change can be complementary and the lessons learned from SEA Change that can bolster the *Act.*

While the *Act* proposes resources to address different parts of the system of barriers that prevent success by women and underrepresented minorities in STEM (e.g., separate funding programs to promote faculty diversity and undergraduate initiatives, which may not coalesce within a single institution), SEA Change asks that institutions examine a unified set of metrics and conditions across an institution which collectively promote systemic approaches to transformation. While one particular aspect may emerge as having greater priority initially, it is being considered in the context of impacts across the system.

Again, we see that the initiatives proposed in the *Act* and the requirements within SEA Change as highly complementary.

The *Act* notes the value of self-evaluation/assessment in highlighting NASA's guidance report and proposes support for a number of efforts to support diversity and inclusion, including funding to enable self-assessment. SEA Change also begins with self-assessment, and then directs institutions to processes of reflection on the policies, processes and practices that contribute to the conditions noted and the formulation of an action plan, based in research, to address what is seen. While the scrutiny and reflection are undertaken internally, there is an opportunity for external validation and recognition as a component of the SEA Change Awards system—a public affirmation of the value of the internal work. Often, efforts will be undertaken and then disappear with the loss of resources and/or a champion. The SEA Change requirement for review every five years promotes the process of continuous improvement and sustainability. Since circumstances change, it would be useful to imagine how to promote a process for periodic self-evaluation.

We concur in the need to make institutions and national labs aware of research and evidence-based models. We are establishing the SEA Change Institute for such a purpose: raising awareness of initiatives that are likely to be effective in removing barriers and promoting opportunities for better utilization of the entire talent pool for science and engineering. There are other aspects which we are including in the Institute that may emerge in implementation, such as creating interventions that are effective and also legally sustainable.

We strongly support discipline-level efforts, such as providing funding to work with chairs and other department-level leadership. The professional societies are already demonstrating leadership around culture change, including through their membership and involvement in the Societies Consortium on Sexual Harassment in STEMM. Societies are taking leadership roles in developing SEA Change department-level awards and in promoting effective interventions through NSF's INCLUDES initiative. This focus on culture change within the disciplines and "owning" the challenges within their fields is impressive and worthy of support.

Funding agencies possess considerable leverage to influence the actions of institutions. As noted earlier in the testimony, the United Kingdom has used Athena SWAN as a lever to encourage institutional transformation by treating having received an award as a plus factor in its grant making.

For some efforts described within the *Act* there is no need to start from scratch: program infrastructure is in place that can be tweaked to encompass intent, where additional resources can be used effectively. Examples include the Alliances for Graduate Education and the Professoriate (AGEP), ADVANCE, LSAMP and programs to recognize outstanding mentoring.

Any number of promising projects within AGEP are worthy of scaling; for example, the California AGEP's postdoc effort, which has already resulted in placement of scholars from underrepresented minority populations in the physical and mathematical sciences and engineering into major positions in research institutions, industry and government. More resources may allow for adaptation and replication of such strategies. In addition, promising practices exist where experiences can be shared across the federal system, such as NSF's arrangements for PIs with caregiving responsibilities, NIH's experience with its re-entry program, and other arrangements in other agencies.

In addition to these suggestions, I want to express three specific concerns with the *Act.*

It is critical to focus data collection and reporting at the level where such efforts can best be positioned to catalyze change. In some cases, data collection within an agency can lead to greater levels of scrutiny regarding internal agency behaviors and processes, such as composition of the reviewer pool, differential success rates for women, underrepresented minorities and women of color across programs, and consideration of implicit bias among reviewers. In other cases, the review can best serve action within an institution. The grain size of data matters, as does the end-user. Institutions have the opportunity to consider fine-grained data internally in ways that leave them protected legally and where data are actionable, such as in demographics of those interviewed, hired and tenured. Federal collection purposes should focus on monitoring the overall changes in the system across institutions.

The data scrutinized within SEA Change may be even more fine-grained than requested in the *Act*; but the purpose is NOT for monitoring but to drive self-assessment. We explicitly direct institutions not to give us data where there is the potential for identification of individuals. Given the small numbers of faculty among certain populations, the issue of personally identifiable information (PII threshold) is inevitable. We believe it is important to highlight the need for legally sustainable, forward-looking action to remove barriers to diversity in STEM, including faculty diversity. It is equally important not to require disclosure of confidential legal advice by an institution's lawyers about current and past legal status so that institutions are encouraged to engage in self-assessment and continuous improvement.

Second, in Sec11(a) the *Act* proposes award of grants to address undergraduate level reforms to increase recruitment and retention of students from minority groups who are underrepresented in STEM, with a priority focus on natural sciences and engineering. While this doesn't rule out attention to the social, behavioral and economic sciences, I would note minorities' under-participation in SBE fields, including economics and political science.

Finally, a number of countries are moving ahead with Athena SWAN/SEA Change-like programs with the realization that systemic problems require systemic approaches. The *Act* addresses various parts of the system, but without providing an opportunity to bring the pieces together. I urge consideration of institutional grants to support the entire planning and self-assessment process required to embrace a systemic transformation, whether through SEA Change or another mechanism. Not every institution has the resources or knowhow to put the pieces together, but change cannot happen until issues are considered holistically.

In Conclusion

With almost a half century of experience working through the issues of broadening the talent pool for STEM, we have concluded that only a systemic approach will move us forward. We know of many things that work, but not at scale. We know of many things that work, but not for all groups. We know that institutions have barriers baked into their structures, but the nature of each institution's challenges is different. We know that institutions have to want to change, and that they can be incentivized through deployment of carrots and sticks. We know that funding agencies can play a major role in incentivizing change, and so too can the STEM and higher education communities themselves. The natural competition among institutions can be drivers for change, or as President Kennedy asked in his moonshot speech in Houston, "Why does Rice play Texas?" Because it's hard.

We need to use whatever leverage we can muster to expand the talent pool for STEM; our economy, health, quality of life and our democracy depend on it.

BIOGRAPHY
Dr. Shirley Malcom

Shirley Malcom is Senior Advisor and director of SEA Change at AAAS. She works to support transformative change in teaching and learning, research and practice to improve the quality and increase access to education and careers in STEM fields. Dr. Malcom is a trustee of Caltech, and a regent of Morgan State University. She served on the National Science Board, the policymaking body of the National Science Foundation (NSF), and on President Clinton's Committee of Advisors on Science and Technology. Malcom, a native of Birmingham, Alabama, received her PhD in ecology from Penn State, masters in zoology from UCLA and bachelor's in zoology from the University of Washington. She holds 17 honorary degrees.

Malcom serves on the boards of the Heinz Endowments, Public Agenda, the National Math-Science Initiative and Digital Promise. Internationally, she is a leader in efforts to improve access of girls and women to education and careers in science and engineering and to increase use of S&T to empower women and address problems they face in their daily lives, serving as co-chair of the Gender Advisory Board of the UN Commission on S&T for Development and Gender InSITE, a global initiative. In 2003, Dr. Malcom received the Public Welfare Medal of the National Academy of Sciences, the highest award given by the Academy.

Chairwoman JOHNSON. Thank you very much.
Dr. Espinosa.

**TESTIMONY OF DR. LORELLE ESPINOSA,
VICE PRESIDENT FOR RESEARCH,
AMERICAN COUNCIL ON EDUCATION**

Dr. ESPINOSA. Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for the opportunity to testify today on this important topic.

My name is Lorelle Espinosa, and I'm the Vice President for Research at the American Council on Education with a 20-year professional focus on diversity and inclusion in the STEM fields.

Today, I'm here primarily in my capacity as Co-Chair of the National Academies of Sciences, Engineering, and Medicine's Committee on Minority Serving Institutions, which recently published the report "Minority-Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce." I have submitted a copy of the publication's highlights, along with my written testimony.

The report has many key findings, recommendations, and strategies related to strengthening STEM education and research at the more than 700 2- and 4-year minority-serving institutions, also known as MSIs, across the United States. MSIs, of which half are community colleges, enroll nearly 30 percent of all undergraduates, including a sizable portion of the Nation's STEM students, yet are vastly under-resourced and in need of critical STEM infrastructure.

In addition to their reach, it is important to acknowledge who MSIs enroll, namely a large proportion of students of color, many of whom are low-income and the first in their families to attend college. Given this, many MSIs have developed, with intentionality, ways to offer a rich set of academic and social support systems for students that help them thrive academically and prepare for meaningful and sustained contributions to the workforce and to our society.

Of the committee's 10 recommendations to MSI stakeholders, specific actions we recommend Congress take include, first, incenting greater investments in MSIs and the strategies that support their student success as outlined in our report and in my written testimony. This includes new and expanded funding mechanisms that strengthen STEM infrastructure and encourage innovative teaching, learning, and laboratory experiences, as well as substantial growth and mutually beneficial public-private partnerships. Such investment requires significant increases in annual appropriations to support capacity building, funds for MSIs, and need-based student financial aid, including scholarship aid.

Second, taking strategic actions to enhance the clarity, transparency, and accountability for Federal investments in STEM education and research at MSIs. It is in the Nation's best interest not only to establish new and expand current STEM-focused investments but also to increase the information available about these funds and their impacts to the MSIs themselves and to their many stakeholders.

Third, requiring that federally funded programs include proper resources for a rigorous evaluation component in order to measure

the impact of these investments on student learning and career outcomes for STEM graduates at MSIs.

For improvements in the short term, Congress should require all relevant Federal agencies to identify an MSI liaison to coordinate activities, track investments, and report progress toward increasing MSI participation in STEM research and development programs.

Next, undertake a production of an annual procurement forecast of opportunities, including grants, contracts, and subcontract opportunities and cooperative and other transactional agreements that will enable increased participation of MSIs in basic, applied, and advanced STEM research and development programs. This report could serve as a critical resource for policymakers, government agencies, and MSIs themselves to assess and benchmark the impact of national investments in high-potential but underserved communities. This forecast report may further encourage other stakeholders to partner with MSIs in new and innovative ways.

Next, report on the level of participation of MSIs in prime or subrecipient or contractors in STEM-related activities, including the type of procurement mechanisms and the current investment totals that support STEM research and development.

Finally, Congress can track proposal submissions by MSIs in Federal contracts, grants, cooperative, and other transactional agreements and Small Business Innovation Research and technology transfer programs.

In closing, as the Nation continues to grow more diverse, the proportion of MSIs in America's higher education system will continue to grow. These institutions are a valuable but underutilized asset for the Nation, and with greater investment and intentional support from Congress, States, and the private sector, they can contribute in significant ways to local, regional, and national economic development and job creation.

Thank you for your time and attention and for your commitment to diversifying and strengthening our STEM workforce in this country, and I look forward to your questions.

[The prepared statement of Dr. Espinosa follows:]

Testimony of Lorelle L. Espinosa, Ph.D.
Co-Chair, Committee on Minority Serving Institutions
National Academies of Sciences, Engineering, and Medicine[1]
Vice President for Research
American Council on Education[2]

Before the U.S. House of Representatives
Committee on Science, Space, and Technology

Achieving the Promise of a Diverse STEM Workforce
May 9, 2019

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for the opportunity to testify today on this important topic. I am the vice president for research at the American Council on Education, and have been in the higher education field as a practitioner and researcher for over 20 years, with a longtime focus on diversity and inclusion in the STEM fields. Today I am here primarily in my capacity as co-chair of the National Academies of Sciences, Engineering, and Medicine's Committee on Minority Serving Institutions (MSIs), which published the recent report, "Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce."[3]

The report has many key findings, recommendations, and strategies related to strengthening STEM education and research at the more than 700 Minority Serving Institutions across the United States (U.S.). I have submitted a copy of the report highlights for policymakers along with my testimony. Allow me to start with what I believe are the four key messages from the report:

- MSIs are a valuable but underutilized asset for the nation, and with appropriate levels of support and investment from Congress, states, and the private sector, they can contribute in significant ways to local, regional, and national economic development and job creation.

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[1] More than 150 years ago, the National Academy of Sciences was created through a congressional charter signed by Abraham Lincoln to serve as an independent, authoritative body outside the government that could advise the nation on matters pertaining to science and technology. It later expanded to include engineering and medicine. Every year, approximately 6,000 National Academies members and volunteers serve pro bono on our consensus study committees or convening activities. Our consensus study process is considered the gold standard of independent, nonpartisan, evidence-based advice.

[2] The American Council on Education (ACE) is the major coordinating body for the nation's colleges and universities. ACE represents over 1,700 college and university presidents from public and private, two-year and four-year institutions. Members represent two out of every three students in all accredited, degree-granting institutions. ACE also plays an important role as the convening body for higher education in Washington DC.

[3] For the full report, please see https://www.nap.edu/catalog/25257/minority-serving-institutions-americas-underutilized-resource-for-strengthening-the-stem. This study was undertaken with the generous support of the Helmsley Charitable Trust, the Alfred P. Sloan Foundation, the ECMC Foundation, and the Wallace Foundation.

- The nation's roughly 700 MSIs enroll nearly 30 percent of all undergraduates in the U.S., but too often they are under-resourced and required to "make do" with their limited resources. Imagine how substantial the contributions of these institutions could be to our society, and our economy, if they received the resources they need to prepare one-third of our nation's future workforce.

- MSIs typically enroll students who have faced substantial financial and academic challenges over their lifetimes, and yet many MSIs have developed ways to offer a rich set of academic and social support systems for students that help them thrive academically and prepare for meaningful and sustained contributions to the workforce and to our society. Our report focuses in part on those systems, emphasizing "what works" on MSI campuses based on what we know from the scholarly literature and from the MSI community and its many stakeholders. It is because of the creativity and resourcefulness of MSI leadership, faculty, and staff that we know that increased investments would yield a substantial return for the nation's STEM workforce.

- The concept of "intentionality" is a core component of our report, and is something that many MSIs embody. By intentionality, we mean meeting students where they are when they arrive on campus, setting high expectations for student success no matter where they start academically, and tailoring programs, services, and institutional policies to recognize and address students' academic, financial, and social needs—all with cultural mindfulness. There are indeed many lessons learned in our report on how an institutional culture of intentionality serves all students—whether at MSIs or non-MSIs.

With those key points in mind, please allow me to elaborate on the report's findings and recommendations.

Findings and Recommendations from the Report, *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*

Although America's STEM workforce has grown more diverse over time, it is still far less diverse than the general population. In 2015, Black, Hispanic, and Native populations represented roughly 10 percent of the STEM workforce,[4] but 30 percent of the U.S. population in that same year.[5] Furthermore, research shows that although White, Black, and Hispanic students declare STEM majors at similar rates in their first year, STEM is

[4] National Science Board. 2018. *Science and Engineering Indicators 2018*. NSB-2018-1. Alexandria, VA: National Science Foundation.

[5] Espinosa, Lorelle L., Jonathan M. Turk, Morgan Taylor, and Hollie M. Chessman. 2019. *Race and Ethnicity in Higher Education: A Status Report*. Washington, DC: American Council on Education.

the only field in which Black and Hispanic students are significantly more likely than White students to switch majors before graduation.[6]

As a nation, we need to reverse these trends for several reasons, not the least of which concerns an imminent non-White majority in the United States. Put simply, the educational outcomes and STEM-readiness of students of color will have direct implications for America's scientific and technological innovation, economic growth, and global competitiveness.

MSIs and Their Reach

Just as communities of color remain an underutilized resource for advancing America's scientific and technological innovation, so too do the colleges and universities that enroll the greatest number of students of color—namely, the nation's over 700 Minority Serving Institutions, of which there are seven types. The first two—Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs) are historically designated.[7,8] This means that they were established to serve a specific population of student.

The other five are designated based on enrollment and financial resources. These are: Hispanic-Serving Institutions (HSIs); Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs); Predominantly Black Institutions (PBIs); Alaska Native-Serving Institutions or Native Hawaiian-Serving Institutions (ANNHIs); and Native American-Serving Nontribal Institutions (NASNTIs).

The number of enrollment-designated MSIs has grown significantly in the past 20 years, and as the country's demographics continue to change, many more MSIs can be expected to emerge. For example, in addition to the 492 existing HSIs, 333 institutions are on their way to reaching HSI status in the coming years. Such growth has led MSIs to become a model of diversity for American higher education, both in terms of undergraduate enrollment and for their role in sending students of color on to graduate study and into the STEM workforce.

While we often talk about MSIs in the aggregate, it is important to acknowledge their unique contexts, missions, student populations, contributions, and financial models:

- MSIs encompass two-year and four-year, public and private, rural, urban, and suburban institutions, enrolling from a few hundred to tens of thousands of

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[6] Riegle-Crumb, Catherine, Barbara King, and Yasmiyn Irizarry. 2019. "Does STEM Stand Out? Examining Racial/Ethnic Gaps in Persistence Across Postsecondary Fields." *Educational Researcher* 48 (3): 133-144.

[7] Espinosa, Lorelle L., Jonathan M. Turk, and Morgan Taylor. 2017. *Pulling Back the Curtain: Enrollment and Outcomes at Minority Serving Institutions*. Washington, DC: American Council on Education.

[8] Gasman, Marybeth, Thai-Huy Nguyen, and Clifton F. Conrad. 2015. "Lives Intertwined: A Primer on the History and Emergence of Minority Serving Institutions." *Journal of Diversity in Higher Education* 8 (2): 120–138.

students, and representing a range from highly selective to open-access institutions. They are found in nearly every state, and every Member of this committee likely has constituents enrolled in an MSI, in or near their district; for example, the University of North Texas at Dallas and Langston University in Oklahoma.

- MSI students vary in terms of race and ethnic origin, but also age, economic background, and enrollment intensity (full or part time). MSI students are also more likely than those at non-MSIs to be the first in their family to attend college and are more likely to come from low-income backgrounds than are students who attend non-MSIs.

- Although MSIs have long provided pathways to educational success and workforce readiness for millions of students, their contributions to STEM education and the workforce are often overlooked. In fact, more undergraduate students are enrolled in STEM fields at four-year MSIs than at four-year non-MSIs, and when taken together, HBCUs, HSIs, and AANAPISIs produce one-fifth of the nation's STEM bachelor's degrees. Moreover, research we have conducted at ACE shows that MSIs do as well as, or better than, non-MSIs in moving students up the income ladder.[9]

- While a larger share of revenue at MSIs come from public investment than at non-MSIs (e.g., federal, state, and local appropriations, grants, and contracts), on average, MSIs experience lower funding per full-time equivalent student. Nonetheless, MSIs have shown success in providing return on investment for students, the STEM workforce, regional and national economies, and their local communities. As the number of MSIs continues to grow, more targeted funding, attention, and support are needed to support these contributions.

The bottom line: As a distinct and vital sector of American higher education, MSIs are primed for STEM-focused investments.

Recommendations

With these and other findings in mind, the study committee set forth ten recommendations to MSI stakeholders in the areas of Institutional Leadership, Public and Private Partnerships, Financial Investments, and MSI Performance and Accountability. The study committee hopes that the report will incentivize the adoption of evidence-based approaches to support and advance STEM education and workforce outcomes for the tens of millions of students enrolled at two- and four-year MSIs.

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[9] Espinosa, Lorelle L., Robert Kelchen, and Morgan Taylor. 2018. *Minority Serving Institutions as Engines of Upward Mobility*. Washington, DC: American Council on Education.

Specific actions we recommend Congress should take include:

- Enhance transparency and accountability for federal investment. It is in the nation's best interest not only to establish new and expand current STEM-focused investments for MSIs, but also to increase the information available about these funds and their impacts. Substantial growth in MSI-specific public-private partnerships could help to bolster domestic achievements in STEM, but more information on the current federally funded initiatives at MSIs and their return on investment for the institutions, students, and STEM workforce is needed in order to inform future partnership initiatives and help to determine which are most needed, underfunded, or unexplored.

- To more effectively measure MSIs' returns on investments, and to inform current and future public-private partnership initiatives, Congress should undertake strategic actions to enhance the clarity, transparency, and accountability for all federal investments in STEM education and research at MSIs, including the production of an annual MSI STEM Research and Procurement report.

- The report further encourages the requirement that any such programs include a strong and rigorous evaluation component, and the resources required to support high-quality evaluation, in order to measure the impact of new initiatives on student learning and on career outcomes for STEM graduates at MSIs.

- Incent greater investments in MSIs and the promising strategies that support their students' success (outlined in the next section). Invest in new and expanded funding mechanisms that strengthen STEM infrastructure, and create and fund programs that encourage innovative teaching, learning, and laboratory experiences in STEM on MSI campuses. Significantly increase annual appropriations to support need-based aid and capacity-building funds for MSIs (e.g., Pell grant and Title III and V funding), and increase funding for programs that support institutional endowment-building activities.

For improvements in the short-term, Congress should:

- Require all relevant federal agencies to identify an MSI liaison, which would become the responsible organization or representative to coordinate activities, track investments, and report qualitative and quantitative progress toward increasing participation in STEM research and development programs.

- Produce an annual procurement forecast of opportunities including but not limited to grants, contracts, or subcontract opportunities, cooperative agreements, and other transactional agreements that will enable increased participation of MSIs in basic, applied, and advanced STEM research and development programs. This report could serve as a critical resource for policymakers, government agencies, and MSIs to assess and benchmark the impact of national investments in underserved high-potential communities.

The findings from this report may also encourage other stakeholders to partner with MSIs in broader STEM research and development initiatives.

- Report on the level of participation of MSIs as prime recipients/contractors or subrecipients/subcontractors, including the type of procurement mechanisms (i.e., contracts, grants, cooperative agreements, and other transactional agreements) and the current investment totals that support STEM research and development programming.

- Categorize MSI investments and distinguish between type of investments (i.e., internships versus training grants versus basic/applied/advanced research actions).

- Track proposal submissions by MSIs (as lead investigators, principal investigators (PIs), or co-PIs) in federal contracts, grants, cooperative agreements, other transactional agreements, and Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) programs.

Practices and Strategies to Consider when Allocating Resources

When considering how to target federal and other forms of investment, the study committee set forth seven broad practices and strategies that hold the greatest promise for strengthening the quality of STEM education, research, and workforce preparation for MSI students—if implemented with *intentionality* and fidelity and sustained over time. These practices are also applicable to colleges and universities on the verge of becoming MSIs, and indeed the study committee recommends that such institutions work to implement them. They include:

1. *Dynamic, multilevel, mission-driven leadership.* MSIs are best served by forward-looking, mission-driven presidents and other senior leaders who have a well-articulated vision and willingness to hold themselves accountable for committing the necessary capital, educational resources, and services to meet the particular needs of their student body.

2. *Institutional responsiveness to meet students where they are.* Because of the student populations they serve, MSIs have a particular need to design and implement policies and practices that intentionally support nontraditional students and students of color, especially those in STEM fields, who may need additional academic, financial, and social support and flexibility.

3. *Supportive campus environments.* A welcoming and nurturing campus climate—one that supports a fundamental sense of community and an equity-oriented culture—contributes to academic attainment and professional commitment at MSIs.

4. *Tailored academic and social supports.* Intentional policies and practices, and holistic, student-centered supports, such as Summer Bridge programs and

supplemental instruction, help guide students through higher education and make an important difference in persistence and success.

5. *Mentorship and sponsorship*. Meaningful, accessible relationships with faculty and other meaningful adults are critical to students' success in STEM education, and their advocacy and support can help to advance students' careers.

6. *Availability of undergraduate research experiences*. Entry into graduate and professional fields increasingly demands high-quality research experience as an undergraduate. Increasing numbers of MSIs are pioneering creative ways to extend such opportunities to more students through course based research experiences and external partnerships with research-intensive colleges and universities, government agencies, and private companies.

7. *Mutually beneficial public- and private-sector partnerships*. Partnerships between MSIs and business, industry, and state and federal governments, as well as other MSIs and non-MSIs, have the potential to provide alternative funding mechanisms and educational and research opportunities for students and encourage collaborations among faculty and industry scientists, engineers, and health professionals.

These practices and strategies take investment at a variety of levels, including by federal science agencies and the U.S. Department of Education.

Recommendations for Improvements to the *STEM Opportunities Act*

The study committee appreciates the intent of previously introduced legislation, including the *STEM Opportunities Act*, to promote more women and underrepresented minorities in the STEM workforce. Our report recommends that future legislation should address a broad set of institutions, including MSIs, and not just the top research institutions, where only a fraction of the already small number of women and minority students and faculty learn, teach, and work.

Our report also recommends investment in *mutually beneficial* partnerships between research universities and community colleges, where a sizeable portion of underrepresented minority students enroll after high school.[10] Moreover, partnerships between research universities and MSIs should prioritize building effective pathways to the doctorate for students of color.

Speaking now in my capacity as a long-standing researcher and practitioner, I would finally recommend that future legislation prioritize institutional research, policy, and practice on campus and STEM disciplinary climates as mutually reinforcing and predictive of STEM success for women and students and faculty of color.

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[10] Espinosa, Lorelle L., Jonathan M. Turk, Morgan Taylor, and Hollie M. Chessman. 2019. *Race and Ethnicity in Higher Education: A Status Report*. Washington, DC: American Council on Education.

In Conclusion

MSIs are essential anchors within the U.S. higher education system—and in the communities they serve. Despite being under-resourced, and despite the fact that they are willing to take chances on students with significant financial and academic challenges, MSIs will continue to grow in importance—especially as the demographics shift in our country and more students from underrepresented populations enroll in institutions of higher education. Let me end with a quote from a recently published National Academies journal, *Issues in Science and Technology*,[11] that summarized our report:

> The historical contributions, current value, and future potential of MSIs are a crucial part of the nation's educational story—as is their relative neglect as key pillars of the educational enterprise. That MSIs are so little recognized and understood is an object lesson in the difficulties of expanding minority representation in STEM fields. But if demography is destiny, then US economic prospects can no longer be separated from the educational prospects of its increasingly diverse student population. A substantial, and potentially uncomfortable, shift in thinking about the potential strategies to expand and diversify the nation's STEM workforce is essential for every American's future.

Thank you for your time and attention, and for your commitment to diversifying and strengthening our nation's STEM workforce.

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[11] Miles Jackson, Leigh, and Tom Rudin. 2019. "Minority-Serving Institutions: America's Overlooked STEM Asset." *Issues in Science and Technology* 35 (2): 46-49.

Lorelle L. Espinosa, Ph.D.
Biography

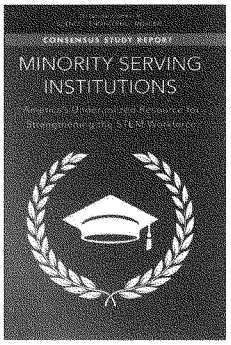
Lorelle L. Espinosa is the vice president for research at the American Council on Education, a national membership organization that mobilizes the higher education community to shape effective public policy and foster innovative, high-quality practice. She is responsible for developing and managing the organization's thought leadership portfolio and for ensuring a strong evidence base across ACE's myriad programs and services. Espinosa has served the higher education profession for 20 years, beginning in student affairs and undergraduate admissions at the University of California, Davis; Stanford University; and the Massachusetts Institute of Technology. Prior to ACE, she held senior roles at the Institute for Higher Education Policy and Abt Associates. Espinosa's scholarship spans a variety of issues, including race and ethnicity in American higher education, diversity and inclusion in the STEM disciplines, race-conscious practices in selective college admissions, the role of minority serving institutions in meeting 21st century educational and workforce goals, and contributors to positive campus climates. She has contributed opinion and scholarly works to peer-reviewed journals, academic volumes, and industry publications and websites, including the *Harvard Educational Review, Research in Higher Education,* the *Chronicle of Higher Education, Inside Higher Ed, Diverse Issues in Higher Education,* CNN.com, *The Hechinger Report,* and HigherEdToday.org. Espinosa is co-chair of the National Academies of Sciences, Engineering, and Medicine study committee, Closing the Equity Gap: Revitalizing STEM Education and Workforce Readiness Programs in the Nation's Minority Serving Institutions, and is a research affiliate at the University of Southern California Pullias Center on Higher Education. Espinosa earned her Ph.D. in higher education and organizational change from the University of California, Los Angeles; her bachelor of arts from the University of California, Davis; and her associate of arts from Santa Barbara City College.

Consensus Study Report

DECEMBER 2018 HIGHLIGHTS FOR CONGRESS

MINORITY SERVING INSTITUTIONS

America's Underutilized Resource for Strengthening the STEM Workforce



America's Minority-Serving Institutions (MSIs) are an important and underutilized source of talent to fulfill the needs of the nation's current and future STEM workforce, says *Minority-Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*, a report from the National Academies of Sciences, Engineering, and Medicine.

Given the nation's urgent need to expand its domestic STEM-capable workforce and the poised position of MSIs as a national resource for STEM talent, the report recommends a range of actions to support the advancement of MSI students in postsecondary STEM education and to increase the capacity of MSIs to educate an increasingly diverse student body. It identifies promising evidence-based strategies to support students' success, such as strong mentoring, undergraduate research experiences, and academic and social supports tailored to students' needs. And it urges policymakers, foundations, tribal leaders, and other stakeholders to increase MSI-specific funding opportunities and to form partnerships that enable promising strategies to be implemented.

The report recommends two specific actions Congress should take to support these efforts.

* Enhance transparency and accountability for federal investment

It is in the nation's best interest not only to establish new and expand current STEM-focused investments for MSIs, but also to increase the information available about these funds and their impacts. Substantial growth in MSI-specific public-private partnerships could help to bolster domestic achievements in STEM, but more information on the current federally funded initiatives at MSIs and their return on investment for the institutions, students, and STEM workforce is needed in order to inform future partnership initiatives and help to determine which are most needed, underfunded, or unexplored.

Recommendation: To more effectively measure MSIs' returns on investments, and to inform current and future public-private partnership initiatives, Congress should undertake several strategic actions to enhance the clarity, transparency, and accountability for all federal investments in STEM education and research at MSIs, including the production of an annual MSI STEM Research and Procurement report.

For improvements in the short term, Congress should require all relevant federal agencies to:

- Identify an MSI liaison, which would become the responsible organization or representative to coordinate activities, track investments, and report qualitative and quantitative progress toward increasing participation in STEM research and development programs.
- Produce an annual procurement forecast of opportunities including but not limited to grants, contracts, or subcontract opportunities, cooperative agreements, and other transactional agreements that will enable increased participation of MSIs in basic, applied, and advanced STEM research and development programs.

- Report on the level of participation of MSIs as prime recipients/contractors or subrecipients/subcontractors, including the type of procurement mechanisms (i.e., contracts, grants, cooperative agreements, and other transactional agreements) and the current investment totals that support STEM research and development programming.
- Categorize MSI investments and distinguish between type of investments (i.e., internships versus training grants versus basic/applied/advanced research actions).
- Track proposal submissions by MSIs (as lead investigators, principal investigators (PIs), or co-PIs) in federal contracts, grants, cooperative agreements, other transactional agreements, and Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) programs.
- Participate in SBIR/STTR programs to report MSI level of participation, including metrics on level of pursuits.

For sustained, systemic improvements, Congress should require federal agencies to produce an annual MSI STEM Research and Procurement Report that provides an account of specific investments and measurable outcomes on the institutions, faculty, students, and priorities of the national agencies. This report could serve as a critical resource for policymakers, government agencies, and MSIs to assess and benchmark the impact of national investments in underserved high-potential communities. The findings from this report may also encourage other stakeholders to partner with MSIs in broader STEM research and development initiatives.

* Incent greater investments in MSIs and strategies to support their students' success

Despite receiving a fraction of the federal and state funding appropriated for higher education and experiencing deep cuts in public education spending, MSIs have shown success in providing return on investment for students, the STEM workforce, regional and national economies, and the institutions' local communities. As the number of MSIs continues to grow, more targeted funding, attention, and support, are needed to support these contributions.

Recommendation: As it considers regular adjustments to federal higher education policies and programs—including, but not limited to, its reauthorization of the Higher Education Act—Congress should use the legislative process to incent greater investments in MSIs and the strategies outlined in the report.

The report suggests that leaders of congressional committees with oversight on higher education consider the following legislative actions:

- Significantly increase annual appropriations to support need-based aid and capacity-building funds for MSIs (e.g., Pell grant and Title III and V funding). This funding should include institutional endowment-building activities.
- Invest in new and expanded funding mechanisms that strengthen STEM infrastructure on MSI campuses.
- Create and fund programs that encourage innovative teaching, learning, and laboratory experiences in STEM on MSI campuses. The report further encourages the requirement that any such programs include a strong and rigorous evaluation component, and the resources required to support high-quality evaluation, in order to measure the impact of new initiatives on student learning and on career outcomes for STEM graduates.

COMMITTEE ON CLOSING THE EQUITY GAP: SECURING OUR STEM EDUCATION AND WORKFORCE READINESS INFRASTRUCTURE IN THE NATION'S MINORITY-SERVING INSTITUTIONS

Lorelle Espinosa (*Co-Chair*), American Council on Education; **Kent McGuire** (*Co-Chair*), William and Flora Hewlett Foundation, **Jim Bertin**, Chief Dull Knife College; **Anthony Carpi**, John Jay College, CUNY; **Aprille Ericsson**, National Aeronautics and Space Administration Goddard Space Flight Center; **Lamont Hames**, LMH Strategies, Inc.; **Wesley Harris**, Massachusetts Institute of Technology; **Eve Higginbotham**, University of Pennsylvania; **Spero Manson**, University of Colorado, Denver; **James Minor**, California State University; **Leo Morales**, University of Washington; **Anne-Marie Nunez**, The Ohio State University; **Clifton Poodry**, Howard Hughes Medical Institute; **William Spriggs**, Howard University; **Victor Tam**, Santa Rosa Junior College; **Cristina Villalobos**, University of Texas Rio Grande Valley; **Dorothy Yancy**, Johnson C. Smith and Shaw University; **Lance Shipman Young**, Morehouse College; **Thomas Rudin**, Director, Board on Higher Education and Workforce; **Leigh Miles Jackson**, Study Director, Board on Higher Education and Workforce.

For More Information . . . This Consensus Study Report Highlights was prepared by the Committee on Closing the Equity Gap based on the report *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* (2018). The study was sponsored by the ECMC Foundation, the Helmsley Charitable Trusts, the Alfred P. Sloan Foundation, the W.K. Kellogg Foundation, and the Wallace Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the report are available from the National Academies Press, (800) 624-6242; http://www.nap.edu.

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Chairwoman JOHNSON. Thank you very much.

Before the next witness, I want to acknowledge the presence of Dr. Rush Holt, a former Member of this Committee, who is now directing AAAS. Thank you for being here.

Dr. James Moore.

TESTIMONY OF DR. JAMES L. MOORE, III,
VICE PROVOST FOR DIVERSITY AND INCLUSION
AND CHIEF DIVERSITY OFFICER,
THE OHIO STATE UNIVERSITY

Dr. MOORE. Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for inviting me to speak with your distinguished Committee today. Again, my name is James Moore from The Ohio State University.

It is a considerable honor to be here today, and I would like to commend Chairwoman Johnson and Ranking Member Lucas for the leadership of the *STEM Opportunities Act*. I also would be remiss if I didn't thank Representatives Anthony Gonzalez and Troy Balderson for helping to make my testimony possible. I also would like to thank Representative Joyce Beatty from Columbus, Ohio, although she is not a Member of the Committee, but she is a very active advocate for broadened participation in STEM.

How OSU is addressing the lack of diversity in STEM fields is best illustrated through a pair of Ohio students, Shelby Newsad and Omari Gaskins. Shelby grew up in Beverly, a village of 1,300 in southeastern Ohio, not too far as the crow flies from Representative Balderson's district. Like many rural districts, Shelby's small high school lacked basic science labs, and her only science courses were taught out of old fading textbooks.

While Shelby's intellect earned her a Morrill Scholarship, one of Ohio State's premier diversity merit scholarship programs, she struggled in her biosciences major. As she headed to special tutoring sessions, she questioned whether she would ever catch up to her peers.

Now, Omari also grew up in Ohio but in urban Dayton, a once-proud city now battered by opiates and joblessness. Inspired by Marvel Comics and Iron Man movies, Omari joined a robotics team after he left his neighborhood school for a charter high school, smart enough to teach himself how to code but without the means to pay for college.

Omari found a pathway to Ohio State thanks to our flagship Young Scholars Program, what we reference as YSP. Now in its 30th year, YSP finds promising, low-income eighth-grade students in some of Ohio's most vulnerable school districts across the State. We provide our Young Scholars with ongoing academic support during their high school years and later offer them strong financial packages to Ohio State, provided that they maintain certain academic standards throughout high school and college.

The ongoing support during their precollegiate and collegiate years allows students like Omari to pursue STEM fields and other academic areas. Currently, 43 percent of our Young Scholars are STEM majors. We have approximately over 800 precollegiate students and over 400 students who are—who have matriculated at The Ohio State University.

Both Shelby and Omari—one white, rural, and female, and the other black, urban, and male—teach us valuable lessons about diversity in STEM. Lesson one, we need to be innovative and inclusive in the way that we identify talent. We are losing too many promising students before they ever reach our doors simply because of their ZIP Code and the schools that they reside—that reside in these communities.

Lesson two, when we find these students from underserved areas, they're often unprepared for college-level STEM coursework, requiring valuable human and financial resources to bring them up to speed. Sadly, this can cause them to want to quit college altogether.

Higher education partnerships with school districts like YSP can help improve STEM education outcomes for students of color, especially those who attend high-poverty, under-resourced school systems.

Further, early intervention programs can be a major part of the solution to the preparation gap. YSP intervenes at the eighth grade to ensure that students are prepared for college and offers ongoing academic support experiences.

Major companies are beginning to understand the importance and significance of attracting STEM and non-STEM from diverse communities. Hence, J.P. Morgan Chase recently made a major investment in both our Morrill Scholars Program and Young Scholars Program to ensure our students develop the right skills and directions to enter the world of work.

My own academic research has studied key factors impacting academic and career development of African-American males in STEM fields, and based on this research, we found that family influence and encouragement, positive K–12 experiences, their own interests and aspirations in STEM, as well as their academic experiences in college with their peers, college faculty, and staff were all crucial in impacting factors for African-American males.

Thank you.

[The prepared statement of Dr. Moore follows:]

Testimony

Before the U.S. House of Representatives Committee on

Science, Space & Technology

ACHIEVING THE PROMISE OF A DIVERSE STEM WORKFORCE

James L. Moore III, PhD

Chief Diversity Officer and Vice-Provost for Diversity and Inclusion

The Ohio State University

May 9, 2019

Chairwoman Johnson, Ranking Member Lucas and Members of the Committee:

Thank you for inviting me to speak with your distinguished committee today.

My name is Dr. James L. Moore III, and I am the vice-provost for Diversity and Inclusion and chief diversity officer at The Ohio State University, as well as the Executive Director for the Todd Anthony Bell National Resource Center on the African American Male and Distinguished Professor of Urban Education in the College of Education and Human Ecology. From 2015 to 2017, I served as a program director for Broadening Participation in Engineering in the Engineering Directorate at the National Science Foundation.

It is a considerable honor to be here today, and I would like to commend Chairwoman Johnson and Ranking Member Lucas for their leadership on the

"STEM Opportunities Act." I would also be remiss if I didn't thank Representatives Anthony Gonzalez and Troy Balderson for helping to make my testimony possible. I would also like to thank Representative Joyce Beatty from Columbus, Ohio. Although she's not a member of this committee, she's been very engaged in broadening participation in STEM education for women and underrepresented minorities.

How OSU is addressing the lack of diversity in STEM fields is best illustrated through a pair of Ohio students—Shelby Newsad and Omari Gaskins. Shelby grew up in Beverly, a village of 1,300 in southeast Ohio. Not too far—as a crow flies—from Rep. Balderson's district.

Like many rural districts, Shelby's small high school lacked basic science labs, and her only science courses were taught out of old, fading textbooks. While Shelby's intellect earned her a Morrill Scholarship, one of Ohio State's premier diversity/merit scholarship programs, she struggled in her biosciences major. As she headed to special tutoring sessions, she questioned whether she would ever catch up to her peers.

Now, Omari also grew up in Ohio, but in urban Dayton, a once-proud city now battered by opioids and joblessness.

Inspired by Marvel comics and "Iron Man" movies, Omari joined a robotics team after he left his neighborhood school for a charter high school. Smart enough to teach himself how to code but without the means to pay for college, Omari found a pathway to Ohio State thanks to our flagship Young Scholars Program, or YSP.

Now in its 30th year, YSP finds promising, low income eighth grade students in some of Ohio's most vulnerable urban school systems. We provide our Young Scholars with ongoing academic support during their high school years and later offer them strong financial aid packages to Ohio State provided they maintain certain academic standards throughout high school and college. The ongoing support during their pre collegiate and collegiate years allows students like Omari to pursue STEM fields and other academic areas. Currently, 43 percent of our Young Scholars are in a STEM major.

Both Shelby and Omari—one white, rural and female, the other black, urban and male—teach us valuable lessons about diversity in STEM.

Lesson 1: We need to be innovative and inclusive in the way that we identify talent. We are losing too many promising students before they ever reach our doors simply because of their zip code and the schools that reside in these communities.

Lesson 2: When we find these students from underserved areas, they are often unprepared for college-level STEM coursework, requiring valuable human and financial resources to bring them up to speed. Sadly, this can cause them to want to quit college altogether. Higher education partnerships with school districts, like YSP, can help improve STEM education outcomes for students of color, especially those who attend high-poverty, under-resourced school systems.

Further, early intervention programs can be a major part of the solution to this preparation gap. YSP intervenes, at the eighth grade, to ensure that students are prepared for college and offers ongoing academic enrichment experiences and other support programs.

Major companies are beginning to understand the importance and significance of attracting STEM and non-STEM talent from diverse communities. Hence, JPMorgan Chase recently made a major investment in both our Morrill Scholars Program and Young Scholars Program to ensure that our students develop the right skills and education to enter the world of work.

My own academic research has studied the key factors impacting academic and career development of African-American males in STEM fields.

Based on field interviews done with STEM grads from historically black colleges, we found that family influence and encouragement, positive K-12 academic

experiences, their own interests and aspirations in STEM as well as their academic experiences in college with their peers, college faculty and staff were all crucial impacting factors in African-American male achievement.

Coming out of that 2014 study, we recommended that colleges look to increase the amount and quality of student-faculty interactions focused on out-of-class research and lab experience. The paper also recommended, as others have previously in the field, that pre K-12 teachers set high academic and social expectations for African-American males.

At Ohio State, we have adopted that strategy by starting a bridge program in physics that has been expanded to other STEM fields in recent years, significantly boosting the number of underrepresented students in our STEM graduate programs. These bridge programs focus on the quality of student-faculty interactions through opportunities for out-of-class research and lab experience.

Another Ohio State initiative built around decades of key research findings about African-American male academic success is the Todd Bell National Resource Center on the African American Male.

Through our programs at the Bell Center, we offer our incoming African-American males additional targeted resources including the chance for mentoring, role models and an early arrival program geared toward increasing retention. Our

best practices for African-American males have resulted in rising retention and graduation rates for males in the program and have been studied and adopted by more than 50 colleges and universities across the country.

We are also taking a fresh look at how we select students for advanced degree programs. Our screening panels take implicit bias training, and we have moved away from relying solely on GRE scores to looking at the student holistically.

While we are pushing forward with our own initiatives, we also need federal partners like the Louis Stokes Alliances for Minority Participation (LSAMP), a $4.5 million grant that was recently renewed for a second, five-year term.

Since 1991, under LSAMP—named for the legendary Ohio Congressman Louis Stokes—more than 650,000 underrepresented minority students across our country have earned bachelor degrees in STEM fields.

I truly believe LSAMP represents the best $46 million that gets spent every year by the federal government. In our Ohio LSAMP Alliance, for which Ohio State serves as lead administrator, we have 350 students participating from 10 member institutions across Ohio.

Our LSAMP students have been accepted into some of the world's top graduate programs at Harvard, Yale, Cal-Berkeley and MIT. Others have traveled the world conducting research in Costa Rica and Cyprus.

We need highly-trained scientists from every background to solve the world's most pressing problems. And that means advanced degrees.

I'd like to leave you today by turning back to Shelby and Omari. Shelby rose above her early struggles and graduated from Ohio State in the biosciences in 2016. After a post-graduate year spent with the NSF, Shelby is today studying for her PHD in plant sciences at Cambridge University as she works on cutting-edge science to help grow algae in space.

Meanwhile, Omari is a sophomore at Ohio State flourishing on the Dean's List who recently returned from a study abroad trip to Brazil. With plans of someday becoming a software developer, Omari is headed back to South America this summer.

I am immensely proud of both of these students. Unfortunately, the reality is that these students are exceptions. How many Shelbys and Omaris have fallen through the cracks over the years?

We all share a responsibility to broaden STEM participation to maintain our global edge and to continue to provide hope to communities where economic opportunity is limited. I look forward to working with the Committee as it works on the "STEM Opportunities Act."

Thank you.

James L. Moore III, PhD
Chief Diversity Officer and Vice Provost for Diversity and Inclusion
The Ohio State University

Dr. James L. Moore III is the Vice Provost for Diversity and Inclusion and Chief Diversity Officer at The Ohio State University, where he is also the Distinguished Professor of Urban Education in the College of Education and Human Ecology and the inaugural Executive Director of the Todd Anthony Bell National Resource Center on the African American Male. From 2015 to 2017, Dr. Moore also served as a program director for Broadening Participation in Engineering in the Engineering Directorate at the National Science Foundation.

An internationally-recognized researcher, Dr. Moore's research focuses on school counseling, gifted-urban-multicultural-higher education, counseling, and STEM education. He is also renowned for his work on African American males, and throughout his career, he has received numerous prestigious awards, honors, and distinctions. He has taught undergraduate and graduate students at Ohio State. His work is widely published and has appeared in more than 100 publications. He also has garnered more than $9 million in grants and contracts and given more than 200 scholarly presentations globally.

He earned a bachelor's degree in English Education from Delaware State University and both a master's degree and doctorate in Counselor Education from Virginia Polytechnic Institute and State University.

Chairwoman JOHNSON. Thank you very much.
Now, Ms. Barbara Whye.

TESTIMONY OF BARBARA WHYE,
CHIEF DIVERSITY AND INCLUSION OFFICER,
VICE PRESIDENT OF HUMAN RESOURCES, INTEL

Ms. WHYE. Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, thank you for inviting me to be with you this morning. I'd also like to recognize Representative Bonamici from Oregon and Representative Biggs from Arizona.

It was a STEM education that rapidly propelled me and my seven siblings out of poverty. I am the product of a STEM education. I was born in the South to two amazing parents who lived through segregation and racism like so many other black families. Their options for finishing high school were filled with insurmountable obstacles. Neither of my parents finished high school, yet they pushed on, they instilled in us the importance of an education. All eight of us became STEM professionals, scientists, engineers, and executives. I sit before you today as an engineer because I had access and role models.

My great-great-grandparents were born enslaved in this country in the 1800s. Recently, I visited their tombstones in Conway, South Carolina. They had the wherewithal to name my great-great-grandfather Favor and his wife was named Pleasant. It is the same optimism that is a part of my inherited DNA that I believe we as a Nation can bring to this challenge.

It is imperative that legislation expands opportunities in undergraduate STEM education for underserved students receiving degrees in STEM education. The *STEM Opportunities Act* does exactly that, and thank you, Madam Chair.

For the proposed legislation to be successful, our country should quickly shift from problem-admiring to problem-solving. We have Einsteins all over our Nation who are untapped and who have not been given access to an equitable and quality education. As a Nation, we must put forth compelling, specific, and immediate steps to achieve a different outcome.

Access to a quality education should be a basic human right. With the rate of technology and the increase of STEM jobs across this Nation, a STEM-ready student is a workforce-ready student. However, students all over this country cannot tap into the coursework that would put them on the right trajectory. Every child should have coding as a school subject and experience by third grade. Students are using technology in everything they do. They should understand the power and the opportunity it provides.

Intel recognizes the importance of growing pathways. For example, we partner with three schools in the Navajo Nation and the Oakland Unified School District as a part of our $300-million diversity-in-tech commitment. Within 2 years, student enrollment in computer science classes increased by nearly 400 percent.

Being bold and taking specific actions is in the DNA of Intel. Through the leadership and commitment of our CEO Bob Swan, the executive team, and employees around the world, Intel has achieved full representation based on market availability in the

U.S. workforce a full 2 years ahead of schedule. We have the ability within us to solve anything when we take action. We know the power of making the impossible possible, and the power lies within every single one of us.

As you consider the legislation this Congress, I would ask this Committee to be bold in your actions and be transparent. We must strengthen our systems and hold leaders accountable to eradicate biases. You can hold programs accountable to ensure that students at the most mature stages of the pathway are successfully retained and complete their education as those earlier in the pathway.

Ensure that HBCUs (historically black colleges and universities), HSIs (Hispanic serving institutions), and the tribal colleges have the resources to establish top-tier programs in the STEM disciplines. Focus on the creative programs and collaborations that emphasize hands-on STEM activities that connect technology careers to real applications. Authorize more funding to our STEM-based research and faculty programs, especially those targeting the underserved.

The *STEM Opportunities Act* is a good start and a testament to this Committee's commitment to developing solutions to support underrepresented minorities and women in STEM. Intel will remain a committed partner to growing STEM opportunities and solutions, and I look forward to continuing the work with this Committee. Thank you for your time.

[The prepared statement of Ms. Whye follows:]

Testimony of Barbara Whye

Chief Diversity and Inclusion Officer and Vice President of HR,

Intel Corporation

Before the US House of Representatives

House Committee on Science, Space, and Technology

Achieving the Promise of a Diverse STEM Workforce

May 9, 2019

Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, thank you for inviting me to be here with you this morning.

I am Barbara Whye, Chief Diversity and Inclusion Officer and Vice President of Human Resources, at Intel Corporation where I have served in my current role since 2016. I joined Intel in 1995 as an electrical engineer. My path to engineering was made possible because of my parents, both products of the segregated south, who were denied both the access and opportunity to complete even a high school education. Yet, they valued education and insisted that their children prioritize education in all we do. Being the eighth of eight children, my older siblings chose math and sciences and I followed their lead.

Intel is a leader in the semiconductor industry, shaping the data-centric future with computing and communications. The company's engineering expertise is helping address the world's greatest challenges as well as helping secure, power, and connect billions of devices and the infrastructure of the smart, connected world – from the cloud to the network to the edge and everything in between. We make things possible and we do that through our people.

Diversity in the STEM Workforce Matters

We live in an intelligent and rapidly evolving world where diversity, inclusion, and racial equity practices must be a core aspect of shaping business practices, product development, tech innovation, and company success.

Intel's commitment to diversity comes from our conviction that reaching—and surpassing—a critical mass of women and underrepresented minorities (URM) in our workforce brings ample benefits. Our CEO, Bob Swan, leads our commitment to diversity and inclusion, and participates in Intel's formalized diversity executive committee monthly meetings to ensure roadblocks are removed as he would with any other key Intel business objective. During these meetings, we review our progress to key goals and work in collaboration across the corporation to execute.

As a company, we are committed to developing solutions to advance diversity and inclusion not only at Intel but across the technology industry. We realize the technology industry will excel when we appropriately value and collectively focus on the full pool of available talent.

Improving ethnic and gender diversity in the U.S. technology workforce represents an economic opportunity that could create $470B to $570B in new value for the technology industry and could add 1.2%-1.6% to the national GDP. Research reveals that if two companies are identical in every way except for racial and ethnic diversity and female representation in leadership, the more diverse company will, in all likelihood, have higher revenues, be more profitable, and have a higher market value.[1]

Thus, access to a diverse slate of talent is imperative to continue Intel's growth and impact on the industry and the economy.

Efforts to Increase Representation of Women and People of Color in Our Workforce

In January 2015, Intel set a bold goal to reach full market representation of women and URM in our U.S. workforce by 2020. We committed $300 million to support work internally and the broader goal of improving diversity and inclusion in the entire technology industry. We believe that diverse and inclusive teams with different perspectives, experiences, and ideas are more creative and

[1] Decoding Diversity: The Financial and Economic Returns to Diversity in Tech, June 23, 2016, https://www.intel.com/content/dam/www/public/us/en/documents/reports/decoding-diversity-report.pdf.

innovative.[2] And a diverse workforce and inclusive culture are key to Intel's evolution and driving forces of our growth. It is not only the right thing to do but also a business imperative.

Because of our commitment to setting specific goals and accountability metrics across the company, in 2018, Intel achieved full market representation in our U.S. workforce, two years ahead of schedule.[3] The company's workforce now reflects the percent of women and URM available in the skilled labor market in the U.S. This achievement was the result of a comprehensive strategy that focused on hiring, retention, and progression.

Reaching full representation in Intel's U.S. workforce is a testament to the hard work of our employees as well as the investments we have made in people, our partners, and communities around the world. But there is still work to be done. It is not enough to SAY work needs to be done, as a company we need to go "under the hood" and start to systematically address the issues we face in the workplace.

We started on this journey by assessing the available talent in the pipeline, recruiting from a larger pool of universities that graduate diverse talent, and investing in transformational education solutions.

Starting with 2014 data as a baseline, we identified the gaps in our workforce, created customized playbooks, for each business unit (based on data), and assigned accountability metrics to close the gaps.

An in depth look at the company's hiring practices afforded another opportunity to accelerate hiring and retain talent. By using an inclusive hiring methodology, intentional focus was placed on the systems to ensure all jobs are posted, a diverse slate of candidates are available to apply, and a diverse slate of managers are interviewing top talent.

There is a saying that "like, likes, like"...in business that translates to "like hires, like," or the proverbial tap on the shoulder. To go a little further, if there is no system of accountability, "like progresses likes." By making changes in the system, our teams are working to ensure all current and

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[2] Intel CEO Outlines Future of Computing, Jan. 6, 2015, https://newsroom.intel.com/news-releases/intel-ceo-outlines-future-of-computing/.
[3] Intel 2018 Diversity and Inclusion Report, Oct. 29, 2018, https://www.intel.com/content/dam/www/public/us/en/documents/corporate-information/2018-annual-diversity-and-inclusion-data-addendum.pdf. A copy of the report is attached.

potential talent has a level playing field to compete. Silicon Valley is a prime example of a predominately homogenous work culture. We are working to shift the culture.

Through these efforts, Intel's global workforce is currently comprised of approximately 107,000 employees, with about 55,000 in the U.S. Our workforce representation is 26.8% female, 9.2% Hispanic, 4.6% African American, and 0.7% Native American.[4]

The scope of Intel's efforts go beyond hiring and retention to include the entire value chain, from spending with diverse suppliers, diversifying our venture portfolio, to transformational education solutions. The importance of this work is embedded in our business as evidenced by including this work as a business goal in the company's strategy and as a part of the annual performance bonus structure.

Intel's Best Practices: Challenges, Lessons Learned, and Successes

It is critical to understand that this work is a journey and there is no one way to solve the problem. The key is taking action; we must stop admiring the problem. Industry collaboration, innovative solutions, and the ability to adapt when needed is imperative to move forward.

Lack of inclusion and belonging in the workplace, access to progression, and leadership representation continue to be major gaps.

Hiring top talent is not enough; creating an environment where talent can thrive and progress is critical. Connecting employees through forums, groups, training, and events has been a longstanding hallmark of Intel's workplace culture. These and other resources allow employees to cultivate tools to navigate Intel more quickly, and for those who still need support, Intel implemented a confidential service to focus on retention of our workforce.

In 2016, Intel developed and launched the "Warmline" for our U.S. employee base. The warmline is a confidential service that helps employees work through professional roadblocks and improve overall employee experience at Intel. Internal research revealed that employees mull over several factors before deciding to leave the company. Intercepting employees at the critical point when they

[4] Intel 2018 Diversity and Inclusion Report, Oct. 29, 2018, https://www.intel.com/content/dam/www/public/us/en/documents/corporate-information/2018-annual-diversity-and-inclusion-data-addendum.pdf.

are making a decision to leave gives Intel an opportunity to address concerns and resolve issues resulting in the retention of key talent.

To date the warmline has received over 20,000 cases and case managers have achieved an 81% retention rate. One employee left the following anonymous comment: *"I cared about Intel and didn't want to just throw it away. The fact that somebody cared and said, 'Don't leave Intel,' meant so much to me."* We hire the best talent, enact solutions to retain the best talent, but we recognize that without growth and progression, we will lose great talent.

It is not enough to have representation in the company if representation does not exist in leadership and key roles up to and including the board of directors. Leaders control and progress employees, and systematically set the direction. Confronting the challenge of diversity in the technology sector requires an honest reckoning with American life.

At the heart of the diversity and inclusion work is asking people behaviorally to acknowledge and effectively manage their biases against women and URM, both implicit and explicit that have developed over a lifetime of segregated living, false narratives, and inequality in education. Diversity and inclusion work requires addressing the individuals views on hiring, progression, and retention, and ensuring that the value placed on one group's competencies and intellect is not devalued because of the hue or color or gender one lives in.

Achieving leadership representation for underrepresented minority groups is the next step on our journey. There is currently a 10% gap in our leadership representation for women and that gap widens when we include people of color.

We still need to work with managers to identify succession plans that include a diverse set of employees, ensuring that women and people of color have the opportunity to participate in key projects, and sponsorship opportunities.

Growing the STEM Education Talent Pool: Investment and Recruitment[5]

If we want to shape the future of technology, we must be representative of that future.

[5] Although we often refer to STEM, we need to broaden the education focus to include Arts, to capture the creativity and critical thinking skills essential to architecture, design, and entrepreneurship. The STEAM Caucus, co-founded by Representative Suzanne Bonamici (OR-1), leads Congress on this concept and we are supportive of its efforts.

There is not a talent shortage but rather access and opportunity shortage. The Intel STEM Education Strategy is rooted in going to where the talent is and investing in the next generation of talent.

A few of the programs Intel is currently investing based on workforce data gaps include:

- **Oakland Unified School District (OUSD):** Intel entered into a $5 million partnership to strengthen the computer science and engineering pathway curriculum at two of OUSD's high schools. The comprehensive approach focuses on students, teachers, parents, and the community. In this program, students enrolled in Computer Science classes grew from 196 in 2015 to 2800 in 2017. Students enrolled in AP Computer Science went from 24 in 2015 to 416 in 2017. URM students enrolled in Computer Science grew from 127 in 2015 to 1933 in 2017, while females climbed from 47 in 2015 to 1238 in 2017.[6]
- **HBCU Grant partnership:** Intel committed to a three-year, $4.5 million program to encourage students to remain in STEM pathways at six historically black colleges and universities (HBCUs), including Florida A&M University, Morgan State University, Howard University, Prairie View A&M University, North Carolina A&T State University, and Tuskegee University. Intel has tailored an individualized partnership with each university based on a co-design with each HBCU and is focused on meeting each HBCU's individual needs, including scholarships, curriculum support/course development for professors, and tech industry workshops.[7][8]
- **Reboot Representation:** Intel supports and is a founding member of the Reboot Representation Tech Coalition, an initiative spearheaded by Melinda Gates' investment and incubation company, Pivotal Ventures. The coalition will align existing philanthropic donations and increase funding to double the number of women of color graduating with computing degrees in the U.S. by 2025.[9]

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[6] With Intel's STEM Support, High School in Oakland, California, Reaches Graduation Milestone, https://www.youtube.com/watch?v=6Jn3Rapidqs&t=67s.
[7] New Intel Grant Program Invests $4.5 Million to Support STEM Pathways for HBCU Students, June 27, 2017, https://blogs.intel.com/csr/2017/06/new-intel-grant-program-for-hbcu-students/.
[8] I would like to personally thank Representative Alma Adams (NC-12) and her team for their leadership work with HBCU's through the Bipartisan HBCU caucus and the HBCU Partnership Challenge. Intel was the first company to accept the challenge, focused on providing greater resources for HBCU's, strengthening public/private partnerships, and supporting a commitment to educational excellence.
[9] Closing the Gender Gap in the Tech Sector, https://www.rebootrepresentation.org/.

- **AISES/Intel Growing the Legacy Program:** As part of a partnership between Intel and the American Indian Science and Engineering Society (AISES) to create pathways for Native American students, Intel contributed $1.32 million to AISES' "Growing the Legacy" scholarship program for Native American undergraduate and graduate students. This initiative supports Native American university students every year for four years by providing financial support, Intel mentors, and opportunities for paid internships and/or jobs at Intel upon graduation.[10]
- **Tech Learning Lab:** Intel is addressing the needs of educators through advanced technology that enables effective and dynamic classroom experiences and drives students' skills development to prepare them for the demands of the future workforce. The Tech Learning Lab is a custom-built mobile container truck, outfitted with VR demo stations, education PCs and IoT (Internet of things) smart whiteboards that are accompanied by immersive, hands-on workshops. The tour is designed to engage with educators and spark conversations that go beyond the classroom to fuel curiosity about the role of technology and its impact on our world and daily lives.[11]
- **Intel® Future Skills:** The rapid pace of technological advancement is fundamentally changing the skills needed for the jobs of the future. To address these changes, the Intel Foundation launched the Intel® Future Skills Program, a scalable approach to develop globally competitive learners. Intel collaborates with governments, educators, and community-based organizations to empower youth to reach their full potential, become innovation ready, and prepared for roles in technology. The Future Skills program builds upon a research-based methodology, introducing essential skills and computational learning for youth with no prior technical training, so far reaching ~1200 students in the United States across seven states.[12]

Moving Forward: STEM Opportunities Act

I applaud the Chairwoman for her introduction of the STEM Opportunities Act. The legislation would implement best practices at Federal science agencies and at institutions of higher education to

[10] Intel's Growing the Legacy Program, http://www.aises.org/content/intel-growing-the-legacy.
[11] Intel Tech Learning Lab Starts Tour to Shape Education's Future, Oct. 17, 2018, https://newsroom.intel.com/news/intel-tech-learning-lab-starts-tour-shape-educations-future/.
[12] Intel Foundation, https://www.intel.com/content/www/us/en/corporate-responsibility/intel-foundation.html.

remove or reduce cultural and institutional barriers limiting the recruitment, retention, and success of underrepresented minority groups in academic and Government STEM research careers. It would provide grants to higher education institutions to recruit, retain, and advance STEM faculty members from underrepresented minority groups. It would also issue grants to implement or expand reforms in undergraduate STEM education in order to increase the number of students from underrepresented minority groups receiving degrees in these fields. These are laudable goals that are focused on increasing the diversity of the STEM talent pool and ensuring inclusion of all Americans to be able to thrive in the new economy.

As you consider reintroducing the legislation this Congress, with the intent on growing the diverse STEM talent pool, I recommend that you take bolder and actionable steps and include language that requires concrete measurable outcomes related to expanding availability and access to STEM offerings for students from pre-K to college, increasing diverse faculty representation, and increasing the employability of students that complete a STEM education. These measurable outcomes are needed to keep the U.S. globally competitive, to move our economy forward, and to generate economic participation and mobility for all.

In your next draft, you should consider requiring the federal government to leverage data and analytics in your reporting systems to give more real-time insights and prescriptive recommendations so that agencies can prioritize their resources on efforts that are showing results and positive impact. Intel and others in the sector could be convened to help formulate solutions that could support the development of a data platform in support of that work. Predictive analytics and quality data matter.

You can hold programs accountable to ensure that students at the most mature stages of the pipeline (graduate level), are just as successful completing their education as those that are beginning and entering the early stages of the K-12 pipeline.

You can ensure that Historically Black Colleges and Hispanic Serving Institutions establish top tier programs in the STEM disciplines.

You can focus on creative programs and collaborations that emphasize hands-on STEM activities and clearly connect technology careers and real-world applications.

And you can authorize more funding toward STEM-based research and faculty programs, especially those targeting underrepresented minority groups.

While outside the scope of this Committee, but an example of available opportunities with pre-existing programs, Congress can encourage the Defense Department to leverage its ROTC program to help build a diverse STEM talent pool. For example, Junior ROTC serves almost 500,000 secondary students, most of whom are underrepresented minorities and economically disadvantaged. The program could add new offerings, such as a cybersecurity credential focused on the critical issue of IT security or an artificial intelligence credential focused on AI, to build out a stronger diverse STEM talent pool.

Conclusion

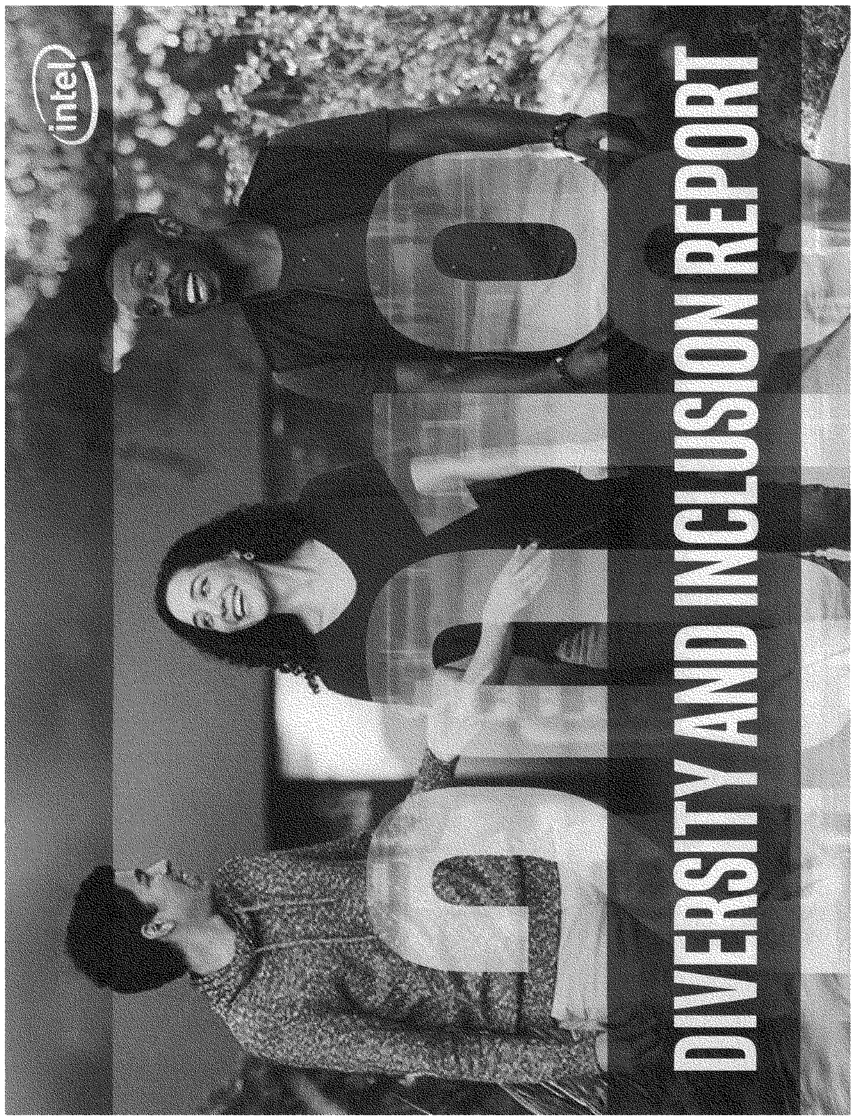
Thank you for allowing me to share Intel's journey to full workforce representation and providing an opportunity to touch on the importance of Congressional leadership to grow the talent pool of students in STEM. The STEM Opportunities Act is a good start and is a testament to this Committee seeking solutions to support underrepresented minorities and women in STEM.

I would ask this committee to be bold in your actions, set clear and measurable goals, drive transparency, and hold people accountable.

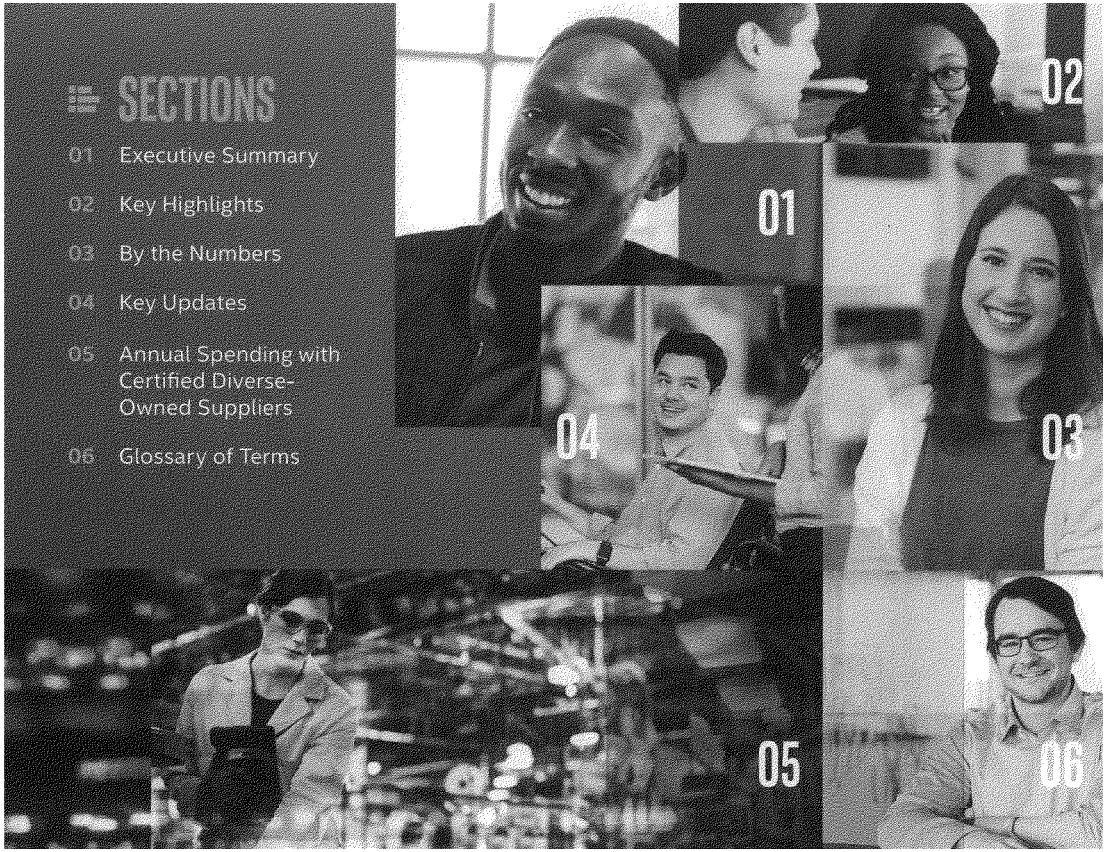
Action is the foundational key to all success- Pablo Picasso

Barbara Whye

Ms. Barbara H. Whye is Intel's Chief Diversity and Inclusion Officer and Chief Human Resources Officer for the Technology, Systems Architecture and Client Group (TSCG), the company's largest business group. This group is responsible for aligning technology, engineering, product design and business direction to extend Intel's strategy and speed execution across the client device and IoT segments — all core to growth in the smart and connected compute era. She also leads Intel's Diversity in Technology initiative as the company endeavors to reach its goal of full representation in its U.S. workforce by the end of 2018. A champion of Intel's culture of inclusion, with 21 years of experience, she develops strategies that accelerate progress and integrate diversity and inclusion across the ecosystem to enhance innovation and drive business results. Barbara joined Intel in 1995 as an engineer and held a number of leadership roles driving large scale and enterprise wide change. Prior to joining HR and Global Diversity and Inclusion in 2015, she spent 15 years in key leadership and project engineering roles responsible for acquiring and starting up new facilities for Intel Corporation worldwide, including Talent Management as an expatriate in San José, Costa Rica. Barbara also led the investment strategy for Intel's global (STEM) education portfolio, with an emphasis on girls and underserved populations, and was a strategist on Girl Rising, a global campaign for girls' education and empowerment. Barbara earned her bachelor's degree in electrical engineering from the University of South Carolina and her MBA from the University's Darla Moore School of Business. Recognized as a force for positive social change, she has been awarded with the 2014 National Society of Black Engineers Career Excellence Award, a 2015 Society of Women Engineers Spark Award, and a 2016 Inspiring Women of South Carolina Award.


intel
DIVERSITY AND INCLUSION REPORT

SECTIONS



01

Executive Summary

A Letter from Barbara Whye

Chief Diversity and Inclusion Officer and Vice President, Human Resources

Today, we are all part of something special.

In 2015, we announced plans to achieve full representation of underrepresented minorities and women in our U.S. workforce by 2020. I'm happy to share that we have reached our goal two years ahead of schedule!

At Intel, we set goals and achieve them. It didn't happen overnight and we did it together. Even though the focus has been on the U.S., this accomplishment would not have been possible without the support and outstanding efforts from Intel employees around the world.

We are very proud of what we've achieved, but we are far from being done. This goal is one step in our journey towards global inclusion.

We are more committed than ever to ensuring we have an inclusive culture everywhere around the world. That means creating a sense of belonging and instilling a culture where employees can bring their full experiences and authentic selves to work while enjoying rewarding careers with us.

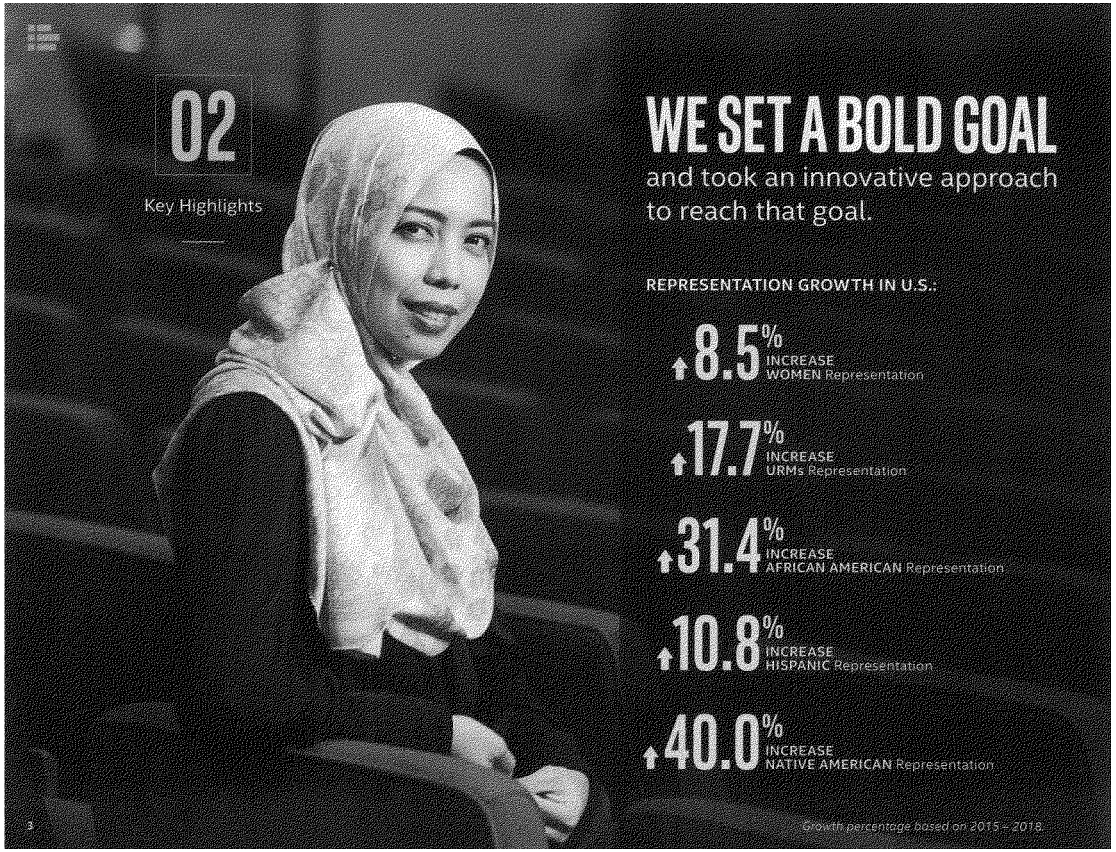
THE BEST PART? WE'RE JUST GETTING STARTED.

Thanks to the work that has been done, we have a solid foundation for building an inclusive culture, fueling innovation and generating a broad, positive impact on our employees and customers.

With the combined focus, commitment, and support of every Intel employee, we will shape the future of technology. **Together.**

#WEAREINTEL


02
Key Highlights
IT'S BEEN SAID THAT EVERY JOURNEY BEGINS WITH A FIRST STEP.
We're proud to announce that we've taken a big leap forward in our diversity and inclusion efforts, reaching full representation in our U.S. workforce—two years ahead of schedule.
THERE IS STILL MORE WORK TO BE DONE AND WE'RE JUST GETTING STARTED.


02
Key Highlights
WE SET A BOLD GOAL
and took an innovative approach to reach that goal.
REPRESENTATION GROWTH IN U.S.:
↑8.5% INCREASE WOMEN Representation
↑17.7% INCREASE URMs Representation
↑31.4% INCREASE AFRICAN AMERICAN Representation
↑10.8% INCREASE HISPANIC Representation
↑40.0% INCREASE NATIVE AMERICAN Representation
Growth percentage based on 2015 – 2018
3

02

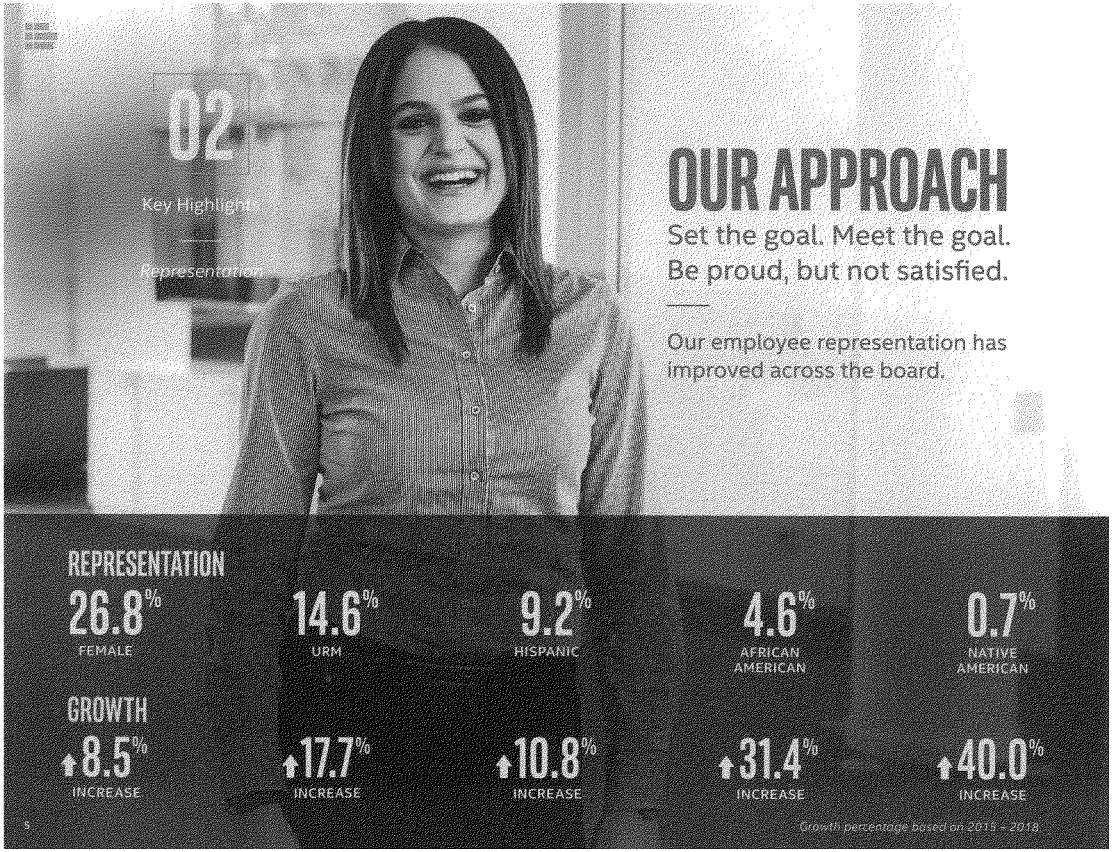
Key Highlights

"When people ask me about the business case for diversity and inclusion

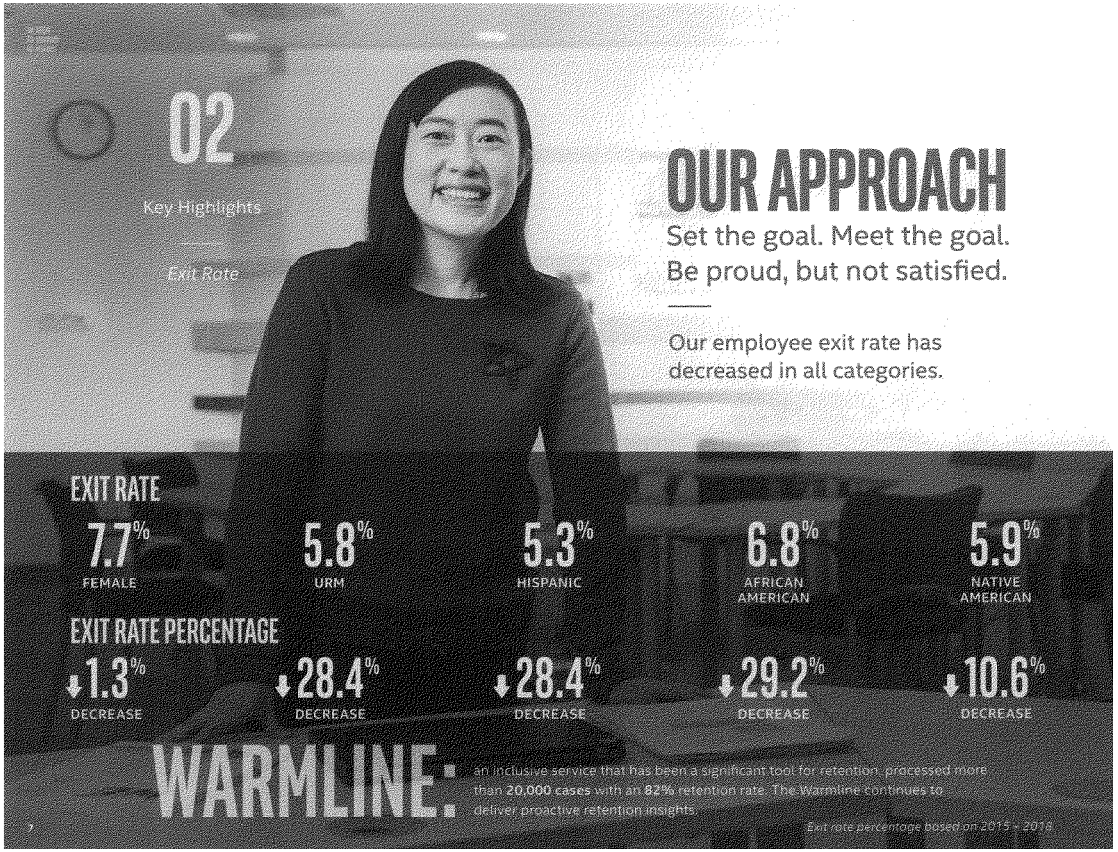
I ASK THEM TO TELL ME THE BUSINESS CASE FOR HOMOGENEITY."

BARBARA WHYE

Chief Diversity and Inclusion Officer and Vice President, HR


02
Key Highlights
Representation
OUR APPROACH
Set the goal. Meet the goal.
Be proud, but not satisfied.
Our employee representation has improved across the board.
REPRESENTATION
26.8% FEMALE
14.6% URM
9.2% HISPANIC
4.6% AFRICAN AMERICAN
0.7% NATIVE AMERICAN
GROWTH
↑8.5% INCREASE
↑17.7% INCREASE
↑10.8% INCREASE
↑31.4% INCREASE
↑40.0% INCREASE
Growth percentage based on 2015 - 2018
5


02
Key Highlights
Hiring
OUR APPROACH
Set the goal. Meet the goal.
Be proud, but not satisfied.
The hiring efforts have delivered
in all categories.
HIRING
32.9%
FEMALE
22.2%
URM
10.0%
HISPANIC
11.2%
AFRICAN AMERICAN
0.9%
NATIVE AMERICAN
GROWTH
↑3.8%
INCREASE
↑89.7%
INCREASE
↑38.9%
INCREASE
↑160.5%
INCREASE
↑350.0%
INCREASE
Growth percentage based on 2015 – 2018
6


02
Key Highlights
Exit Rate
OUR APPROACH
Set the goal. Meet the goal.
Be proud, but not satisfied.
Our employee exit rate has decreased in all categories.
EXIT RATE
7.7% FEMALE
5.8% URM
5.3% HISPANIC
6.8% AFRICAN AMERICAN
5.9% NATIVE AMERICAN
EXIT RATE PERCENTAGE
↓1.3% DECREASE
↓28.4% DECREASE
↓28.4% DECREASE
↓29.2% DECREASE
↓10.6% DECREASE
WARMLINE:
an inclusive service that has been a significant tool for retention, processed more than 20,000 cases with an 82% retention rate. The Warmline continues to deliver proactive retention insights.
Exit rate percentage based on 2015 - 2019

03

By the Numbers

FOUR-YEAR TREND: FEMALE REPRESENTATION

Intel was a founding member in the Reboot Representation Tech Coalition. Intel and 11 other companies have pledged more than $12M to double the number of women of color graduating with computing degrees in the U.S. by 2025.

Intel is involved in a variety of programs to support and retain women, including the Pay It Forward (PIF) initiative and Women at Intel Network (WIN). The company has invested in the Technology Pathways Initiative, a partnership with Center for Advancing Women in Technology (CAWIT).

While Intel has made strides over the years, we continue to look for and implement partnerships and programs to increase female retention, especially for women of color.

23.9% in 2018

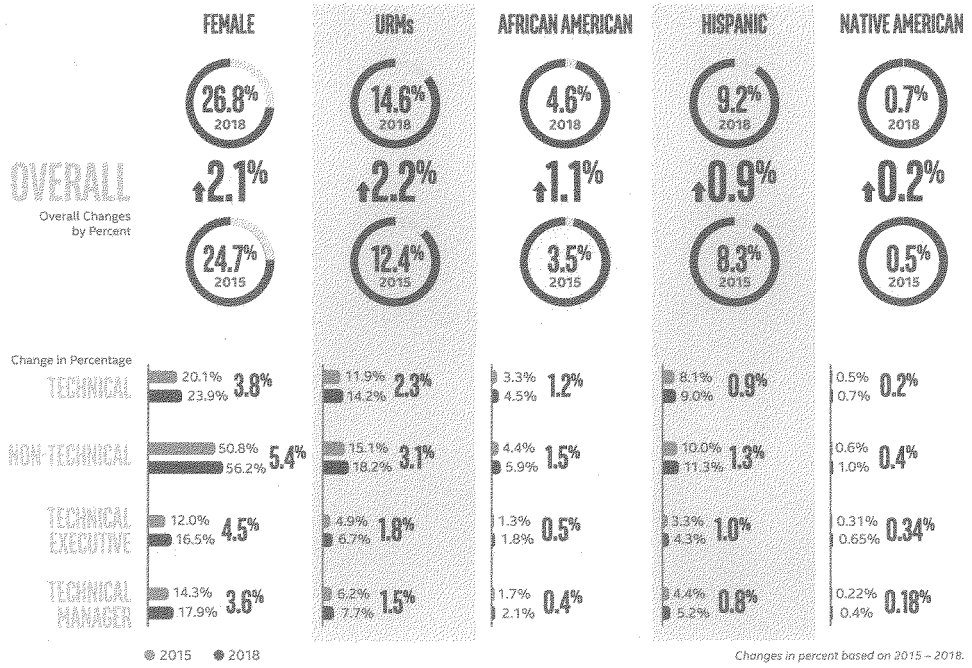
Since 2015, our technical female representation has increased by 3.8%.

19.4% in 2018

Out of all women at Intel, 19.4% are in leadership roles.

0.6% ↑ Increase in women of color between 2015 – 2018.

CHANGES IN DIVERSITY



Changes in percent based on 2015 – 2018.

04

Key Updates

SUCCESSES AND OPPORTUNITIES

We work to incorporate diversity and inclusion in everything we do.

Pay Equity

That's one of the reasons why Intel is committed to global pay equity. For more than a decade, we've performed an annual compensation analysis in the U.S. to ensure pay equity by gender and race/ethnicity; and are continuing to close the identified gaps in 2018 as well.

Pay adjustments are made in the U.S. every year regardless of gender or race/ethnicity. We also assess the pay equity audit process annually to make sure that it is compliant with the current federal and state pay laws.

Domestic Partners

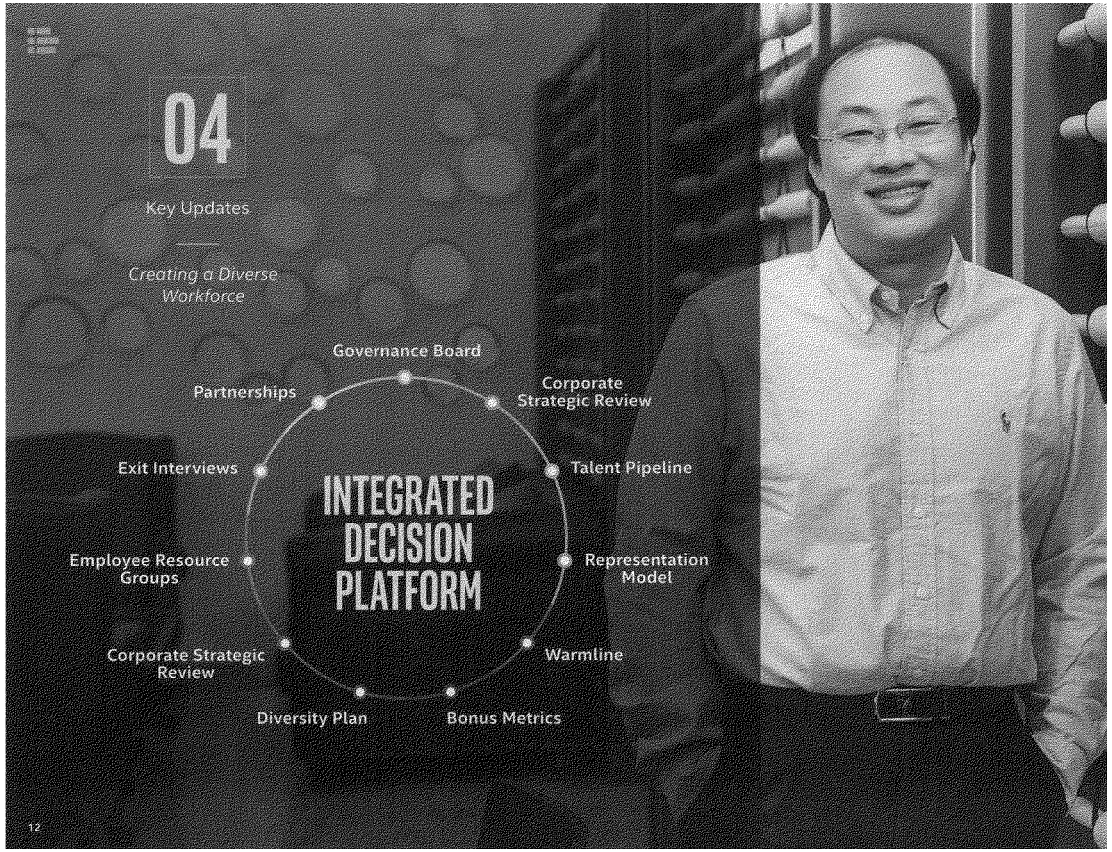
We are also expanding the flexibility of our U.S. Health and Welfare Plans to include an eligible domestic partner and his or her eligible children. The added eligibility for domestic partners reflects our focus on creating an inclusive environment.

Opportunities

We recognize that we need to do more in order to retain high-value employees, while increasing the level of diversity among our leadership. We view these challenges as opportunities to make a positive impact on our employees, partners, and technology for generations.

We have been successful in setting and meeting the goal of full representation in our U.S. workforce, which is just part of our long-term journey. Our focus is now on continuing to be creative and innovative in making global inclusion a reality at Intel.


04
Key Updates
The impact our technologies have
on people's lives around the world
IS A DIRECT RESULT
OF OUR DIVERSE
EMPLOYEE POPULATION.
11


04
Key Updates
Creating a Diverse Workforce
Governance Board
Corporate Strategic Review
Talent Pipeline
Representation Model
Warmline
Bonus Metrics
Diversity Plan
Corporate Strategic Review
Employee Resource Groups
Exit Interviews
Partnerships
INTEGRATED DECISION PLATFORM
12

05

Annual Spending with Certified Diverse-Owned Suppliers

DRIVING CHANGE THROUGH SUPPLIERS

Our commitment to diversity extends beyond workforce hiring and retention to diverse-owned businesses in our global communities.

Intel has grown its supplier diversity spending from $150M in early 2015 to $650M by the end of 2017. Intel is on track to achieve $1B in annual spending with diverse-owned suppliers and the related goal of $100M in annual spending on women-owned businesses internationally, in 2020.

This will generate a more inclusive and more innovative supply chain and create more opportunity for diverse businesses to thrive—empowering the communities where they hire and spend.

$600M

Original goal for supplier diversity spending in 2017.

$650M

Actual spend for supplier diversity in 2017.

13

06

Glossary of Terms

URM: Underrepresented Minority

The population of African American, Hispanic, and Native American males and females.

Non-URM Males

Majority population, including White and Asian males.

Female

URM and non-URM females.

Hispanic

Males and females who identify as having Hispanic heritage.

African American

Males and females who identify as having African American heritage.

Native American

Males and females who identify as having Native American heritage.

Non-Exempt

Employees paid hourly.

Technical

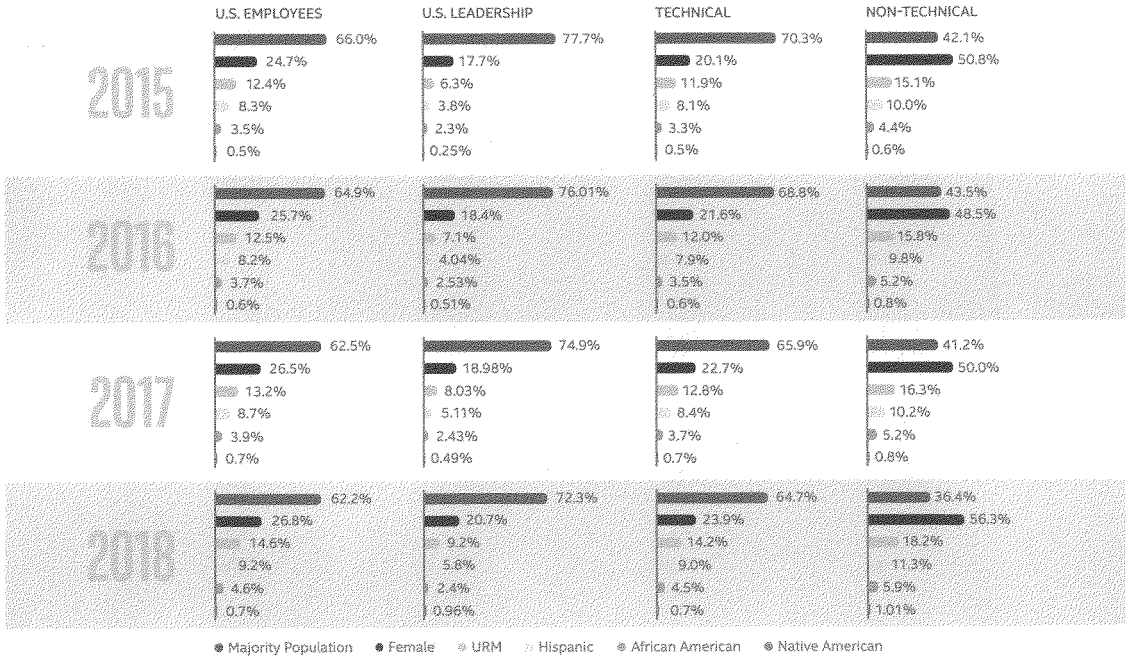
Roles that are technical in nature, such as engineers.

Non-Technical

Roles that are non-technical in nature, such as Marketing, HR, Legal, and other support functions.

Addendum

HOW THE DIVERSE EMPLOYEE BASE OF INTEL HAS GROWN AND CHANGED



www.intel.com/diversity

The data reflected in this report is from the beginning of 2015 through Oct. 16, 2018. Ethnicity categories use EEOC ethnicity definitions. Intel complies with federal regulations and uses post-employment records to identify gender, race and ethnicity of individuals who do not self-identify. These updates are done on a quarterly basis. Definition of "technical" is based on Intel internal job codes and reflects technical job requirements.

Chairwoman JOHNSON. Thank you very much.

We will begin our first round of questioning. And I'll recognize myself for 5 minutes.

Despite a lot of attention being focused on the issue of increasing the participation of women and underrepresented minorities, progress has been very slow and in some cases nonexistent. Why has so little progress been made despite the amount of resources and attention devoted to these issues and our knowledge of proven solutions? And you can start, Dr. Jemison, and we can just go down.

Dr. JEMISON. I want to just start off by saying I'm here also as the Chair of a committee of the National Academies of Sciences, Engineering, and Medicine on how do we improve the representation and the leadership of women in STEM fields. And the report is due out in November, and I'm going to make sure we—everybody gets a copy. But some of the things that we are looking at is the fact that there are solutions. We already know how to increase things. The issue is how do we get individual organizations and institutions to enact them?

And some of the things we're finding is many times it has to do with that perception that there's not enough support at the head of institutions. We know that when there is that support, things change. At Harvey Mudd College when Maria Klawe came in, she was able to triple the number of women graduating in computer sciences in 5 years, so it really has to do with institutional support at the top and there being some repercussions about not effecting change.

Chairwoman JOHNSON. Thank you.

Dr. MALCOM. We have invested in a lot of intervention programs over the years, and we do have a lot of answers for a lot of the barriers that we see. The difficulty I think is that we don't put the pieces together. This is one of the reasons that we have turned to SEA Change as a more systemic institutional transformational strategy. You can't have just someone worried about the entering student over there and not the graduate student over here. You've got to really look at the entirety of the policies, the practices, and the processes that are in place that put barriers in the way. And we utilize the interventions that appear actually as solutions to a lot of these things.

I think that this notion of having a scaffold for institutions to look at all of these elements at the same time is really powerful. That is the only way to begin to look at these issues possibly at scale.

Congresswoman Johnson, we were pleased to have you at the celebration and have you as the keynote at the celebration for SEA Change. Those institutions had gone through a process of self-assessment. They had gone through a process of actually looking at all of the aspects. They might not have chosen to deal with all of them, but they had solutions that had come from the earlier investments that have been made around intervention programs.

So I think that we've got to move this to a different scale. We can't really up the numbers in a large amount without having institutional change. And having them do a lot more of the holistic

strategies that it's really going to take to make a difference. Thank you.

Chairwoman JOHNSON. Thank you. Dr. Espinosa.

Dr. ESPINOSA. Thank you for the question. The committee that I co-chaired would say that we're not investing dollars and attention into the institutions that are serving the greatest number of students of color and low-income students, again, our Nation's minority-serving institutions. These are institutions that are underresourced and don't have, in many cases, the critical infrastructure that are needed.

The best practices that we know—again, as someone just mentioned, we know a lot about what works in broadening participation. We know that undergraduate research experiences, for example, is a huge predictor of success, but we don't equip many of the institutions where these students are attending with the infrastructure to offer such experiences. So there is a great deal of focus in our report on many of these successful strategies.

I'll just also mention that MSIs not only offer these experiences when they can, but they do it in a way that is culturally aware and in a way that sets high expectations for their students no matter where they start.

Chairwoman JOHNSON. Thank you. Dr. Moore.

Dr. MOORE. I'll be succinct and try not to say some of the same things, but there are four—five things that is really important that should be thought about consistently. The first one is interest. We know how to get students interested in STEM, but it's not as much how do we sustain their interest. And as they—from—these are K-to-gray kinds of issues. Even the individuals who do obtain a STEM degree, oftentimes they opt out of the field because of the experiences that they had throughout the educational experience.

The other one is preparation. Preparation is a major issue at the K–12 particularly, and sometimes it even seeps in at the graduate and professional level. All AP is not created equally. All honors is not created equal. Students matriculate at Ohio State and they realize they have classmates who had the same textbook, the same biology textbook in high school and that was the first time that they have ever been exposed to it. So we see malpractice going on throughout our educational institutions in America.

The other one is experiences, making sure that they have adequate educational and career experiences that is indicative of what it means not only to go into a STEM field, to be a part of the new frontier of STEM. If we don't think about the new frontier of STEM, we'll just have another disparity even when they get in STEM.

The next one is connections, making sure that they have access to mentors that reflect and look like them. You know, this is anecdotal. When I was at the National Science Foundation and when we would do reviews of other—we would do reviews of grants, if the professor was Iranian, it seemed like all the students were Iranian. When the professor was Chinese, it seems that all the professors were Chinese.

And increasingly we know that HBCUs, minority-serving institutions, are educating a disproportion of underrepresented groups, but what is happening when you're not—when most people are not

paying attention? The professors do not mimic the students even at HBCUs like they did many years ago. Internally, it's creating—it's not creating the kind of relationships that they once had many years ago.

And last but not least, opportunities. Even when you—at every level of the educational journey, students need to have opportunities because where they don't have these opportunities, they don't necessarily get to reach the level that they—to reach their full potential. But if you—you know, interests, your preparations, your experiences, and your connections impact whether or not you can even access the opportunities when they come to you.

Chairwoman JOHNSON. Thank you. Ms. Whye?

Ms. WHYE. At Intel we learned that what you measure matters, and we learned right away that we can't hire our way to success. Thank you—that we can't hire our way to success. You actually have to focus on retention. We're one of the few companies that's actually monitoring our retention and how our women not only starting in engineering and engineering careers at Intel but how are we being inclusive in our environment and creating a sense of belonging so that we can also retain this talent.

Chairwoman JOHNSON. Thank you very much. Mr. Lucas stepped out. He will return. In the meantime, I will call on Ms. Bonamici. I'm sorry, Mr. Brooks.

Mr. BROOKS. Yes, ma'am. We do have Republicans here today.

I represent the Tennessee Valley of Alabama, home of the Marshall Space Flight Center. We like to call ourselves the birthplace of America's space program.

And, Dr. Jemison, I'd be remiss if I didn't mention that, to us, you're a hero and a role model having come from the Tennessee Valley, Decatur, your birthplace, which is in the Tennessee Valley, and we also named a high school after you, Jemison High School just a few years ago. So that gives you an idea of how highly we think of you and everything you've done in your personal life and in your professional career.

I'd be remiss though if I didn't add that I'm a Trekkie, and knocking the ball out of the ballpark was when I found out you also were on a role of Star Trek, "Second Chances," so that's really cool, OK?

With that as a little bit of a backdrop, here's a question for you if you don't mind. In your testimony you highlight the demand for skilled technical workers, STEM jobs that do not require a 4-year degree. You also mentioned that women and underrepresented minorities are frequently unaware and left out of pathways to these careers. What can be done to improve the awareness and participation in these programs, and is there a role for industry to play?

Dr. JEMISON. Thank you very much for the question. My father worked on Redstone Arsenal as a roofer before I was born, so he was part of it, too.

Thank you for the question about skilled technicians and skilled labor, which actually do represent the majority of the STEM workforce. And in addition to that, they're very high-paying jobs and women very frequently do not know about them. And we also have a workforce shortage in those areas.

What can we do? We can, first of all, make people aware of them by actually having those jobs represented in television programs. When we talk about this—right now—we always talk about 4-year degrees. I was busily writing notes about that. We talk about 4-year degrees. We talk about academia, but the workforce that actually built the Shuttle were not 4-year degree engineers. They were skilled technicians. So we need to make sure that those jobs are represented.

Then we have to make sure—I believe that community colleges have the ability to do vocational work and are not seen as a sort of a remedial place for what was not done in high school so that people can get into 4-year colleges. Actually, community colleges do incredible work with training technicians.

Vocational education in high school could also be a pathway for people seeing and understanding what are some of the jobs that are available to them.

And I just want to go back to something that is really clear. During World War II, women fulfilled many of the jobs that were considered masculine jobs from, you know, the iconic image of Rosie the Riveter. They also were the ones who transported airplanes around. We need to understand that women can do not only the biotechnician jobs, but that they can also do the jobs in mechanical, welding, and building aircraft. Those things are important. So thank you for that question. But we need to get that out front and keep it in our eyesight.

Mr. BROOKS. I've got some facts I want to give. I don't know if we're going to have time for a question or not, but this is rather troubling to me. And I just did this research while I was sitting here. One was a comment by Don Lemon that a put a fact then analyzed, and it was out-of-wedlock births. And then looking at STEM and degrees and which races are going into STEM. And it seems that there's an unusual correlation. Let me run through it.

Asian Americans, they are number one with the lowest number of out-of-wedlock births, and this is according to the National Center for Education Statistics at 17 percent out-of-wedlock births. They are also number one in terms of number of STEM degrees at 33 percent of the degrees that are given out to Asian Americans. Caucasian Americans were number two in out-of-wedlock births at 29 percent, and then number two in STEM degrees at 18 percent. Hispanic Americans were number three in out-of-wedlock births at 53 percent and number three in the STEM degrees at 15 percent. Native Americans were number four out-of-wedlock births at 66 percent and number four in STEM degrees at 14 percent. And then African-Americans were number five at 73 percent out-of-wedlock births, and that's what caused PolitiFact to look into Don Lemon's statements because that's what he said. And number five in STEM degrees.

I hope that we can somehow or another as a body, Madam Chair, also look into this societal issue and see what can be done given this rather startling correlation between out-of-wedlock births and then people who then go thereafter into STEM degrees. And my time is expired.

Chairwoman JOHNSON. Ms. Bonamici.

Ms. BONAMICI. Thank you very much, Chairwoman Johnson and Ranking Member Lucas, and thank you to all of our witnesses.

We often talk about our global leadership here in the United States and that we have a country of innovators. And we know that part of that is because of the groundbreaking research that we have invested in, but we also know that we need to educate the next generation to be innovative, to be cutting-edge. I also serve on the Education Committee where right now we're talking about affordable college and retention. That's why I am back and forth.

But, Dr. Jemison, you said in your testimony, excellent education must be universal. That's all connected to what we're talking about here today. But we also know that it's not enough just to educate world-class engineers, technologists, and scientists. We need critical thinkers who are creative, who can come up with new ideas and new ways to solve problems. So I am the Co-Chair—Founder and Co-Chair of the STEAM (science, technology, engineering, arts, and math) Caucus, will continue to advocate for integrating arts and design into traditional STEM fields to increase the competitiveness and the diversity of our workforce.

Ms. Whye, I appreciate your reference in your testimony to the value of Intel support for STEAM. For students to be successful in the modern economy we want to teach them to think creatively, and I think I want to point out that in the district I'm honored to represent we have about 20,000 Intel employees. There's a nationally recognized public STEAM elementary school not too far away.

So we know that historically our science and technology workforce has not been inclusive of women and people of color. We heard a lot about that from the witnesses about the persistent biases and inequities. We know how that's limiting us because diverse voices help identify problems to tackle and help find new ways to solve them.

So according to the recent report from the National Academies of Science, Engineering, and Medicine, 58 percent of individuals in academia experienced sexual harassment. Unfortunately, the prevalence of sexual harassment in the sciences often undermines career advancement for women in STEM fields, and I'm proud to support the Chairwoman's bill to direct the Federal science agencies to implement policy changes to address sexual harassment. I thank her for her continued leadership.

Dr. Malcom, in your testimony you mentioned the engagement of AAAS in the Societies Consortium on Sexual Harassment, and I wonder has the consortium developed any new guidance, and what can Congress do to make sure that we're not losing the valuable scientific contributions from women in STEM because of an unsafe working environment?

Dr. MALCOM. Thank you very much for that question. AAAS is engaged with the American Geophysical Union, the Association of American Medical Colleges, and Education Council in this 100-member consortium, and we have our colleagues from mathematics and from all the other—many of the other fields there within this member group.

We are actually developing draft policies right now so our constituent member societies can have options about what they do about different issues. It extends all the way from having policies

that allow us to affect behaviors, for example, in our conferences. If someone—if they've demonstrated that the—you have a bad actor there, to be able to—how do we manage that in a way that we can in fact have a code of conduct for our meetings.

Ms. BONAMICI. Right, and I'm going to try to get another question in real quickly.

Dr. MALCOM. Oh.

Ms. BONAMICI. Dr. Jemison, you mentioned the ongoing National Academies of Science study addressing the barriers for advancement. Through my work on the Education and Labor Committee, we've made progress on addressing some of those barriers, but I'm concerned about our lack of understanding of issues regarding the retention of women and people of color. So I'm going to ask you and Ms. Whye, we know the cultural changes and willingness to confront the implicit and explicit biases in the workforce are essential, but what policy changes can Congress explore to improve the retention of women in STEM/STEAM fields?

Dr. JEMISON. So the report coming out in November we are very excited about, and has some more concrete ideas, but really quickly, part of it is holding people accountable for what they do and doing bias training——

Ms. BONAMICI. OK.

Dr. JEMISON [continuing]. And recognition as part of perhaps tenure processes, as part of processes for promotion so that it is ingrained into the culture.

Ms. BONAMICI. Right. And, Ms. Whye?

Ms. WHYE. So quickly, I think where there is leadership, accountability, and transparency of data anywhere you have the opportunity to be transparent with your data and also holding leadership accountable for the barriers that exist for women is where you can support.

Ms. BONAMICI. And you have—you call it a hotline or a warm line or something?

Ms. WHYE. A warm line. We actually have a warm line service that we implemented inside Intel. It's an innovative service that employees that are challenged by being retained inside the company can reach out to these case managers and get assistance right away so that we can retain them inside of Intel. Over 20,000 cases, we have over 80 percent save rate of our employees.

Ms. BONAMICI. Thank you. My time is expired. I yield back. Thank you, Madam Chair.

Chairwoman JOHNSON. Thank you very much. Mr. Lucas.

Mr. LUCAS. Thank you, Madam Chair.

Dr. Moore, we often hear in this Committee about the importance of mentorship and applied learning opportunities like internships, apprenticeships. And you recommend that colleges look to increase the amount of quality faculty-student mentorship and research experiences to keep students in STEM. Can you please elaborate on your recommendation and provide some examples of how programs at the Federal science agencies could support those activities?

Dr. MOORE. Thank you for the question. Well, there's a new initiative at the National Science Foundation called GRIP (Graduate Research Internship Program), and basically that initiative is try-

ing to give individuals opportunity to have real-time experiences, as we know that having real-time experiences is one of those factors—when I say real-time experiences, apprenticeships, internships, co-ops. They allow individuals to go deeper in their content area, and not only that, they begin to explore new opportunities that further engage their interest in those kinds of things.

At Ohio State we have an initiative. It's a Big Ten consortium called the Summer Research Opportunities Program, and some of the institutions have a focus on STEM. Ours is a little bit more broad, but a majority of the participants are STEM majors.

We know academic achievement is highly correlated with a relationship that a student has with his or her major professor, as well as the number of contact hours. Having research experiences is a strong indicator of whether or not you'll go to graduate and professional schools. And those kind of experiences, too often students foreclose on exploring these opportunities because—based on what they think research is, so it's very important—we know that when women and other underrepresented groups have hands-on experiences, they're more likely to stay in those kinds of activities.

So part of the university enterprise should really be thinking about how do we develop an academic experience that goes beyond the didactic but it has the experiential pieces. And as I indicated in my earlier remarks, we're trying to do that with J.P. Morgan Chase as a testbed where they come and actually have office hours, and they're going to be engaged with our students ongoing so they can develop the skill—the workforce skills ongoing.

And particularly some students, when they come from communities where they're the first in their families to go to college or they're pioneers, sometimes they don't know the importance of participating in these kinds of activities, so we need—it's very important that we get diverse faculty so we can begin to shatter myths and share realities and be role models, but also it's important that we have support systems in place in our institutions of higher learning that further support students and help them guide them in certain places.

I'm here—you know, I like to share that at Ohio State we've only had seven Rhodes Scholars in our history and, you know, three were in the early 1900s, but the last two came out of my office, and they came from parents of immigrants. And so those things just don't happen. You can be very bright, have high aptitude, and still don't perform at an optimal level. So it's important that we build these kinds of things in the curriculum.

Mr. LUCAS. Absolutely. Dr. Jemison, workforces needs across the country for aerospace and technicians are great, including Oklahoma, and many good-paying jobs are going unfilled. Women are particularly underrepresented in the aerospace field. Could you expand for a moment on the barriers to women in aerospace and how we should address that?

Dr. JEMISON. Many times it's the perspective that people have about who does what jobs, what they've seen visibly whether it's in media where they see the professors, that makes a difference. When you look at workforce, though, many of the jobs that you see in aerospace, they have machinists there, people who are riveting stuff, putting things together, and these have been jobs that tradi-

tionally people don't think of women as doing, but yet girls do as well as or actually better than boys in math and science all the way through high school, and many of these jobs are filled with people coming out of high school.

And then there are apprenticeship jobs. So, we have to actively bring in girls out of high school into these apprenticeship kinds of programs because that's going to make a difference and let them know that, yes, this is a part of what you can do. What's really important about that is those jobs pay well, and so women who put so much money into their homes, into their children, would have even that much more to support the future.

Mr. LUCAS. Absolutely. I yield back, Madam Chair.

Chairwoman JOHNSON. Mr. Cohen?

Mr. COHEN. Thank you, Madam Chair.

Financial aid is real important for folks in diverse populations to go to college. In Tennessee we have a lottery that's dedicated to higher ed, and part of the lottery is merit-based and some of it's need-based. How important is it for these scholarship programs—and if you have them in Ohio and if you're familiar with them in other States—to be need-based in addition to merit-based and getting students the opportunity to go to college? I don't know who should go first, maybe Dr. Moore because you're—I know you're at The Ohio State University.

Dr. MOORE. Well, as you all—you know, Ohio State is a land-grant university, and staying true to that mission our President Michael Drake has made—as a major part of his platform is to make college more affordable. In fact, I'm proud to say Ohio State is one of the national leaders. And so for every Ohio resident, we cover cost for tuition for every—every Pell-eligible student at Ohio State, and it just went to our regional campuses. And that is a—we've invested over $100 million into this, but I can say it's still not enough.

Mr. COHEN. What are the results that you've seen from that? Have you seen higher graduation rates?

Dr. MOORE. Oh, yes, our graduation rates are still on a vertical trajectory, but not only that, as our institution historically we've had attention between land-grant and flagship. We're both. And so our average ACT is a 29.2, and some alums will say I couldn't even—we became—we were open admissions prior to 1987, and so it used to be your birthright if you had a high school diploma in Ohio you could go to Ohio State, but now it's more difficult to do that.

But what we found is not only when you have students, they all have the capability, but they all don't come in with the same kind of supports and traditions in their families. And what we've done is we've put a major emphasis in creating support structures for our students to ensure that they are successful and so they won't—first-generation college students oftentimes make unwise academic decisions not because they're not smart. It's because they rely on the same people who are just like them who had the same amount of knowledge. And what we try to do is to reach out to students early and we try to coach them ongoing to ensure that they're very successful. But the financial piece is critical, but it's not the only piece because it only covers tuition.

Ms. WHYE. Yes, let me just chime in here. I think it's critically important because for some of the students it creates a choice for them studying versus having to work, so the scholarships—and you'll see in my written testimony we have a project with AISES (American Indian Science and Engineering Society), which provide scholarships for our Native American students. And in doing so, that scholarship helps them in a couple ways. One, they get paid internships at Intel, but also because they're having the paid internships, they're not having to really choose between studying and also having to work, so it's critically important.

Mr. COHEN. Dr. Malcom, please.

Dr. MALCOM. Let me say that sometimes the amount of money that we're talking about is not really a lot. It is not necessarily just the cost of tuition. It may be that in fact the students need book money but they don't have it at the time, in which case they delay getting it—getting their books until they could earn the money or whatever it is in order to do it. Well, that puts you behind.

And there's also an increased number of students who are in fact employed—working full-time who are also trying to go to school, and that's a more difficult row to hoe. I am a Regent at Morgan State and I chair the Finance and Facilities Committee, so I see the kinds of things that come across about—that can really stop students right in their track, for lack of $500 for the books or $1,000 to be able to become financial. So it's really a very critical thing that needs to be looked at across the board.

Mr. COHEN. Thank you.

Dr. ESPINOSA. I might just add to the point that several have made. Many institutions are experimenting with having emergency funds available. For many low-income students, books, and other critical needs for an education can be out of reach because they have to spend money on repairing their car because that's the only way they can get to school or they have to spend money on their family. So having emergency dollars available out of the financial aid office is also a really effective strategy.

Mr. COHEN. All right. Have you noticed any——

Dr. JEMISON. May I——

Mr. COHEN. Yes, Dr. Jemison.

Dr. JEMISON. I just wanted to add one thing. There is this romantic notion about working your way through school, and people have done that. But the reality is that it is not necessarily fair when those students are working and in classes with people who do not have to work their way through school. And our responsibility as a Nation is to make sure people have access and opportunity to develop their talents that we're going to need, all of us, in the years to come.

Mr. COHEN. My time is up, and I thank each of you for your testimony. And it's what I—you know, we need to have more need-based scholarships and people understanding that if you give people a step up, it's really important not only for them but for the whole society. Thank you.

Chairwoman JOHNSON. Thank you. Mr. Biggs.

Mr. BIGGS. Thank you, Madam Chair. Madam Chair, I appreciate you and the Ranking Member for holding this hearing today. It's been very insightful. I appreciate all the witnesses being here.

I've read your testimony and listened to your testimony carefully. I appreciate it very much.

And it's good to see, Ms. Whye, you're here representing Intel, which is so important to my community and my congressional district, and thank you. And I only want to say this with regard to Dr. Moore and The Ohio State University. Oddly enough, the largest engineering school in the country is right there at Arizona State University, so I just had to get that out, no competition from me, though. I just wanted you to know that.

I am grateful that you're here. I always prefer—and most people on this Committee have heard me say this before—that the States and the private sector rather than the Federal Government take the lead on a lot of the issues we're talking about, particularly in expanding STEM opportunities. But I'm confident that regardless of how we get there, I think all of us in this room share the same end goal.

In order to remain internationally competitive, it is critical that an increasing number of American students are able to keep up with and actually in my mind ideally outperform students from China, Western Europe, and elsewhere in the developed and developing world. The data suggest the United States has made great strides over the past decade even though we have a long way to go, particularly in the postsecondary level.

According to research compiled by the National Center for Educational Statistics, graduate enrollments in science and engineering grew 15 percent over the past 10 years. Additionally, Latino, African-American, and female participation in graduate STEM education increased by 122 percent, 35 percent, and 37 percent, respectively over the same period. Certainly, there's more work to be done, particularly in K–12 education, but this seems to indicate we may be moving in the right direction.

And going back to this private sector for moment, I think so many efforts to encourage STEM and diversity hiring should originate in the private sector. And I appreciate Dr. Moore mentioning what J.P. Morgan Chase has done to assist Ohio State University, but clearly, Intel has been a real leader in this area. The statistics speak for themselves. An 8.5 percent growth in female workforce and 17.7 percent growth in the number of historically underrepresented minorities just between 2015 and 2018 alone. Those accomplishments are testaments to your leadership, Ms. Whye, and also Intel.

And I also wanted to thank Dr. Jemison for her comment with regarding 2-year schools and their ability to turn out very accomplished technicians in the STEM field. We use those and we see them in my district.

Boeing has many machine shops around my district filled with a diverse portfolio of workers because they've reached out and teamed up with community colleges.

I'm most interested in learning a little bit more about the Tech Learning Lab and Intel Futures Skills programs that you referenced in your testimony, Ms. Whye, and I'm wondering if you could give us a little more insight into your own engagement with these programs and share with us why you think they've been so

successful at encouraging more young people to pursue STEM education.

Ms. WHYE. Thank you. And I'm from the University of South Carolina, the other USC, and currently working on a Ph.D. obviously at Arizona State University, so I got to give it up for AZ.

Just two things. So what's important about both of these programs and all of the programs that Intel is currently driving, it's really about access and opportunity because in every corner of our communities, even like the rural community that I grew up in, there's a student there waiting to be engaged. And I think far too often we talk about the narrative of the students aren't interested when, quite frankly, the students are interested. It's on us to bring the STEM and STEAM to these students.

So both the Tech Learning Labs as well as the Intel Future Skills, these programs are put in place to do that, to ensure that in our communities and to ensure that communities around the Nation, that we can give access to these students so that they are developing the critical skills that they will need to compete in this Nation and to help Intel with its future workforce.

So, specifically, the Tech Learning Lab, you could think of it as a really cool bus that's driving through the rural communities in your neighborhood, and that bus is equipped with all sorts of fun technologies that you can just geek out. That's kind of the visualization for that.

The Intel's Future Skills program is very similar in that it gives the students hands-on skills and entrepreneurship skills so that they can do hands-on because the research—and Dr. Jemison will agree with this—it's easier for our students to see it if they can actually touch the technology and do the hands-on project. So it's a very easy way to give our students access, and I think all of us could play a role in that and do more of that.

Mr. BIGGS. Thank you very much. My time is expired.

Chairwoman JOHNSON. Thank you very much. Mr. McAdams.

Mr. MCADAMS. Thank you, Chairwoman Johnson and Ranking Member Lucas, for your leadership on the *STEM Opportunities Act* to build our American workforce and to include more Americans in our STEM careers.

Utah, my home, is also home to several life sciences and medical companies, medical device companies, a robust technology sector, and an ecology that provides unique opportunities for environmental research. When I talk with business and university leaders in Utah working in this wide range of STEM fields, the top concern that I hear is about their ability to recruit the bright students and the workers that they need to keep their organizations and not to mention our country globally competitive.

Utah has amazing community partners working to address these needs, including our higher education institutions like Salt Lake Community College, which has partnered with local Title 1 junior high schools to sponsor robotics teams and to provide more hands-on STEM learning to students. And businesses in Utah's Silicon Slopes area like Adobe, which has engaged students from the Ute tribe in workshops designed not only to teach tech skills but also encourage their creativity and passion for further learning, which

I was interested in your comments about scholarships to Native Americans.

We certainly have more work to do in each of our communities and in Congress to ensure that all students have the opportunity to study STEM and to pursue a career in innovative and well-paying STEM fields.

So my first question is to Ms. Whye, and thank you for your testimony. Your testimony notes that retention is a key issue for Intel's and other STEM businesses' workforces, and I can tell you that I regularly hear the same thing from employers in my district. And, you know, certainly we need to do more to educate and train that workforce, but once we do get them into the workforce, to retain them and keep them in the workforce.

So I'm interested from your private-sector experience at Intel, what programs or practices have helped Intel to create a more inclusive workspace for your employees from underrepresented backgrounds.

Ms. WHYE. Great, thank you. At its simplest for your employees from their point of view, they walk into your companies as if they are a bank. Negative transactions result in withdrawals from the bank. Positive transactions result in deposits. So at Intel what we learn is when our employees are at insufficient funds, they call our warm line. And the warm line services there is backed by case managers, and employees get to ask their questions about their pay, their managers. It could be they're ready for the next job assignment. And through using this innovative service—and I think all companies should have a warm line, all universities should have a warm line. And, in fact, the warm line equivalent for me at my university was the engineering program office, right? You agree?

And so what we've learned about retention is really two things. Because we've had this warm line in place, over 20,000 cases now, we now have predictive analytics that can tell us what we're doing right and what we're doing wrong. And the two top themes from the warm line are employees want to progress and they want to have a good connection between them and their manager.

Based on those predictive analytics, what Intel has then done is we've retrained all 13,000 of our managers so that they have the leadership muscle to ensure that they're creating the right inclusive environments for their employees.

Mr. MCADAMS. So you started on my second question, which is what kind of—type of training do you give to managers? In my experience as an employer as county executive before coming to Congress and we had 4,000 employees and leadership starts at the top, too, right?

Ms. WHYE. Yes, absolutely.

Mr. MCADAMS. Create the environment, but what type of things do you do——

Ms. WHYE. Yes, so we——

Mr. MCADAMS [continuing]. For your managers?

Ms. WHYE. We have an in-house training that's called Managing at Intel. One of the modules in that training is how to lead as an inclusive leader. It's based on the content of Amy Edmondson, creating a psychologically safe environment for employees to bring their voices to the table and how you can facilitate as a leader and

be a coach as a leader as opposed to not allowing your employees to be heard. That would be one very specific example.

Mr. MCADAMS. Thank you. Thank you, Madam Chair. I yield back.

Chairwoman JOHNSON. Thank you very much. Mr. Baird?

Mr. BAIRD. Thank you, Madam Chair, and thank you to all the very talented witnesses that we have here today. I appreciate it very much.

My first question goes to Ms. Whye. You know, many of our universities have programs designed to promote diversity in STEM. Purdue University, for example, has a Division of Diversity and Inclusion, and each department has their own diversity program as well, including a Women in Science program at Purdue's College of Science and the Minority Engineering Program in their College of Engineering.

So my question to you is, you mentioned some of the programs that Intel has been able to use to create a more diverse STEM workforce. How do some of the things I just mentioned above like at Purdue—are you able to work with those programs? Are they beneficial to getting people into the STEM programs?

Ms. WHYE. Absolutely. So we have strong partnerships with several universities, and what I would say about it is it's not enough to get the talent in the door at Intel. So we haven't had huge obstacles getting the talent into Intel. Our obstacles have been more around the retention and inclusion of talent once the students, women and underrepresented minorities, enter into Intel. So we actually did a study inside of Intel to make sure that we could get to the root of what were some of the specific challenges in the way of retaining talent at Intel and asking our employees who are staying at Intel what's at the root of them staying.

And I think we can all agree on some of those critical elements. It's really largely around having an inclusive environment where I feel a sense of belonging. That's critically important. The second thing is to have a sense of community, so inside of Intel we have about 29 employee resource groups so that individuals can have a place—a safe landing to ask some of their difficult questions. And then I think the third thing is just the leadership and the leadership accountability, which is what I spoke about in my written testimony about how we are training managers to be more inclusive.

Mr. BAIRD. Thank you. My second question goes to Dr. Moore and, you know, since we're getting these university priorities corrected, I just wanted you to know, maybe you're not aware that Purdue University considers The Ohio State University as our eastern campus. I'm watching you recover from that.

This year, I introduced with my colleague and Chairwoman of the Subcommittee on Research and Technology, Ms. Haley Stevens the *Building Blocks of STEM Act*. And this legislation would work to ensure that NSF provides research and insight into STEM education during early childhood and particularly for girls.

So my question to you, Dr. Moore, is one of the lessons you brought up was that students in the underserved communities are often unprepared for college-level STEM work. Do you think there is a real gap in the pipeline for our young children's STEM education, and if so, what should we do to address that gap?

Dr. MOORE. Certainly. You know, ZIP Codes do matter currently unfortunately. You know, when I was talking about Shelby and Omari, Shelby grew up in Beverly, Ohio, but I didn't finish. Even though she had struggles, we kind of supported her through our office, and she's now a Ph.D. student at the University of Cambridge in the U.K., right? And so, thank goodness we have an institution like what we have to support students and help them reach their dreams and aspirations. And Omari is a constant on the Dean's list, even though—so great minds come from every ZIP Code.

I think first and foremost our society has to believe that. And how we can coach, everybody needs coaching. I know Congressman Gonzalez, the former NFL star, Buckeye football player, and Coach Drexel coached him up no matter how good he was. And so I'm saying that that's the philosophy we have is that we want students to reach optimal success regardless of whether you're a fifth-generation college student or whether you're going to be the first-in-your-family college student.

I think when we talk about we have to change the whole ecosystem, and we know when families sometimes may not be able to play a part, our schools used to play a part. But now our schools are fragile, our communities are fragile, and it's making it very difficult. So our land-grants, our public and private institutions of higher learning, they are required to do even more. But not only that, we can't do it by ourselves without industries and community because they play a—it is a part of the ecosystem.

And so some of the students, when you're first, you have anxiety about being the first. You're going places that no one has ever been before. And sometimes you don't know how to ask for help. And it's not because—even when they have a 4.0, Shelby was one of the top students in her high school, but you come to Ohio State, you're talking about any given day we got 100,000 people near our campus, and it can be quite overwhelming if you don't have the right support. So we're working on that not only for students, incoming freshmen, but we're even working on it how will we do a better job with our transfer students.

When you go to schools that may not have all the resources, the 2-year college route is becoming another—a preferred route to get to Ohio State and Purdue and other places. And so our institutions of higher learning have to do more.

But I will say this. I would be remiss, there's no federally funded program that's probably been more impactful for broadening participation than the Louis Stokes Alliance for Minority Participation. What might be an idea how could we think about that and expanding it, I have—our grant is $4.5 million. We have 10 universities, 10 universities trying to share $4.5 million. It's very—it's not a lot of money. But thinking about how do we leverage what we all do to make an even greater impact.

Mr. BAIRD. Thank you. I think I'm out of time unless——

Dr. JEMISON. I just want to add, and I don't know if this is out of order, but to add something about the question of childhood and what happens as we get children through it. We're mistaken sometimes when we believe that we have to get students interested in science. We come out of the chute excited about science. We're picking up the bugs, the snails, the stuff in the couch. We're asking

what it is. What happens many times is children go to school, instead of using this prodigious construct for learning that all children have, it's very well-documented for childhood, we demotivate them. We take the energy away by teaching science in a way that just isn't science. It's really about hands-on.

Besides parents, the most impactful part of this is teachers. And many teachers in K–8 have not had science as a specialty. And so we have to really make sure that we look at teacher training. And again, I want to just go to the idea of teacher certification, how do we support that so that teachers actually are able to do the work that maintains a student interest that helps them to build the kind of resilience that they need to continue through? If we do that and build science literacy, then we will have the pipeline, the resilient pipeline that we need to go into skilled labor, 4-year degrees, or post-doctorate degrees.

Mr. BAIRD. Thank you. I yield back.

Mrs. FLETCHER [presiding]. Thank you. I'll now recognize Mr. McNerney for 5 minutes.

Mr. MCNERNEY. First of all, I want to thank the panel for coming today and for your work in this area. It's important.

STEM programs form a cornerstone of the United States' educational system and were created to ensure that the United States remains competitive in the global marketplace. However, data shows that there is a growing gap in STEM-related educational achievements between men and women. While women earn over half of college degrees in the United States, they hold only 28 percent of STEM-related jobs.

That's why I plan on introducing the *Getting Involved in Researching, Learning, and Studying of STEM Act*—that's the *GIRLS STEM Act*—which, combined with this bill under discussion today, will help address this inequality. My legislation would help establish a program in the United States Department of Education to provide grants to eligible local education agencies to assist elementary and secondary schools in encouraging and preparing female students in STEM careers. This would ensure that more female students participate in and have access to STEM educational opportunities. And you know we're leaving out a large block of very qualified, very talented people that would help enhance our economy and our national security, so it's very important that we do this.

Dr. Jemison, in your testimony you highlighted several barriers to women in STEM. Included in this list is less access to mentoring and higher service expectations. With so few women in leadership positions, how can we balance the need for these women to serve as mentors and role models and to make sure their voices are heard without putting too much of a service burden on them?

Dr. JEMISON. So the comment that has been made a couple of times is how important mentorship is and mentorship being people who care about your careers and help you see new opportunities. And very frequently mentors who are similar to you are most effective, yet it can be very effective where others mentor you as well. And so there needs to be some onus put on everyone in academia or other professions that they have individuals that they're respon-

sible for in terms of making sure that they are brought into the system.

So when I joined NASA, I was the first woman of color to go into the astronaut program, and I had a big brother who helped me to sort of navigate what was going on, and that made a difference. And so I think that part of the way we decrease the burden on women of color and women, period, is by making sure that everyone has a responsibility. In fact, we could say that it is the Department Chair in academia who should have the responsibility for making sure that postdocs are coming in, that students are coming in, and are actively mentored by people who already have tenure, so to shoulder that burden.

So if you're a woman and you're in an academic institution and then you're asked to do all the work around women and community and keeping them in, and yet at the same time you're having to do all your tenure work as well and you get no credit for the community work, and maybe we can also look at how we do a credit for community work. There are many type of ways——

Mr. MCNERNEY. Thank you. I only have 5 minutes, so——

Dr. JEMISON [continuing]. And it's something that we need to do.

Mr. MCNERNEY [continuing]. I'd like to get to another question.

Dr. JEMISON. Thank you.

Mr. MCNERNEY. Dr. Moore, are there policies and practices that you have found to be effective in increasing participation of women and underrepresented minorities in STEM at Ohio State that you believe could be practiced at other institutions?

Dr. MOORE. Many of our academic units have mentoring programs specifically for women, but not only that, we try to create a community for women where they can draw on and share resources, but not only that, what we're finding and right now we're in this process of trying to revisit our benefits around leave, family leave that—which is a big component that sometimes women opt out of the academy particularly at the professor level. But also we're thinking about other mechanisms in which we can begin to keep people in the profession.

The other piece in regard to what we know that has been very supportive is when you have representation, diverse faculty attracts diverse students. When you look at the faculty who tend to graduate the most women, they typically are women. And I think that's why most of us do it the opposite. We focus on the students rather than the faculty, but the faculty is—plays a critical role in whether or not you get a Ph.D. or a graduate degree because they make selections and grants, et cetera.

The advanced grant is the big grant that we—we have an ADVANCE program on our campus, and what they constantly do is present best practices, exemplary practices that we can use on campus. But the new initiative is we have programs specifically for the male faculty because sometimes we have implicit biases. We communicate differently sometimes that sometimes alienate our women colleagues, so we have lots of programs like that on campus.

Mr. MCNERNEY. Thank you. I yield back.

Mrs. FLETCHER. Thank you. I'll now recognize Mr. Gonzalez for 5 minutes.

Mr. GONZALEZ. Thank you, Madam Chair. Thank you for holding this important hearing.

The beauty of tech in my opinion or one of the beauties of tech is that we know for sure from experience and data suggests this, that diverse viewpoints and diverse experiences help us build better technology. I ran a technology company, and it was clear the more diverse we were—and we did a great job on this—the better our products were, the easier it was for us to serve our customers. And so I think the fact that this has become a national imperative in many senses is fantastic.

My first question will go to my friend Dr. Moore. There's been a lot of crazy talk on who the real OSU is here. I mean, would you agree that the real OSU is Ohio State?

Dr. MOORE. Affirmative.

Mr. GONZALEZ. Thank you. Now that we've got that out of the way, and frankly I want to commend you. I am so proud of you and the university, as I was reading your testimony and listening to you today, to know that Ohio State is working so hard on this and you're getting it right. I couldn't possibly be happier sitting in this chair, so I just want to thank you and everybody at the university for the work that you're doing.

I think the anecdotes that you shared are really powerful because we're talking about two totally different backgrounds, but ultimately, we're kind of driving toward the same goal. And you have different programs, which makes perfect sense.

I want to read a part of your testimony. You mentioned—"We found that family influence and encouragement, positive K–12 academic experiences, their own interests and aspirations in STEM, as well as their academic experience in colleges with peers were all crucial impacting factors in African-American male achievement." It strikes me—and I've heard this echoed before. It strikes me that the family influence part is maybe the hardest at the university level to kind of, I guess, encourage. I guess I'd ask the question to you and to anybody, how can we do a better job—and not just to the African-American community but broadly—of making sure that our parents and kind of local leaders are promoting STEM as well?

Dr. MOORE. Well, what we do through our Young Scholars Program, we recognize not only are you educating the child, you're educating the family as well. In the State of Ohio we survey all 12th graders across race, gender, urbanicity, et cetera, and when you ask what individual has been most influential in your educational/career aspirations every year, it's families.

Mr. GONZALEZ. Yes.

Dr. MOORE. So families are influencing your child whether they went to college or whether they didn't go to college. And so it's very important that we recognize the importance of families.

And even when they have a college education, what we do, what we're very proud of, we have the only center that focused on African-American males in the United States, and I'm here to say I'm proudly—when I first started we only had about 130 African-American males who had a cumulative 3.0 or better. And today, we have 692 out of 1,291, nearly 50 percent of our African-American males on our campus, athletes or nonathletes, have a cumulative 3.0 or better.

And what we've found is talent—there are certain things that play out in our school systems—I'm not trying to be sexist or any of that kind of—that plays out for different groups just like we hear my colleagues talk about women. But minority males have similar experiences that sometimes they—it's suppressed, and that impacts their educational outcomes.

Mr. GONZALEZ. Yes. Thank you. And then shifting to Dr. Malcom, so a 2018 recent report published by National Academy of Science, Engineering, and Medicine mentions that 50 percent of women faculty and staff at academic institutions report having been harassed. We talked about this yesterday. You all weren't here but this was a topic of conversation yesterday in this hearing. And the simple question I've asked now for the fourth time and I think, you know, we're getting close to being able to produce something is what—how can we do better? What can we possibly do to make sure that we're cutting those instances down, and how can we foster an environment that is more conducive to women? I mean, we should just eradicate this from STEM if we could, right? So I'll open it up to you.

Dr. MALCOM. I think that right now what we're seeing is trying to operate on multiple tracks, trying to look at the issue of preventing harassment, not just dealing with it once it's there.

Mr. GONZALEZ. Right.

Dr. MALCOM. How do we change the culture, that is, within institutions with regard to graduate students and postdocs so that when they come through the system that they understand that this is not a good thing in terms of supporting the environment for STEM.

And the professional societies have stepped up in terms of saying that—in terms of our fields that we do not think that harassment has any place within our fields. For the disciplines themselves to say that this is not to be tolerated is a major point of movement, and we are very pleased to see that.

Mr. GONZALEZ. Fantastic. Thank you, everybody, and I yield back.

Mrs. FLETCHER. Thank you. I'll now recognize Ms. Hill for 5 minutes.

Ms. HILL. Thank you so much, Madam Chair.

Dr. Moore, the relationship between a faculty advisor and his or her students, including graduate students and postdocs, is highly imbalanced in terms of power. I'm really proud of the number of women who are entering—young women who want to enter STEM—the STEM field. This is happening in my district. We're a huge aerospace center in my district and biotechnology, and so we're seeing more and more young women who want to get into that space, but we still have these huge inequities and concerns around the balance of power.

Most STEM faculty manage that imbalance carefully and respectfully but abuse also happens with little recourse for students. If the student just quits or even if she reports through official channels, her entire career may be derailed. Minority, female, and first-generation college students are especially vulnerable.

This actually happened to a woman who has worked for me before who was in—she was working in a lab at her university, and

it was pervasive sexual harassment happening from her advisor. Many women quit, they left. Finally, they stood up and said that this was enough, they got together, they coordinated around it. It went through the entire process at the university, and at the end of the day, after going through everything, the public exposure, et cetera, the man, the advisor got 2 days off and that was it.

So direct sources of funding from fellowships such as the NSF Graduate Research Fellowship give graduate students more autonomy, but that helps just a tiny fraction of all STEM trainees. What discussions are underway about policies to better protect trainees and, more importantly, to reduce the incidence of abuse of power altogether?

Dr. MOORE. Well, I can tell you what is mandatory. We just created newly—we just made the announcement. We just hired someone at Ohio State, a new office called the Office of Institutional Equity, and it's going to focus on those very things that you highlighted. But not only that, it is now, as Dr. Malcom was indicating, a major milestone for our university. It is mandated, it is a requirement that all faculty, all staff, all students have to take mandatory training. And that's a major milestone.

And not only that, people have blind spots, and it's very inappropriate, and sometimes people, they've been socialized, they've been doing things for a long time, and they carry out in places to where it was—it was inappropriate from the get-go, and it—and they're doing it in public spaces that may isolate individuals. So we're hoping that the training and not only that this office is going—in this office, the person reports directly to the Provost because we wanted to communicate to the university community that this is a serious affair and we want it to stop.

Ms. HILL. Dr. Malcom, yes.

Dr. MALCOM. Yes. I want to also indicate that I think our agencies now are also stepping up. When at times it has been verified that there is a serious, credible allegation, removing that person from a PI responsibility from actually interacting with the rest of the space, the people in the space, I think that seeing that the National Science Foundation and the National Institutes of Health are beginning to move on those issues is a real step forward because it's sending a very different signal than we have had in the past, that in fact if you get lots of grants that the behavior might be tolerated because of the money impact that it actually has on the institution.

Ms. HILL. Thank you so much. Do any of the rest of you want to weigh in? You want to chime in? Sure.

Dr. JEMISON. I was just going to comment from the work that we're doing with the National Academies' women's study for increasing participation. One of the issues we have to talk about is that the power relationship between the faculty advisor and the candidate is so strong that it's a place where everyone should hold it as an egregious attack on the academia when faculty members abuse that position. And in fact the idea of holding their funding from the agencies accountable would make a really big difference because money does push things along. And if the agency said if you have those kinds of issues, we're not going to fund you, it would make a big difference.

Ms. HILL. So would you see a student, for example, who doesn't feel like they get proper recourse from the university or the lab itself having an ability to go to the funding source?

Dr. JEMISON. Well, I think that there should be transparency and a requirement from the funding sources to say what has been going on to show that you have procedures in place for other kinds of requirements—government requirements—that you are not harassing——

Dr. MALCOM. Other compliance.

Dr. JEMISON. Other compliance—that's the term—that you're complying with not harassing students.

Ms. HILL. Thank you. I know I'm out of time. I yield back. Thank you so much.

Mrs. FLETCHER. Thank you. I'll now recognize Mr. Balderson for 5 minutes.

Mr. BALDERSON. Thank you, Madam Chair. Thank you all for being here this morning.

Dr. Moore, thank you very much. I appreciate your time here. It's always good to see constituents.

And one of the issues that drives the skills gap we are seeing is the access to just basic broadband. We talk about broadband, but let's talk about basic broadband. As you all are certainly aware, if you lack access to the internet in 2019 you are at a huge disadvantage in developing marketable skills. Of the 24 million Americans that do not have basic broadband internet access, 83 percent live in the rural communities. Could you each talk about what your organizations are doing to ensure rural communities have an equal opportunity to succeed? Dr. Moore, if you would start, please.

Dr. MOORE. Well, first of all, thank you for the work that you do. And this is a very important topic. It's a part of our ethos at Ohio State because we are a land-grant university. And many of our extension programs work aggressively to ensure that opportunities are available to our rural constituents. In fact, all 88 counties in Ohio, they're guaranteed at least one full ride in every county in the State of Ohio.

We provide a lot of outreach, but not only that, another example of it is, as you know, that the opiates crisis has plagued many of the rural areas in the State of Ohio, and Ohio State is providing leadership to address those issues. But we know some of it is a lack of opportunities, and that's probably one of the biggest gears is to ensure that individuals have opportunities in those areas.

But not only that, with our access and affordability grant, it's ensuring that students won't foreclose on trying to come to Ohio State because they can't afford it. We're trying to make it even more affordable. So we have regional campus, we have the Columbus campus, and our regional campuses, they also—we just recently started access and affordability. It's a lot cheaper on the regional campus, and plus, we have these grant opportunities. So we want to make education accessible to our students.

Ms. WHYE. Go ahead.

Dr. ESPINOSA. Go ahead.

Ms. WHYE. I'll just talk about our Navajo Nation project. We have three schools that we're partnering with just north of Phoenix, Arizona. We provide culturally sensitive curriculum, and we

also—what we haven't talked about today a lot is the importance of a collective impact arrangement so that industry plus academia plus other companies can come together because it—not one company can do it alone. So in the case of the Navajo Nation, we've partnered with Cisco, who actually helps to bring the broadband to those schools that we're partnering with because we think that's also important.

Dr. ESPINOSA. So just to put a number to it, one in six of the Nation's undergraduate students attend rural colleges and universities, and I think this is a group that goes under-discussed and underserved. I like that you brought up the partnerships that exist between tribal colleges and universities and local business and industry as a way to serve those communities, which are often located in rural areas.

Another thing that we're doing at ACE is trying to shine a light on what are called education deserts, so these are places where educational access is limited in terms of higher education. There may be no options, there may be one or two options, and one of the two might be too expensive or out of reach for some of these students.

In addition to broadband, I think we've discussed satellite campuses, also the ability for community colleges located in these areas to have dorms where students can live. It's not common to have dorms at community colleges, but many of these deserts have that as their offering, and some of these institutions have built residences.

I'll say one more thing about the power of dual enrollment in these areas, and that's another role of community colleges, which is to provide dual enrollment for the high schools in the region, which allows those students to have a more promising path to go to the flagship in that State or a 4-year institution.

Dr. MALCOM. We fully recognize the power and the importance of technology now and how it can actually provide access that wasn't possible before. And it isn't just to rural communities, actually to urban ones as well. We have poverty places everywhere.

And I think that in our case in the case of AAAS what we have done in the past is always to try to not necessarily design for the broadband. We tried to design for the lowest, most ubiquitous technology that we can find, and that often means that you're doing things on phones because that's what people have. And I think that we need to look across the spectrum as we are really seeking the opportunities until we can get better.

Mr. BALDERSON. Thank you all very much. And, Dr. Moore, as you and I know, Beverly, Ohio, where the young lady is succeeding in getting her Ph.D. is from a very rural area, so I yield back my time. Thank you.

Mrs. FLETCHER. Thank you. I'll now recognize Mr. Casten for 5 minutes.

Mr. CASTEN. Thank you, Madam Chair. Thank you to the panel.

Dr. Jemison, I think we you an apology because with all of this talk about OSU and ASU, there has been no recognition of the Thayer School of Engineering where I got my graduate degree from at Dartmouth College. And I think particularly in this panel on in-

clusion, the historic underrepresentation on today's panel is duly noted.

On a more serious note, I served for about 10 years on the Corporate Collaboration Council at Thayer, and we were very proud of the fact that it was the first undergraduate engineering school in the country to reach gender parity. I spent 16 years as the CEO of a clean energy company and was fairly proud of the fact that merit doesn't discriminate, we didn't either and, for totally selfish reasons, we had a diverse workforce. And for totally unwelcome reasons, when you treat all people with decency, people who have not been treated with decency elsewhere give you more loyalty than you probably deserve, and there are greedy reasons to do that, and I would hope we would all do that.

I mention that not out of looking for praise acknowledging a limitation, which is that in neither of those institutions did the diversity that we had reflect the diversity of the country. It reflected the diversity of the applicant pool. And you cannot discriminate, and I'm glad you all mentioned intentionality in your conversations that we have to get to, and I want to start with Dr. Espinosa. In those higher education institutions, I had a phenomenally diverse student body that I went to school with and later, you know, had some kind of a mentorship role with. It was largely diverse in the international sense because that reflected the diversity of our applicant pool. What do we need to be doing at the primary education level to help ensure that the diversity of applicants more accurately reflects the diversity of this country?

Dr. ESPINOSA. All right. Well, it all starts there, right? It all starts where students start their journeys, which is at the primary school level. I think there's a lot more that higher education can do to reach that far down. Many admissions offices, when they are doing outreach—and I know this because I'm a former admissions officer myself—really focus at the high school level. And by the time students get to high school, they're already on an educational path that determines where they will go to college and what they will study in college. And this is especially true in the STEM disciplines.

So some of the promising activities that I've seen on college campuses include more of a focus on making sure that they're providing a pathway maybe not to their institutions, certainly to their institution but to higher education overall by focusing their activities and their outreach and the work that they do with teachers and others that serves students in these spaces, that they also focus there, in addition to the pool that they get coming out of high school.

Mr. CASTEN. Thanks. If I could sort of move up the educational chain, Dr. Moore, you made the point earlier about sort of hiring people who look like the students and helping with retention, which I wholeheartedly support. I'm curious, Dr. Jemison, given some of the diversity of institutions you've been involved with, are there any that strike you as being really sort of exceptional best practices from the higher education level at both reaching down to attract people and then making sure that we retain them?

Dr. JEMISON. So let me just sort of say that one of the issues is exposure. Having students exposed to the range of activities, the

range of things that are included in STEM disciplines. I want to comment on Dartmouth and Thayer School of Engineering not only reaching parity in the number of women engineers but actually I think one year actually more women graduated. And part of that was the kind of education that's given at the school, which has a liberal arts requirement for the engineers, and they also have a lot of projects, which really work with people seeing the application.

But I believe it's exposure. I cannot tell you of a university that necessarily does things best. I can go back and say that when universities allow students to come in on their campuses and grade school, when they're in their early high school years, it makes a difference. When programs are held that purposely include students, it makes a difference.

But the one program I want to mention was something called the Junior Engineering Technical Society, where they would bring in junior high school students to the University of Illinois at Champaign-Urbana and expose them to engineering for 2 weeks. It makes a really big difference because all of a sudden you know that these careers exist.

Mr. CASTEN. Thanks. With a little bit of time, Ms. Whye, if you could just quickly chime in then from the employer side, the applicant pool, you know, if you aren't with—intent looks a lot like those of us on this panel and—unfortunately. And there are things that Intel can do as a large company, and yet so many of our companies are small employers. What's your advice to small employers who may not have the size of your H.R. department to reach out with intent?

Ms. WHYE. Yes. So there's a saying that likes likes likes and likes also tend to hire likes. So one of the easiest things to do would be to develop an inclusive hiring methodology. And we have this inside of Intel, and what it looks like is the applicant pool is diverse and inclusive. The interviewers on the other side are also diverse and inclusive, and inside Intel you also have to post a formalized req. We find far too often that jobs are secured through the network or through tapping, so where you can formalize the structure, be inclusive in your hiring pool, to your great point, and also have diverse interviewers that's reflective of that pool on the other side, that action in and of itself has increased our ability to get a more diverse talent.

Mr. CASTEN. Thank you. I yield back my time.

Mrs. FLETCHER. Thank you. I'll now recognize Mr. Waltz for 5 minutes.

Mr. WALTZ. Thank you so much for being here today. This is a critical issue to me. This is a critical issue for my district and I think for the national security of this country.

I represent the 6th District of Florida, north Florida, and spent our Easter work period visiting Daytona Beach State College where they have a vocational and STEM training program, also Pine Ridge High School, where we had a skills forum, but then Cookman, which is a historically black college that received university status in 2007 located in Daytona Beach, and of course Embry-Riddle Aeronautical University.

I appreciate everyone's thoughts today at how to get at this and how to do this better. I just want to emphasize—again, I'm also on

the Armed Services Committee. We are dealing with a situation abroad where we need to combat extremism both abroad and at home but also our near-peer and our peer competitors in China and Russia, and STEM is critical to both.

And I have said and will continue to say that when we look at the extremism problem, where women thrive in countries abroad and in communities here where they are thriving in civil society, where they're thriving in politics, where they're thriving in business, extremism doesn't. It's squashed. So we just need to get this out of the domestic, I think, forum and get us squarely as a national security issue. I want to know if you all agree with me there, number one.

And then, number two is we're looking at the 21st century space race, which is near and dear to what we're dealing with in the Florida and also in the Armed Services Committee. We don't have a workforce and we're not creating a workforce to compete, and that is alarming. We're going from half-a-trillion dollars in our space economy to $2.7 trillion. That will be dependent on space. The average person touches space dozens of times a day and doesn't even realize it, whether it's banking, markets, navigation, you name it.

So question one for you. The Administration issued a report charting the course for success, America's strategy for STEM education. I don't know if you've had a chance to see that December 2018. If you have had a chance to see it, I'd love to know, Dr. Malcom, I see you nodding your head yes. What do you agree with, what do you think could be improved, what are your thoughts on the strategy the Administration just put out?

Dr. MALCOM. There are two major points to the strategy. One is the focus on workforce, and the other is the focus on diversity. And I would absolutely agree with both of them. I think that the major issue is, though, how do we get there. And I think pulling the pieces together across our agencies is necessary, but it's not sufficient. The STEM workforce is a national workforce, and yet we basically don't think nationally when we do this.

In Ohio, they look at The Ohio State University, but they also look at Ohio University and Akron and Toledo and all the community colleges that—to fill in that space. And I think that this notion about how do these pieces come together is the reason that I have basically focused on a strategy to try to operate at scale because we can't do this just one piece at a time. And I do hope that we will start to focus in on how that piece actually overlays with these larger issues of pulling the rest of the pieces together.

Mr. WALTZ. Do you think the report does a sufficient job at describing programmatically how the Federal Government can help and assist States get at this issue, or do you think it's lacking, or where——

Dr. MALCOM. I think that——

Mr. WALTZ. I think—where——

Dr. MALCOM [continuing]. It's not enough.

Mr. WALTZ. Federally, what can we do from this position? I understand the States have a huge role, universities, academia, local, and personally, I think that's where education decisions should be

made. But what can we do to support specifically just in the time that I have—or reinforce that we're already doing?

Dr. MALCOM. Well, I think that a lot of the programs that are already in place are—actually need to be kind of revisited in terms of how they help the institutions put the pieces together, but I also think that the business community has a major role to play——

Mr. WALTZ. Completely agree.

Dr. MALCOM [continuing]. As a partner in all of this and try to put these strategies together in a way that is really coherent. And some of that is I think part of the intention around INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) from the National Science Foundation, but again, it is necessary but it is not sufficient.

Mr. WALTZ. I think we're doing a great job here of describing the problem. I would love any follow up you could send to my office on specific solutions that you've seen that are effective or ones that we're currently frankly throwing resources at that are ineffective.

Dr. MALCOM. I——

Mr. WALTZ. I certainly welcome that.

Dr. MALCOM. I look forward to it.

Ms. WHYE. So just one specific idea, and it's in my written testimony and maybe outside the scope of this Committee, but one low-hanging fruit I believe is encouraging the Defense Department to leverage its ROTC (Reserve Officers' Training Corps) program to help build a stronger diverse workforce and tapping into that talent pool. So, for example, the Junior ROTC that serves about 500,000 students, secondary students, most often they're very diverse and underrepresented minority students. By being able to go to that talent pool and bringing STEM and IoT, Internet of Things or cybersecurity as a curriculum to those students I think is a very low-hanging fruit item.

Mr. WALTZ. I think it's a fantastic idea, and thank you for that. I yield my time.

Mrs. FLETCHER. Thank you.

Mr. WALTZ. I am over time. Thank you. I appreciate the Chairwoman's indulgence.

Mrs. FLETCHER. I'll now recognize Mr. Lamb for 5 minutes.

Mr. LAMB. Thank you. And I'll actually be happy to pick up right where you left off, ma'am, because I was just at a JROTC graduation on Saturday night in my district. I love those programs, and it's nowhere near as large or widespread as it should be. And really what I've seen in my short time in office is sometimes it's actually more privileged and well-off schools that are hosting these programs because of the resources that they have, and so they're doing excellent work, but we need to see it spread to the places that really need it the most.

So I don't know if you had anything else you wanted to say about your experience with JROTC, but what I've seen especially—and as a Marine, I hate admitting this, but the Air Force programs that I've seen are awesome because they really focus on the aerospace science at an early age, you know what I mean, and Marines don't worry as much about complicated science I guess. But go ahead.

Ms. WHYE. No, what I would just say there is back to Dr. Malcom's point about scale, and so I think what we have to do is we have to look at where we have existing infrastructure already ready there and in place for us to tap into. So for all of us in high school, there were clubs that we were all a part of, science club, math clubs, taking the curriculum that we know is important for these students to get these critical skills and moving those critical skills into those clubs until we can get those critical skills into the curriculum of K–12.

I mean, if we wanted to get it right, we could start by changing the curriculum in K–12. But absence of that, until we can catch up, we could insert that into these places like Junior ROTC, the math club, the science club.

And the students will tell you this, my experience working with Intel and our science fair, they know that more money is going to the athletic clubs in comparison to their science clubs, so I think the more we can work from that and work on that is also very helpful.

Mr. LAMB. Thank you. Dr. Jemison, I see you want to jump in. I wanted to ask a related question anyway. Before I do that, I also want to say another existing institution that I think we forget about sometimes in these discussions is the role of labor unions, which has been an enormous force for progress on behalf of people of color for a very long time. And many of these jobs are STEM jobs, you know, electricians, steelworkers, sheet metal workers.

So I know you focused a little bit, Dr. Jemison, on the role of apprenticeships and opportunities short of a 4-year degree. Have you seen what I'm talking about with the role of especially some of our more hands-on labor unions and apprentice programs in the building trades?

Dr. JEMISON. So I wanted to follow up particularly around the military and its capacity to actually train individuals who are skilled technicians and part of the skilled labor force. In fact, so many of the jobs in the military, whether you talk about in the Air Force or I know Navy Staff Sergeants, too——

Mr. LAMB. Just rubbing it in, yes.

Dr. JEMISON. But also——

Mr. LAMB. All the other——

Dr. JEMISON. But if people knew, women knew, girls knew, coming out of high school about the opportunities that are available in the military to be trained in some of these kinds of professions, it would make a big difference in the fact that those professions actually make more money than some of the ones that they're geared to. And so if the military actively recruited women into those jobs, it would make a difference and also help them to develop a pathway.

In terms of labor unions, and labor unions have been fantastic in some cases. In some cases, because of the apprenticeship program, they have been a hindrance as well because this is, again, one of those things where—what did you use, the term like and like, right?

Ms. WHYE. Yes, like and like.

Dr. JEMISON. And so we have to have the conversation with labor unions as well so that they start to broaden their focus and their view.

Mr. LAMB. Thank you. Last question also for you, Dr. Jemison, just because of your background, we found out when the White House submitted its budget this year that they thought we should cancel out the funding for NASA's Space Grants program, which is a relatively small part of the overall NASA budget, extremely small actually, and what it does is provide grants throughout the educational system to encourage people but especially underrepresented minorities, women, people of color to go in to train them to become astronauts or to study aerospace.

And we actually had a great example of this in my home State of Pennsylvania where a recipient of a Space Grant program award eventually became an astronaut just a couple of years ago, I think maybe the first female astronaut from Pennsylvania, a Penn State graduate. And so it just seemed to me like a very successful program that was working at an extremely low cost, and I was surprised that the Administration advocated that.

Are you familiar with this program at all or have you met people who have benefited from it?

Dr. JEMISON. I'm not very familiar with it. I have met people who have been involved with programs. But what I wanted to add onto that is there has been this push recently for the executive branch to pull funding for science education away from agencies, so it was going to be solidified under the Department of Education, and yet the Department of Energy, NASA, they all have very fundamentally important and powerful science education programs that have done wonderful work over the years. They cannot be replicated under the Department of Education.

So one of the things I think it's vital for us to do is to understand that these organizations offer something that the Department of Education can't, and removing the small, as you said, amounts of money from those organizations is not going to benefit the country at large. In fact, it's going to hurt.

Mr. LAMB. Thank you. Madam Chairwoman, I yield back.

Mrs. FLETCHER. Thank you. And now, I will recognize myself for 5 minutes to ask a few follow-up questions.

I really want to thank all of the panelists for being here. I think this has been one of the most informative and engaged panels, which is also why I let some of the answers run over because we really get to the interesting stuff when we hear from you and about your ideas.

For me as the aunt of a niece in high school who wants to become an engineer for—as a Representative from Houston whose second piece of office art in my office here on the Hill is the Women of NASA LEGO series that came at the same time as the Whataburger table tent from Texas, two critical items of office decor.

I am so pleased to have this group here and to hear from all of you. And I represent the energy capital of the world, and this is something I hear from companies across my district and employers across my district, that there is a real need for people in STEM fields and that we need to be bringing our students along, that we

need to have an emphasis on basic science and very advanced science, and that's what we do in my district. So I've been really interested to hear all of your ideas.

And, Ms. Whye, you talked a little bit about partnerships. I wrote lots of notes about these important words, partnerships. Dr. Moore, you talked about the ecosystem and, Dr. Jemison, you talked about teachers and mentors. Dr. Malcom, when you were talking about the agencies, Dr. Espinosa, all the ideas of these interesting ways we all need to work together, and I think that that's a critical theme.

So knowing that we just have a few more minutes I was actually going to ask about the ROTC idea because that is such a great idea, and so I want to make sure that there's nothing that you all had in your written testimony that we haven't covered today that you would recommend as best practices or policies that we should hear and keep in this record of our hearing, any ideas of things that you didn't get to touch on in the questions already that you would recommend, especially for my district from companies to be able to broaden STEM participation. That continues to be a critical, critical issue. But anything else that anyone wants to add in terms of partnership ideas or final thoughts, I welcome those.

Dr. JEMISON. I just want to make a comment about public-private partnerships. I've worked with Bayer Corporation for over a decade on their Making Science Make Sense program, which is about science literacy. And they have created curriculum-changing programs like ASSET, but also programs that look at skilled education like the Bay Area Biotech Partners, which started with at-risk students in Berkeley, and these students graduated as certified biotechnicians. At-risk meaning that they were not expected to graduate. But these are the things that can happen with public-private partnerships.

And, as Ms. Whye said, it wasn't just about Bayer. It then started to encompass all of the biotech companies in the Bay Area. So there is a rich capacity of companies to participate across the spectrum from K–12 all the way into college and postdoc.

Mrs. FLETCHER. Thank you.

Ms. WHYE. I'll just call out one more and kind of staying with the collective impact arrangement because I think it's important for—in the private partnerships and also in the industry, the academia partnerships. It's also important for those partnerships to align toward a very specific outcome and also put in the diligence to have an owner, whether it's one of the companies, or if it's a third-party organization that is responsible for helping those partnerships come together and align around a very specific set of measurements and making sure that they're meeting on a cadence that they can go back and track those measurements to make sure they're getting that work done.

One such partnership that we have right now is called the Reboot Representation. This is kicked off by Melinda Gates and her organization called Pivotal Ventures. In that is multiple companies, but we're all working toward doubling the number of women of color in computer science degrees by 2025.

Now, each of us may do different parts and bring in different dollars, but the machine is going toward the same destination. And

I think sometimes in the partnerships, the partnerships are going in different directions, so we need to partner with a specific outcome on the other side. And in that partnership, by pooling all the resources together, you can then choose the right proposals that can push you toward the right outcome.

Mrs. FLETCHER. Thank you. Anybody else?

Dr. ESPINOSA. I would just add in terms of partnerships, we have a very extensive discussion of public-private partnerships in the report that I talked about today. We also talk about incenting institutions to partner with one another, and that's really important when it comes to graduate education. And the reason we did this work on minority-serving institutions is because that's where the students of color are.

So if we want to see more students of color in these graduate programs that we've touched on today, we need to create a pathway, and many institutions are doing this already, but really incentivize the pathway to the doctorate coming out of not only the 4-year minority-serving institutions but starting with community colleges, which is really where the majority of students of color enroll. So it's also the connectivity across the institutions where they can further learn from one another in undertaking this effort, so that would mean creating consortiums and collaborations so that that learning is taking place.

Mrs. FLETCHER. Thank you very much. I see that I've gone over my allotted time, so before we bring the hearing to a close, I want to thank you all again for testifying before the Committee today.

The record will remain open for 2 weeks for additional statements from Members and for any additional questions that the Committee may ask of all of you as the witnesses.

You are now excused, and the hearing is now adjourned. Thank you.

[Whereupon, at 12:19 p.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Mae Jemison

Dr. Mae Jemison Responses to Questions
U.S. House of Representatives Committee on Science, Space and Technology
Achieving Promise on Diverse STEM Workforce
May 9, 2019

Chairwomen Eddie Bernice Johnson

1. **Much of the discussion about diversity in STEM is focused on increasing representation of women and minorities. Can you speak to the unique challenges facing LGBTQ students, researchers, and STEM workers? What more can be done at universities and in government and private sector workplace settings to improve recruitment and retention of gender and sexual minorities in STEM?**

The research shows that LGBTQ+ students, researchers, and employees often face biases and systemic barriers in STEM. Interestingly, studies reveal that much of the overarching issues, biases and systemic barriers that serve to hinder LGBTQ individuals echo, to some extent, those that decrease participation and advancement of women and minorities in STEM. Yet, the intersections of differences from the stereotypical "STEM norm" – i.e., race, ethnicity, gender, sexual identity, economic status, disabilities also lead to unique challenges and obstacles as well. One longitudinal study of national survey data indicated that male sexual minority students were less likely to persist in STEM fields compared to their male heterosexual peers[1].

The research suggests that the stereotypical image of STEM as an occupation dominated by heterosexual, White, men of higher socioeconomic status[23] can make LGBTQ+ individuals feel unwelcome in STEM environments and steps that educational institutions and employers can take to improve recruitment and retention of gender and sexual minorities. These efforts will likely benefit other groups (White women, women of color, men of color, persons with disabilities, first generation college educated, etc.) as well:

a) ***Change the image of STEM fields***. People with multiple identities that do not match the heterosexual, White, abled-bodied male stereotype in STEM may be at heightened risk for feeling unwelcome in STEM environments. Research as demonstrated that emphasizing to students that people from all backgrounds can be successful in STEM,

[1] Hughes, B. E. (2018). Coming out in STEM: Factors affecting retention of sexual minority STEM students. *Science Advances, 4*, eaao6373.
[22] Fiske, S. T. (2010). Envy up, scorn down: How comparison divides us. *American Psychologist, 65*, 698-706. doi: 10.1037/0003-066X.65.8.698
[3] Kay, A. C., & Jost, J. T. (2003). Complementary justice: effects of" poor but happy" and" poor but honest" stereotype exemplars on system justification and implicit activation of the justice motive. *Journal of personality and social psychology, 85*, 823-837. doi: 10.1037/0022-3514.85.5.823

and that STEM can be used for the benefit of communities and social good, can improve interest and sense of belonging in STEM among underrepresented groups. The media has an important role to play in changing the image of STEM fields. Research has shown that better representation of diversity in STEM on TV and in media writ large can lead to greater interest and sense of belonging in these fields[4].

b) ***Improve diversity and inclusion in STEM, generally***. Preliminary research suggests that better representation of women in STEM is associated with greater inclusion of those who are stereotyped as not conforming to gender roles. In one study, LGBTQ+ scientists working in STEM fields were more likely to disclose their identities to their colleagues in more gender balanced departments.[5]

c) ***Raise awareness of bias*** towards multiple groups and enhance recognition of the specific biases directed towards women with multiple intersecting identities[6]. Previous work has found that raising intersectional bias awareness in college classes can encourage positive changes in attitudes and beliefs[7].

d) ***Create inclusive policies and practices.*** There are many things that institutions can do to improve the experiences of LGBTQ+ students, particularly for trans students[8]. One thing institutions can do is to make information about accessibility available online. For example, if an institution has single-user restrooms that are able to be used by all genders, then this information should be publicly noted on the institution or department website. Additionally, if institutions have a summer research program where students live on campus, information on how housing is divided up (by legal sex, by gender, or private rooms) may encourage trans students to apply for research experiences[9]. Institutions can also do more to signal inclusivity on applications for undergraduate, graduate, and faculty positions. For example, if an institution asks about gender on an application, they can use inclusive terminology, such as "woman, man, non-binary, self-describe" and if legal sex is required, institutions can explain why the information is needed. Additionally, applications can ask for both legal and preferred names and specify if decision letters will be send to permanent addresses, which may impact the name a candidate chooses to use. Lastly, institutions can provide links to

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[4] Steinke, J., Lapinski, M., Long, M., Van Der Maas, C., Ryan, L., & Applegate, B. (2009). Seeing oneself as a scientist: Media influences and adolescent girls' science career possible-selves. *Journal of Women and Minorities in Science and Engineering*, 15, 279-301. doi: 10.1615/JWomenMinorScienEng.v15.i4.10

[5] Yoder, J. B., & Mattheis, A. (2016). Queer in STEM: Workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers. *Journal of Homosexuality*, *63*, 1-27. doi: 10.1080/00918369.2015.1078632

[6] Curtin, N., Stewart, A. J., & Cole, E. R. (2015). Challenging the status quo: The role of intersectional awareness in activism for social change and pro-social intergroup attitudes. *Psychology of Women Quarterly, 39*, 512-529. doi: 10.1177/0361684315580439

[7] Case, K. A. (2017). Toward an intersectional pedagogy model: Engaged learning for social justice. In K. A. Case (Ed.), *Intersectional pedagogy: Complicating identity and social justice* (pp. 1-24). New York, NY: Routledge.

[8] https://twitter.com/EmLedd1/status/1135379381587763200

[9] E. Krum, Tiana & Davis, Kyle & Galupo, M. (2013). Gender-Inclusive Housing Preferences: A Survey of College-Aged Transgender Students. Journal of LGBT Youth. 10. 64-82. 10.1080/19361653.2012.718523.

local resources that are relevant to LGBTQ+ students, which may be as simple as providing a link to the school's LGBTQ+ center website[10].

e) ***Carry out additional research.*** There is a dearth of research on the experiences of sexual minorities in STEM. Without the ability to rigorously assess the status of LGBTQ+ individuals in STEM, or to examine whether the representation of particular groups expanded with the introduction of a certain initiative or policy, institutions and employers lack accountability for promoting the inclusion and advancement of all people. This lack of data perpetuates underrepresentation. One caveat to add however, it is essential that research carried out on 'minoritized', marginalized groups is done in a manner that protects research participants. If anonymity cannot be guaranteed, the research methodology must be revised to do so.

2. **A big concern for me when discussing what is needed to expand access to STEM studies and careers is how can we better support students and scientists with disabilities. The barriers persons with disabilities face can vary widely depending on their individual needs and the field of research they are in. Can you talk about the unique challenges facing persons with disabilities in the STEM workforce? What more can we be doing to support students and scientists with disabilities in STEM?**

My answer to this question is similar to the one above. We know that persons with disabilities face unique challenges, however, we definitley **need more research** to better understand the factors that serve as barriers and facilitators to participation in STEM. This research must be conducted in a fashion that protects individuals. In some instances, the pool of STEM professionals with disabilities may be so small that it is not possible to conduct research using conventional research approaches without exposing the identity of respondents to surveys or interview protocols. Any research on the representation or experiences of persons with disabilities in STEM must ensure that research participants' anonymity is protected.

Changing the stereotypical image of STEM fields will likely also improve interest and sense of belonging in STEM fields among persons with disabilities, as will **creation of formal inclusive and anti-discrimination policies** and **raising awareness of bias**. As long as most people hold a view, implicitly or explicitly, that scientists are, or should be, white, heterosexual, able-bodied men, from privileged socioeconomic backgrounds, all other groups (persons with disabilities, white women, women of color, men of color, LGBTQ+, and the first generation college educated) will not only feel unwelcome, and even threatened, in STEM environments, many of

[10] https://www.campuspride.org/tpc/

their colleagues may rationalize the broad systemic biases against them and for the 'STEM norm'.[11,12,13]

One practical way to make STEM more inclusive for students with disabilities is to include universal design criteria and accessibility components in all STEM funded projects[14]. When funding grant proposals, program officers could ask if the project incorporates elements of universal design so that the products and environments will be usable by all people without the need for adaptation. This includes, but is not limited to, accessible web design that is compliant with web accessibility standards, accessible instructional materials, and purchasing information technologies that are accessible or can work with assistive technology.

Congressman Daniel Lipinski

1. **As you might know, I'm a long-time champion of promoting tech transfer of innovations developed through fundamental research, such as the I-Corps program. One barrier I've heard from students and institutions of higher education in my district is that scientists and engineers from underrepresented groups, especially nontraditional students, might not have a financial safety net or family situation conducive to take the risk of pursuing tech transfer through entrepreneurship.**
    - **What more could the federal government do to support researchers from underrepresented groups, particularly students, who may want to translate their results and discoveries into new products or services?**

Important aspects of federal programs that outreach to and fund grants/contracts to small businesses for translating and applying basic research and IP to daily life should be created, fostered and/or extended. SBIR and STTR programs in various agencies should consistently reach out to these underrepresented and non-traditional groups even while they are still in academia. Programs like NASA NIAC should be funded fully and make concerted, robust efforts to inform groups or opportunities. Include the SBA in formulating opportunities and collaborations that will help alleviate the pressures associated with entreprenuership. In additions steps to decrease the financial burdens that result from post secondary education and graduate schools would be of major benefit. The federal government can move to make

[11] Fiske, ST. (2010). Venus and Mars or down to Earth: Stereotypes and realities of gender differences. *Perspect Psychol Sci* 5(6): 688—692.
[12] Cuddy, A. J. C., Fiske, S. T., & Glick, P. (2007). The BIAS map: Behaviors from intergroup affect and stereotypes. *Journal of Personality and Social Psychology, 92*(4), 631-648.
[13] Dixon, J. C., & Rosenbaum, M. S. (2004). Nice to Know You? Testing Contact, Cultural, and Group Threat Theories of Anti-Black and Anti-Hispanic Stereotypes. *Social Science Quarterly, 85*(2), 257-280.
[14] Duffey, T. (2007). Supporting Students with Disabilities in Post Secondary STEM.

student loans more affordable, allow for loan forgiveness as well as providing direct assistance to STEM majors through scholarships and funding internships in national labs and agencies.

2. **This Committee has taken steps to make graduate study more accessible to a broader array of students at some of our nation's finest research institutions. I applaud my colleagues' work on this issue, including the recent introduction of the STEM Opportunities bill. But I also know that there are many smaller Minority- and Hispanic- serving institutions in my home state of Illinois (such as Northern Illinois University, and Saint Xavier University, the College of DuPage, and Morton College). These schools have developed tremendous support systems to meet students where they are and help them succeed, regardless of their life situation.**
    - **In addition to efforts to make our institutions biggest research universities more accessible to students from diverse backgrounds, what else can we do to build up research programs at these smaller emerging research institutions? In effect, this would be bringing the research to the students, and meeting them where they are.**

Minority serving institutions (MSIs) have long provided pathways to educational success and workforce readiness for millions of nontraditional students and students of color. However, these institutions have been largely overlooked for their contributions to STEM education and workforce. This committee can assist MSIs by increasing local and national partnerships between MSIs and business, industry, and state and federal governments, as well as with other MSIs and non-traditional MSIs. This increase in partnerships will provide more funding mechanisms, research opportunities for students, as well as increased collaboration. These partnerships also create more opportunities for students to receive mentoring, internships, and apprenticeships to prepare them for the workforce.

This committee can also call for an expansion of grant programs support modernization of laboratories, classroom technology, research facilities, and work-based learning programs at MSIs. Given that MSIs have fewer financial resources, a sustained investment in creating competitive STEM environments for students to learn can help prepare students at MSIs for future STEM careers.

3. **The higher education system is built for full time, resident students which disadvantages non-traditional students, especially in STEM fields with demanding in-person laboratory requirements. How can the federal government build financial supports that specifically address the needs of first generation college students, financially disadvantaged students, and students with dependents within a higher education system built for full time, resident students?**

The federal government can provide increased resources for students by increasing need-based financial aid programs for students, such as Pell Grants. These could include scholarship programs tied to STEM retention and capacity building aid for MSIs. Additionally, increasing

federal funding for sponsored research experiences provide opportunities for financially disadvantaged students to gain research experience.

4. **Many higher education institutions are under increasing financial pressure, especially those that are emerging research institutions that serve underrepresented groups. What is the role of the federal government in continuing to support STEM departments which are costly to operate but address critical workforce needs?**

The federal government plays a critical role in sustaining and strengthening STEM departments, particularly through their research grants. Funding agencies should do an inventory of their grantees and provide greater resources to those institutions that are under-resourced. This would expand upon STEM research programs and would increase the capacity of these under-resourced institutions to prepare their students for the STEM workforce. Given the proven return on investment in publically sponsored research and its role in generating and sustaining the STEM workforce, there is no doubt that this support is critical for the future of STEM and the research enterprise.

Congresswoman Haley Stevens

1. **In March, the first spacewalk to be conducted by all women was cancelled because the International Space Station did not have enough available spacesuits in the proper size.**
    - **How important is it for young women to see tangible and remarkable achievements like an all-woman spacewalk?**
    - **What message does it send to young girls that NASA failed to provide the necessary equipment for its female astronauts to do their work?**
    - **More broadly, can you speak about the importance to young women, and young people of color, of seeing role models in fields and positions that these young people may aspire to someday?**

It is important and instructive to understand how the availability of the right size spacesuits became an issue. Yes, the proximate cancellation was due to not having the desired size suit prepped on board and it would have caused a significant hit to the ISS schedule to prep a second smaller suit. This resulted from one of the women had 'made do' with a larger suit during ground training, but found a smaller size more suitable on orbit. But a more foundational concern is that much earlier, in the late 90's early 00's a move was made to decrease the sizes of available spacesuits. The sizes that were dropped were the smaller sizes, which meant that a number of female astronauts would be excluded from EVA (spacewalks) for lack of equipment that fit. Larger, taller women astronauts worked to accommodate themselves in equipment that was built and sized for males. That decision itself sent a

deafening message to women. The message, though perhaps not intentional, is still clear—women while included, are still somewhat coincidental and not foundational to exploration and space. There are 'boy jobs' and 'girl jobs'; and girls will be accommodated secondarily. This is in the face of an astronaut program that has seen, in fits and starts, some exceptional work in including women in its ranks.

It is important that young women see themselves represented in all facets of STEM, research, leadership and exploration. And it is also critical that the gatekeepers of these areas, who are unfortunately mostly still male, see women's accomplishments. The importance is yes what is aspired to, but research has shown that the sense of belonging is critical to enduring in STEM.

2. **In your testimony you highlight several barriers women in STEM face. Included in this list is "less access to mentoring" and "higher service expectations."**
    - **With so few women in leadership positions, how can we balance the need for these women to serve as mentors and role models and to make their voices heard on important committees, with the risk of putting too much of the service burden on them?**

Women leaders may put additional time into mentoring underrepresented students, creating a larger service burden on these individuals[15,16]. Additionally, underrepresented leaders may be disproportionately asked to mentor by underrepresented mentees who perceive them as more effective than non-race or gender matched mentors or colleagues. It is important that universities and workplaces value and reward the women for the time and effort that is put into mentoring. Not just make it 'housework' the women have to do, but goes 'unpaid and not counted economically' so to speak.

However, mentors from all backgrounds can do more to be good mentors for women. By working to acknowledge identities of their mentees and understand the research describing the impact of social identities on students' experiences in STEM, mentors from all background can take on the service of mentoring women in STEM[17,18,19]. Research on women in cross-gender and same-gender workplace mentoring relationships suggests that there may be more

15 Armstrong, M. A., and J. Jovanovic. 2017. The intersectional matrix: Rethinking institutional change for urm women in stem. Journal of Diversity in Higher Education 10(3):216-231.
16 Xu, Y. J. 2008. Gender disparity in stem disciplines: A study of faculty attrition and turnover intentions. Research in Higher Education 49(7):607-624.

17 Brunsma, D. L., D. G. Embrick, and J. H. Shin. 2017. Graduate students of color: Race, racism, and mentoring in the white waters of academia. Sociology of Race and Ethnicity 3(1):1-13.
18 McCoy, D. L., R. Winkle-Wagner, and C. L. Luedke. 2015. Colorblind mentoring? Exploring white faculty mentoring of students of color. Journal of Diversity in Higher Education 8(4):225.
19 Prunuske, A. J., J. Wilson, M. Walls, and B. Clarke. 2013. Experiences of mentors training underrepresented undergraduates in the research laboratory. CBE—Life Sciences Education 12(3):403-409.

important factors that predict mentorship outcomes than gender similarity[20]. For example, when women felt comfortable with their male mentor, they reported similarly positive mentoring experiences as did women with female mentors.

However, these dynamics are different for women role models. People with multiple identities that do not match the heterosexual, White, abled-bodied male stereotype in STEM may be at heightened risk for feeling unwelcome in STEM environments. Research as demonstrated that emphasizing to students that people from all backgrounds can be successful in STEM, and that STEM can be used for the benefit of communities and social good, can improve interest and sense of belonging in STEM among underrepresented groups. The media has an important role to play in changing the image of STEM fields. Research has shown that better representation of diversity in STEM on TV can lead to greater interest and sense of belonging in these fields[21].

20 Allen, T. D., R. Day, and E. Lentz. 2005. The role of interpersonal comfort in mentoring relationships. Journal of Career Development 31(3):155-169.

[21] Steinke, J., Lapinski, M., Long, M., Van Der Maas, C., Ryan, L., & Applegate, B. (2009). Seeing oneself as a scientist: Media influences and adolescent girls' science career possible-selves. *Journal of Women and Minorities in Science and Engineering*, 15, 279-301. doi: 10.1615/JWomenMinorScienEng.v15.i4.10

Responses by Dr. Shirley Malcom

Chairwoman Johnson's Questions

Johnson Question 1: Discrimination has no place in science and denying opportunities in STEM is a terrible waste of talent. AAAS has been concerned about education and career challenges for LGBTQ students, researchers and STEM workers for decades. The Association passed a resolution opposing discrimination against "sexual minorities" in 1975. In 1981, I authored an article that appeared in Science Magazine entitled, "Who Are the Gay Scientists?" This article related findings from a campaign by scientists, engineers and health professionals from LGBTQ communities to add non-discrimination on the basis of sexual orientation to requirements for job advertisements placed in the journal. At that time major concerns were focused on difficulties being encountered by LGBTQ scientists and engineers in receiving security clearances for employment in the federal government.

Almost 45 years later we continue to struggle to provide opportunities to LGBTQ students, researchers and STEM professionals. They share many of the same challenges faced by other underrepresented groups in STEM, such as bias in the classroom or within their programs that can lead to lower levels of retention in STEM for LGBTQ individuals who had declared an intention to major in these fields (Hughes, 2018). There have been reports of bias in program admission, hiring, career development opportunities and advancement. Contrary to the popular stereotype of LGBTQ affluence, LGBTQ people are more likely to be in poverty than non-LGBTQ people overall, and LGBTQ people continue to face persistent and pervasive discrimination in employment, housing, educational, and other important settings (Pizer et al., 2012). Because some students become estranged from families with disclosure of their sexual orientation and/or gender identity, they may share financial hardships like those experienced by students from households in poverty regardless of their families' situation. Moreover, as with many students with non-apparent disabilities, LGBTQ students may be reluctant to disclose due to concern about explicit and implicit bias, leading to other socio-emotional challenges.

A few organizations work to address some of the needs for advocacy, financial support and connection to employers and workplaces that may offer safe and supportive environments, such as our AAAS affiliate, the National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP). In addition, NOGLSTP recognizes scientific and technical achievement by members of LGBTQ communities and offers mentoring and support to students. But organizations are not able to take on these issues at scale. Colleges and universities as well as a number of business and industry employers support affinity groups to combat isolation and promote positive collective action.

These worthy actions are all good. But more can be done, and more needs to be done. At present we can still ask, "who are the LGBTQ scientists?" We lack the data to help us fully understand the barriers faced by LGBTQ STEM students, researchers and professionals. Without these data it is difficult to undertake interventions or propose policies and strategies to address the greatest barriers; and it is likewise difficult to make the case for programmatic support and funding for efforts when data are not there. We have participated in meetings with the leadership of the National Center on Science and Engineering Statistics at the NSF, and we are aware of their interest in and engagement around collecting these data through national STEM workforce surveys. As with collection of any personal data we understand the sensitivity and deliberateness with which this process must be undertaken.

Fortunately, a number of governmental agencies have already been collecting sexual orientation and gender identity information in federal surveys for many years (some since the 1980s), and the Federal Interagency Working Group on Improving Measurement of Sexual Orientation and Gender Identity in Federal Surveys has concluded that sexual orientation or gender identity items in such surveys do not elicit higher non-response rates or survey breakoff than other sensitive questions, such as household income. The Working Group also concluded that respondents are able to willingly and accurately respond to sexual orientation and gender identity questions, and the options such as 'I don't know' or 'I do not

wish to respond' are always available for those who do not wish to provide the information (*Freeman, Romero, & Durso, 2018*).

All this is to say that collecting comprehensive, nationwide data on LGBTQ students and professionals in STEM is highly feasible through NSF NCSES surveys. And the need for this information is high. We need more information to support action to recruit and retain LGBTQ individuals in STEM. And we need more information to allow us to better understand disparities and disadvantages of LGBTQ people in STEM, including career or educational barriers, and to develop strategies to address them. Having data allows universities, government and workplaces to put systems of accountability in place.

Within SEA Change we have wanted to consider impacts on members of marginalized groups other than women, minorities and women of color, such as individuals with disabilities and those from LGBTQ communities; but we too have been challenged by the absence of data in an initiative designed to support data-driven transformation. Believing that fairness and transparency will help members of all groups, we press forward, urging institutions to look closely at how their programs and their climate are experienced by different populations.

There is also concern about the erosion of rights and opportunities to address grievances among LGBTQ STEM students, researchers and workers. Bias, incivility and harassment in STEM remain as issues. We need a greater understanding of how these are experienced by LGBTQ individuals so that we may put strategies in place to address them.

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"Who Are the Gay Scientists?"https://science.sciencemag.org/content/213/4512/1100.1

Hughes, 2013: https://advances.sciencemag.org/content/4/3/eaao6373

Pizer et al. (2012), Evidence of Persistent and Pervasive Workplace Discrimination Against LGBT People, 45 Loy. L.A. L. Rev 715

Freeman, Romero, & Durso (2018), Comment to NSF, Federal Register Doc. 2018-12622. https://williamsinstitute.law.ucla.edu/wp-content/uploads/NSF_NSCG_Comment.pdf.

Johnson Question 2: AAAS has a long history of work to increase opportunities for students and scientists with disabilities. In 1975 AAAS extended its diversity, equity and inclusion efforts and advocacy to include persons with disabilities, and in 1976 AAAS was the first science professional organization to make its Annual Meeting fully accessible to persons with disabilities.

While, over time, federal laws required access to programs, real access to STEM could only be achieved with the removal of physical AND attitudinal barriers and the emergence of critical technological resources. Persons with all kinds of disabilities have been supported by personal computing and adaptive technology to accomplish work even where there were sensory or motor impairments. This technology and other accommodations are critical influences to the success of students and scientists with disabilities in the classroom, laboratory and workplace.

Because of these technologies, there are scientists and engineers with disabilities in virtually every field. But despite this fact, there is the current challenge of the "invisibility" of disabilities, apparent and non-apparent, as an issue when discussing diversity, equity and inclusion.

We have more technological resources than we ever did before, but we still have attitudinal barriers, implicit bias, lower expectations, etc. And given concerns about bias, it is also the case that some individuals do not disclose, making it difficult to provide support that might enable them in their work. On the other hand, with the possibility of bias, can we blame them?

More opportunities are needed for students, such as those that the AAAS Entry Point! initiative has provided, to be involved in research and internships and co-op programs, where they can gain a job history and have a "safe and supportive " way to acquire job skills and see what, beyond content knowledge, is required to be successful. We need to be able to help hiring managers, faculty members and potential mentors navigate this space—a place to express and address personal concerns about working with and mentoring students with disabilities. Entry Point! has provided a bridge between students and employers, not only qualifying students and facilitating placement (matchmaking), but also supporting students and managers alike as they confront bias in the workplace. Specific actions that can support students and scientists with disabilities include:

- Supporting the specific inclusion of students with disabilities within programs such as NSF's Research Experiences for Undergraduates and within the larger broadening participation agendas of the federal agencies and departments.
- Ensuring that support continues to be made available in grants and supplements for adaptive technology and other accommodations for students and scientists.
- Continue, as this committee has, to make visible the issue of scientists and engineers with disabilities and to make STEM students and professionals more visible, as role models and existence proofs, confirming that is possible to contribute to and succeed in any field.

Representative Lipinski's Questions

Lipinski Question 1: As you have heard from your constituents, a lack of a financial safety net and family constraints make it difficult to for many to pursue tech transfer through entrepreneurship. Leveling the playing field for translating research results into new products and services is critical because invention and innovation are the pathway to individual financial security, community development, and creating a robust national economy. There is a clear relationship between parental wealth and a student's likelihood of becoming an inventor. There are also clear discrepancies by gender and race/ethnicity, even when differences in interest and proficiency on academic tests are accounted for. There is no one cause of these inequities, rather it is a multifaceted problem that calls for a multifaceted solution. But finding solutions is critical for the future of our nation. As the *Lost Einsteins* study found "if women, minorities, and children from low-income families were to invent at the same rate as white men from high-income (top 20%) families, the rate of innovation in America would quadruple."

First, students from wealthier families have the financial security to absorb the financial risk inherent in developing a new product or service. Second, students from families with fewer economic resources often have greater family responsibilities and work more hours than students from wealthier families. Additionally, students from lower resourced communities often attend poorly resourced K-12 schools, have few academic supports in their neighborhoods, and tend to have few opportunities to learn the knowledge and skills to conduct research or translate research results into practical application. Third, there are fewer women and underrepresented minorities (e.g., Blacks, Latinx, Native Americans, individuals with disabilities) in the world of translational research or who are entrepreneurs. This means there are fewer role models for students from these communities, and a smaller network of individuals who can mentor and connect new entrants. Finally, there is a clear bias in access to venture capital. In 2018, female founders raised just over 2% of the total venture capital invested, and less than 0.01 percent was raised by Black females. These numbers are not surprising because only 8% of the senior investors at venture capital firms are women, and only 2% are a race/ethnicity other than White or Asian.

We recognize that technology transfer offices are essential for higher education institutions to support student research translation, invention, and entrepreneurship. Technology transfer offices typically serve student and faculty innovators by providing a wide-range of intellectual property and commercialization services that span the research & development continuum. They serve students and faculty by assessing and building upon the commercial potential of new ideas and inventions. Technology transfer offices typically have regional and national networks of experts, industry partners, and potential commercial partners that they can leverage. Many offices also state that they strive to promote an inclusive culture of global citizenship by exploring issues of access to invention and innovation by resource-limited countries and supporting students and faculty from all backgrounds. Students and faculty benefit from the time, financial support, training, and resources that the technology transfer offices provide. However, not all institutions have technology transfer offices or the resources to sustain one.

Institutions with technology transfer offices tend to be research institutions with large research and development budgets that are serving predominantly white student populations. This leaves many talented students in other universities at a disadvantage. The federal government could help level the playing field by providing minority-serving institutions and institutions with less research capacity (e.g., labs, equipment, funding, industry connections) and opportunities in several ways:

- The I-Corps has been successful in supporting efforts by research teams with NSF funding to translate their research findings into new products and processes. The program could be augmented, broadened and strengthened by:
    - Developing a track for students to access the training and resources it provides.
    - Expanding mentoring, resources, and connections to support I-Corp team members to move from customer discovery to initial launch stages. Even large research universities with technology transfer offices have struggled to help I-Corp teams continue the momentum that I-Corps teams generate through the program.

- Federal small business innovation research grants have been an important source of support for driving invention and entrepreneurship. A specific focus on supporting students from minority-serving institutions and institutions with less capacity to support invention and entrepreneurship could open doors for students that would otherwise not have the opportunity for the translation of their research into a product.

- To support underrepresented groups, especially nontraditional students, who often do not have a financial safety net needed to take the risk of pursuing research translation through entrepreneurship, the federal government could establish more fellowships and scholarships to support the researchers from underrepresented groups, particularly students, who may want to translate their results and discoveries into new products or services. In addition, the changes to work-study programs that allow students to be paid to work at their own start-up would be a game changer.

- The federal government could also support regional partnerships among institutions with technology transfer offices, local industries, and minority-serving institutions or institutions with smaller R&D budgets. Such partnerships could encourage federally-funded research equipment be made available to underrepresented students and recent graduates at low cost/no cost.

- Access to funding for underrepresented students and networks that can provide connections to potential funders remains an issue. To address this issue the federal government could provide grants to support underrepresented groups in participating in networking and funding programs such as Springboard, DOD defense conference, or others.

- Transparency in the venture capital, invention, and entrepreneurship funding sector is needed to drive change. Given the significant bias that underrepresented groups face in securing funding, it would be beneficial to create database that lists inventors, organizations, and programs that support research translation, invention, and entrepreneurs. The database should include the gender and racial/ethnic make-up those with funding authority and the percent of funds provided to women or minority owned businesses.

In addition, there are gaps in our understanding of the barriers that female and minority students face in pursuing their passion for invention and entrepreneurship. We need more research to improve our understanding of the key impeding factors so that we can ensure that federal dollars are directed appropriately.

Lipinski Question 2. There is a great deal of research to support what you have observed about the importance of minority-serving institutions (MSI). There are many types of minority-serving institutions, including those with historical designations to support specific groups (Historically Black Colleges and Universities and Tribal Colleges and Universities) and those designated based as such by the Department of Education (Hispanic-Serving Institutions, Asian American and Native American Pacific Islander-Serving Institutions, Predominately Black Institutions, Alaska Native-Serving or Native-Hawaiian -Serving Institutions and Native American-Serving NonTribal Institutions). The institutions are public and private, rural, urban, and suburban. Their enrollment ranges from a few hundred to tens of thousands. The students at the institutions are equally heterogenous in terms of race, ethnicity, age, economic background, and family history in academia. The institutions also employ more diverse faculty and leaders who are equipped to meet their students where they are while holding to the high academic standards of the institution.

The National Academies of Sciences, Engineering, and Medicine released an in-depth study of such institutions earlier this year – *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. Notably, the study indicates that:

> *"more undergraduate students (from all backgrounds) are enrolled in STEM fields at four-year [Minority-Serving Institutions (MSI)] than at four-year non-MSIs, and when taken together, Historically Black Colleges and Universities, Hispanic Serving Institutions, and Asian American and Native American Pacific Islander-Serving Institutions produce one-fifth of the nation's STEM bachelor's degrees."*

In addition, the study found that contributions of STEM graduates from MSIs is on par with the contributions to STEM graduates from non-MSIs in terms of publications, graduate degrees, and income mobility. The effectiveness of MSIs has occurred in the face of historical inequities in funding and resources. For example, they are underrepresented among federal R&D grantees and infrastructure funding. The National Academies study states that "MSIs are working with fewer resources than are non-MSIs, despite enrolling a high percentage of nontraditional and low-income students. Moreover, MSIs have fewer options to raise tuition and fees to offset expenses." The study notes two key barriers to MSI's reaching their full potential for supporting students pursuing or interested in earning a STEM degree:

- Limited opportunities for students to engage in authentic, high-quality undergraduate research experiences; and
- Access to state-of-the-art equipment and facilities.

To address these barriers the Federal government can expand and establish new programs that support public and private sector partnerships with MSIs. These partnerships should leverage the MSIs unique assets, including a diverse student body, successful recruitment/hiring/retention of diverse faculty and leaders, student supports, and inclusive campus cultures. The government could support new partnerships by supporting regional workshops that bring MSI leadership, federal grant officers, Federally Funded Research and Development Centers, National Labs, private industry, and leaders at large research universities to establish regional consortia or partnerships. Along with creating partnerships and consortia to leverage existing research capacity and equipment funded by the federal government, federal agencies should also consider increasing support for MSIs to enhance their R&D capacity and undergraduate research opportunities. In addition, to account for the fact that many MSIs are substantially under-resourced and struggle to effectively compete for large multiyear grants and contracts the federal government agencies should assess opportunities to make 'competitive' grant process more competitive by:

- Offering seed or planning grants to MSIs to enable them to develop the resources and knowledge needed to effectively apply for funds
- Funding organizations or regional experts to offer training programs and guidance to MSI grant offers and faculty who apply for funding
- Supporting research into effective MSI strategies to support diverse students and faculty, to contribute to local and national workforces, and create inclusive campus climates.
- Adjust incentives and funding streams that support MSIs' efforts to develop sustained capacity to expand their science research and development capacity. Incentive to develop sustained capacity could be increased by providing tax exemptions to local industry for construction of research facilities and purchasing laboratory and training equipment. Directing a larger fraction of existing programs such as EPSCoR to infrastructure rather than people would also drive institutions to invent in resources that will remain in the state and institution.

Each year AAAS, in partnership with NSF, hosts the Emerging Researchers National Conference in Science, Technology, Engineering, and Mathematics, which targets graduate and undergraduate students who participate in NSF funded programs, including underrepresented minorities and persons with disabilities. Conference participants include a significant proportion of students from minority serving institution. The conference provides participants with opportunities to enhance their science communication skills, learn about science careers, identify financial support, and network with their peers and STEM leaders. Engaging the conference exposes students to experiences, opportunities, and resources not readily available at their college or university.

Lipinski Question 3. The Report on the National Science Foundation's Merit Review Process, Fiscal Year 2017 (https://www.nsf.gov/nsb/publications/2018/nsb201915.pdf), highlights the fact that the budget pressures mean that many highly rated proposals to the NSF go unfunded. Looking within the report we note that only about one fifth of all research proposals are supported, that women proposers are as likely as men proposers to receive awards, and that Hispanic/Latinx, Black/African American and Asian proposers at 21%, 19% and 17%, respectively, are less likely to receive awards than White proposers (24%). The report further outlines that individual investigators' funding rates for PIs across the last three years was 39%, meaning that 2.4 proposals were submitted by a PI to obtain and award. The difficulty is that many fewer women than men submit research applications, and trends from other research at other agencies indicate that women and underrepresented minorities are less likely to re-submit, which data confirm is essential to increasing one's chances of receiving support. Data were not available beyond those provided above to confirm that researchers from these populations are more disadvantaged, but they are suggestive. For example, early career proposers have lower success rates than experienced, senior proposers, and individuals from underrepresented groups are more likely to be within the early career group. More analysis would be needed to determine whether this is the case.

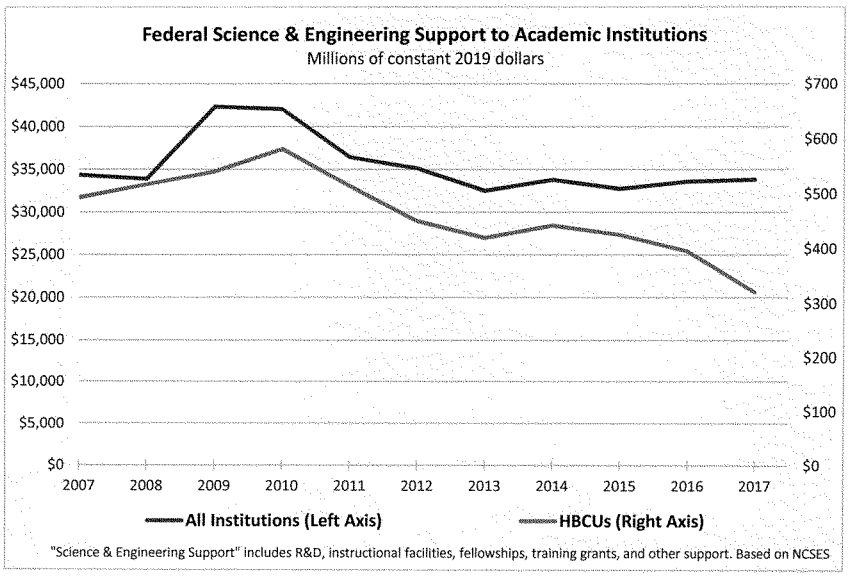
One challenge that I think bears attention is the extent to which institutions which disproportionately provide contributions of students from underrepresented groups to the STEM talent pool are faring in receipt of federal support for research.

Of the top 15 institutions that awarded bachelor's degrees to African American students who received PhDs in STEM between 2013 and 2017, eleven were Historically Black Colleges and Universities. HBCUs still play an outsize role in contributing to the diversity of the STEM community. They do this, despite the fact that they enroll a much smaller fraction of African Americans who are pursuing study in STEM; and despite the fact that they may accept, enroll and graduate students who enter higher education with more deficiencies in their early preparation.

Students need specific supports to be prepared for success in graduate education, such as challenging course work and access to research opportunities. They also need to see and be able to relate to faculty within their institutions who are actively engaged in research.

As the attached graph shows, even starting from a small base, there has been an erosion of support for science and engineering going to Historically Black Colleges and Universities (HBCUs). The institutions have not been able to be competitive within the challenging federal funding environment.

We need to understand and address these trends.



Lipinski Question 4: While it is true that much of the conversation about STEM often revolves around 4-year colleges and universities, more attention is needed on the role of 2-year institutions in supporting students in STEM and providing critical pathways to these fields.

From 2014 to 2016 I chaired the National Academies' Committee on Barriers and Opportunities in Completing 2-Year and 4-Year STEM Degrees. The report from that committee, which I edited with Michael Feder (former NAS staff and now AAAS colleague) notes,

> *Historically, the conception of STEM undergraduates has been students fresh out of high school who enter a 4-year college and complete degrees in 4 years: this pattern has so changed that such students are less than half of the undergraduate population (Eagan et al., 2014; Salzman and Van Noy, 2014).*

The report goes on to note, "Minority, first generation and low-income students disproportionately attend 2-year institutions." Students make this choice for many reasons, including previous preparation, cost, proximity and greater program and schedule flexibility offered by institutions structured to serve non-traditional student populations. Many of the actions that need to be taken require efforts at state, institutional and departmental levels, such as smoothing the alignment of 2-year college transfer policies as well as specific course acceptance and program requirements. The need for remedial work (often through non-credit bearing courses) presents another challenge for students, and students in such courses are more likely to become ineligible for programs such as Pell grants.

At the federal level there need to be opportunities for students to gain access to "work-study" that is actually relevant to their fields of study. Two-year institutions often have better relations with local industry and might be encouraged to engage in partnerships that include promoting co-op, part time and other employment opportunities more related to students' fields of study. There is the need to re-examine the rules surrounding federal support programs of all kinds to see if they are consistent with the reality of education and training in STEM fields. For example, veterans' educational benefits provide 36 months of support (roughly supporting 4 academic years) while time to degrees in engineering, for example, even for full-time students, may exceed this.

Lipinski Question 5: Public colleges and universities saw reductions in funding support from state and local sources during the recession of 2007-2008, leading to financial pressures and precipitating increases in tuition to partially address shortfalls. Cost cutting by institutions included closing programs and reducing support services to students and reducing the number of available course sections. Reductions in the numbers of sections can make it difficult to get courses when needed, a problem in tightly sequenced programs, delaying program completion.

STEM programs can be vulnerable in funding reductions; despite demand, these programs tend to be expensive to run because they may require laboratories with costly equipment, animal care facilities, additional staffing, field work, research opportunities and more. The National Academies' report, *Barriers and Opportunities* notes, *"Degrees in engineering, engineering technologies/technicians, computer and information sciences, physical sciences, and biological and biomedical sciences cost more than the average cost of a degree across all fields of study, while mathematics and statistics cost less than average. Social sciences and psychology also cost less than the average".* The report goes on to discuss the growing trend of "differential tuition," adding to the cost of education for programs that may be more expensive to run. While understanding the budget pressures that can lead to consideration of differential tuition, this trend disadvantages the very populations that are currently underrepresented and underserved.

To respond to these challenges, one would need to decrease program costs, increase program support or a combination of these. Specific actions might include:

- Partnerships among institutions that are closely located and closely aligned that can share the load in running more expensive programs, such as through inter-institutional agreements.

- Development of effective use of online instruction for some aspects of programs.
- Partnerships that include industry, where corporate partners may provide equipment and share in providing instruction.
- Opportunities for faculty and students to participate in research in national labs, local facilities and/or in company-developed programs.
- Federal support for instructional and research equipment, course re-design and renovation to relieve some of the cost challenges of offering quality STEM programs, especially in emerging fields.

There are currently programs within the National Science Foundation, for example, that support STEM undergraduate course and curriculum experimentation as well as those to support success in HBCUs and other minority-serving institutions. Currently the funding to support programs in HBCUs, for example, provides funds for course related equipment but not renovation. At present the overall funding level is not sufficient to allow such support for renovation, yet this is often needed in providing instruction in cutting edge fields.

Representative Stevens Questions

Stevens Question 1: Research suggests that role models are important in supporting retention in STEM for girls and young women as well as for students of color. The faces of STEM need to be diverse if young women and students of color are to believe that they too can join this community. There are efforts emerging across the country to make diverse role models and mentors available to young people from diverse populations. This is a major reason that AAAS has been excited to be a part of the IF/THEN initiative of Lyda Hill, offering "Ambassadors" whose lives in STEM are embodiments of the possibilities open to women. AAAS works to ensure that there is diversity in our programming, within our meetings as well as in our governance.

As young women and students of color move through the educational system toward careers in STEM we need to be concerned about the messages that they receive should they pursue study in STEM at undergraduate and graduate levels. Faculty are also role models. If STEM faculty are not diverse; if women and underrepresented minorities are absent or rare; or if they disappear as they move through the ranks within faculty; if they are unable to advance and assume leadership roles; if they experience harassment, bias and incivility, these things also send a message.

It is critical that we think about the importance of role models and the messages that get sent to girls, young women, students of color and their families of the possibilities for them within STEM and that the messaging is consistent across the span of education and into the workplace and careers.

Representative Balderson's Questions

Balderson Questions 1: We share the congressman's concerns that rural areas suffer disproportionately from lack of broadband access and that they are often forgotten when it comes to discussions about "Digital Divide" issues. AAAS is a strong supporter of efforts to accelerate access to high-speed internet, so that rural communities have unimpeded access to our growing library of science education resources. We are mindful of the challenges that makes improved access slower than it should be; we have therefore focused on making our resources accessible to communities that face challenges in accessing broadband, whether because of socioeconomic status or geography.

AAAS has been involved in developing quality online STEM resources accessible to educators and the public alike for two decades. We realized the potential of the internet to share resources for STEM, and

we targeted underserved communities from the beginning. This meant that we made early choices in design (e.g., to forego graphics-heavy options) and in devices. Research indicated that phones were more ubiquitous than tablets, for example. So that is where we started.

When we wanted to develop programming in science drama for children, we chose to turn to radio: cheaper for us to produce and a more accessible medium. The result was a Peabody Award winning radio science drama, *Kinetic City Super Crew,* which also demonstrated that "low end" and accessible programming could be done at the highest levels of quality.

Kinetic City Active Explorer was designed as a data collecting tool, again using the features available on phones. The National Parks Science Challenge again makes use of phones as digital learning tools. We must continue to work to make broadband accessible to rural areas. But in the meantime, we at AAAS have let our creativity and commitment to access guide our program offerings.

Representative Waltz's Questions

Waltz Question 1: We recognize that the workforce of the 21st century will need appropriate education and preparation to assume the 21st century jobs that are emerging. That workforce includes an increasingly diverse pool of young people who are currently in all levels of schooling as well as those individuals currently in the workforce whose jobs will evolve in ways that require that they learn new skills—for what their jobs become as well as in response to displacement if their jobs disappear. Many of the workforce skills which will be required are those which can be gained in the study of STEM, such as analytics, quantitative reasoning, interdisciplinary thinking and problem solving. In addition workplace skills will be critical, such as communication skills and the ability to work as members of diverse teams in addressing complex problems.

If we look at the "portfolio" of federal STEM programs we see them falling into a number of categories:

- Improving the quality of STEM for school age youth in formal and informal settings such as by: providing compelling STEM content to support instruction; increasing the number of highly qualified STEM teachers available to students in high need schools.
- Improving the quality of STEM education at college and university levels such as by: supporting course and curriculum re-design; improving programs at 2-year institutions that address provision of skills related to local/regional economic development; increasing opportunities for students to participate in undergraduate research; addressing STEM teaching and learning, program and infrastructure needs of institutions serving historically underrepresented groups.
- Supporting graduate education and training for future STEM researchers, including for those underrpresented in STEM and at institutions serving historically underrepresented groups.
- Building public science literacy.
- Providing support for institutions involved in transformational efforts to increase diversity.
- Enhancing our knowledge about STEM teaching and learning and organizational change to support success for all.

These program elements emerge from different departments and agencies and touch different institutions and regions to a greater or lesser extent. But without an overarching strategy on the ground, they do not achieve all that they could.

Imagine if one were to overlay a "place-based strategy" on the lessons learned from the different federally suppported programs, including:

- Mapping STEM education and research assets, including those of educational and cultural institutions, state and federal research facilities, parks and other protected areas, business and industry and more; and
- Developing a strategic plan for how to work together locally and regionally, given these assets, and how synergies might be realized in bringing the pieces together and learning from each other.

This process may sound familiar since it has been an aspect of the EPSCoR and EPSCoR-like programs situated across the federal government to assist states in building STEM research capacity. Should there be similar, systematic mapping and partnership development in states and regions, it should be possible to see how scaling might be achieved.

All states, as well as other jurisdictions (local or regional) could, benefit from the kind of strategic visioning, systematically applied to STEM education, research and workforce development. This might involve establishing partnerships to address one or both of the goals of the federal plan, mapping the gaps and resources that can be applied to address these and adapting evidence-/research-based models as they move forward. We have examples of partnerships that have taken on some particular component of the system in addressing these challenges, such as the STRIVE Partnership in Cincinnati (preK- career), P-20 Partnerships in many locations, and Advanced Technological Education Centers (linking 2-year colleges, local industry and area economic development). We must begin to consider how, using a competitive, place-based approach, we might align these pieces more systemically.

Maryland provides a current example of how to use assest mapping, gap analysis, and benchmarking to move from education interventions to large-scale education reform. Recently the Maryland Commission on Innovation and Excellence in Education issued an Interim Report of its work to consider changes that might be needed in funding formulas and policies to enable its preK-12 system to "perform at the level of the best-performing systems in the world." The interim plan is grounded in preceding information gathering to to produce a *Gap Analysis Comparing Maryland to International and Domestic Top Performers.* With the information from the gap analysis the Maryland Commission was able to put forth a set of priorities and action plan that will move the state from intervention-based reform to systemic reform. Encouraging these efforts can help lift the discussions from small scale interventions to the kind of assessment and benchmarking against top performers as a key step toward total systems transformation. In light of the economy and demographics of the state it is clear that much of this work has direct implications for improving the quality and incresing the diversity of the STEM workforce.

Responses by Dr. Lorelle Espinosa
"Achieving the Promise of a Diverse STEM Workforce"

Questions for the Record to:

Dr. Lorelle Espinosa
Vice President for Research American Council on Education

Questions from Chairwoman Eddie Bernice Johnson

1. **Much of the discussion about diversity in STEM is focused on increasing representation of women and minorities. Can you speak to the unique challenges facing LGBTQ students, researchers, and STEM workers? What more can be done at universities and in government and private sector workplace settings to improve recruitment and retention of gender and sexual minorities in STEM?**

The experiences of LGBTQ students and professionals in STEM, as for other underrepresented and marginalized populations, has a great deal to do with the culture and climate in their schools and workplaces. In fact, LGBTQ students, researchers, and STEM workers experience many of the hardships faced by women and racial and ethnic minorities working in these disciplines, and sometimes to a greater extent given the intersecting nature of these identities.

In most cases, the overwhelming issue is that LGBTQ individuals are made to feel unwelcome, both intentionally and unintentionally, across most STEM disciplines. Moreover, the unique experiences of LGBTQ professionals are rendered invisible through omissions of gender identity and sexual orientation from conversations about diversity in STEM,[1,2] which can lead members of the LGBTQ community to shelter their identities if they are unsure of their colleagues' perspective on their rights and personhood.[3] These concerns are not unfounded: LGBTQ STEM professionals experience professional devaluation and fewer professional development opportunities despite holding similar qualifications and dedication to those of their heterosexual, cisgender[4] counterparts.[5]

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[1] Hughes, Bryce E. 2018. "Coming Out in STEM: Factors Affecting Retention of Sexual Minority STEM Students." *Science Advances* 4 (3): 1-5. DOI: https://dx.doi.org/10.1126%2Fsciadv.aao6373

[2] Linley, Jodi D., Kristen A. Renn, and Michael R. Woodford. 2018. "Examining the Ecological Systems of LGBTQ STEM Majors." *Journal of Women and Minorities in Science and Engineering.* 24 (1): 1-16. DOI: 10.1615/JWomenMinorScienEng.2017018836

[3] Atherton, Timothy J., Ramón S. Barthelemy, Wouter Deconinck, Michael L. Falk, Savannah Garmon, Elena Long, Monica Plisch, Elizabeth H. Simmons, and Kyle Reeves. 2016. *LGBT Climate in Physics: Building an Inclusive Community.* College Park, MD: American Physical Society

[4] Cisgender individuals are those whose gender identity corresponds with the sex with which the individual was identified as having at birth.

[5] Cech, Erin. "The STEM Inclusion Study: LGBTQ Professionals in Science and Engineering Workplaces." Lecture, Sexual Minorities in the STEM Pipeline: From Education to Workforce, American Association for the Advancement of Science Annual Meeting, Washington, DC, February 16, 2019.

An important first step in addressing the experience of LGBTQ students and professionals is to embrace this form of diversity alongside that of women, persons of color, and persons with disabilities in STEM; and to make visible the experiences, challenges, and barriers facing LGBTQ individuals in scientific disciplines. Inclusion efforts on campuses, in STEM departments, and in the private sector should further address this population. This includes bias training for faculty, staff, and leaders at all levels, and the creation of anti-discrimination policies.[6] Finally, as a field we require more evidence on the unique experiences of LGBTQ individuals in STEM; as it stands, there is little data to evaluate the representation and experiences of this group.[7] Through its array of programs, research dollars, and other funding streams, the federal government can address these solutions and incentivize STEM communities to include gender and sexual minorities in diversity and inclusion efforts writ large.

2. **A big concern for me when discussing what is needed to expand access to STEM studies and careers is how we can better support students and scientists with disabilities. The barriers persons with disabilities face can vary widely depending on their individual needs and the field of research they are in. Can you talk about the unique challenges facing persons with disabilities in the STEM workforce? What more can we be doing to support students and scientists with disabilities in STEM?**

Stereotypes and messages about who belongs in science and engineering send powerful messages and can result in persons with disabilities (and indeed other marginalized groups) feeling unwelcome and even threatened in STEM environments. Such attitudes by faculty, staff, and others working in STEM environments are further compounded by physical environments that often discourage participation by physically disabled students. Moreover, the strong meritocratic and individualistic culture of STEM, as well as the way STEM is taught and organized on most campuses, often sets aside the necessary accommodations that many physically and intellectually disabled students require,[8,9] which further disadvantages and stigmatizes students with disabilities.

Working to shift this culture, and the proximate climate of STEM is required. Diversity and inclusion efforts need to not only include persons with disabilities, but also emphasize awareness raising and education on the spectrum of conditions included, and the unique

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[6] Hughes, Bryce. "Coming Out and Leaving STEM: Experiences of LGBTQ STEM Undergraduates." Lecture, Sexual Minorities in the STEM Pipeline: From Education to Workforce, American Association for the Advancement of Science Annual Meeting, Washington, DC, February 16, 2019.

[7] Patridge, Eric V., Ramón S. Barthelemy, and Susan R. Rankin. 2014. "Factors Impacting the Academic Climate for LGBQ STEM Faculty." *Journal of Women and Minorities in Science and Engineering*. 20 (1): 75-98. DOI: 10.1615/JWomenMinorScienEng.2014007429

[8] Bettencourt, G., Kimball, E., & Wells, R. S. (2018). Disability in postsecondary STEM learning environments: What faculty focus groups reveal about definitions and obstacles to effective support. Journal of Postsecondary Education and Disability, 19(4), 387-400. Retrieved from https://scholarworks.umass.edu/cfssr_publishedwork/19

[9] Lee, Ahlam. 2011. "A Comparison of Postsecondary Science, Technology, Engineering, and Mathematics (STEM) Enrollment for Students With and Without Disabilities." *Career Development for Exceptional Individuals* 34 (2): 72-82. DOI: 10.1177/0885728810386591

challenges facing these groups. Role models can be particularly important such that students with disabilities see people like them succeeding in STEM fields.[10] Concretely, STEM departments can review physical accommodations, including in STEM laboratories, reconsider teaching pedagogies, and collect, examine, and act upon data related to when students with disabilities fall behind or leave STEM majors.[11] Finally, as is the case with LGBTQ student experiences, there is a dearth of research on students with disabilities in STEM. As such, funding agencies should prioritize research examining the unique challenges that students with disabilities face, as well as best and promising practices within university STEM departments.

Questions from Congressman Daniel Lipinski

1. As you might know, I'm a long-time champion of promoting tech transfer of innovations developed through fundamental research, such as the I-Corps program. One barrier I've heard from students and institutions of higher education in my district is that scientists and engineers from underrepresented groups, especially nontraditional students, might not have a financial safety net or family situation conducive to take the risk of pursuing tech transfer through entrepreneurship.

- **What more could the federal government do to support researchers from underrepresented groups, particularly students, who may want to translate their results and discoveries into new products or services?**

One of the most impactful ways the federal government can support these goals is through increased funding for undergraduate research opportunities. Exposure to high-quality research experiences is a major predictor of successful outcomes for students of color in STEM, including increased retention and graduation rates in STEM, higher GPAs, cognitive gains, increased self-confidence, and the pursuit of postgraduate STEM education and careers.[12]

As noted in the Academies' Minority Serving Institutions (MSIs) report, and in other Academies reports[13], the two most effective components of undergraduate research experiences are: (1) deep immersion into the culture of laboratory research that supports critical-thinking and communication skills, laboratory technical skill development, co-authoring publication(s), and

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[10] Friedensen, Rachel. 2018. "STEM Climate for Students with Disabilities." *Higher Education Today* (blog), American Council on Education. May 23, 2018. https://www.higheredtoday.org/2018/05/23/stem-climate-students-disabilities/

[11] Friedensen, Rachel. 2018. "STEM Climate for Students with Disabilities." *Higher Education Today* (blog), American Council on Education. May 23, 2018. https://www.higheredtoday.org/2018/05/23/stem-climate-students-disabilities/

[12] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. DOI: 10.17226/25257.

[13] National Academies of Sciences, Engineering, and Medicine 2017. *Undergraduate Research Experiences for STEM Students: Successes, Challenges, and Opportunities.* Washington, DC: The National Academies Press. DOI: 10.17226/24622.

attending a professional conference, and (2) participation in a sustained, rather than short-term, research experience.[14] Importantly, sustained experiences should provide financial support to students through paid positions or research experience scholarships, funding for which can be built into federally sponsored undergraduate research programs.

The federal government can also incentivize research partnerships between institutions of higher education, and between institutions and the public (e.g., government labs) and private sectors, that build in undergraduate research opportunities as a formal component of said partnerships. For MSIs, in particular (many of which lack sophisticated research infrastructure), mutually beneficial public- and private-sector partnerships can serve as an alternative mechanism to secure new educational, research, and workforce training opportunities for students and faculty, increase institutional capacity, and expand their current network to better serve students.[15]

Such aims further require federal investment in offices of sponsored research, as well as support for training for MSI faculty and staff to acquire knowledge about federal and private sector grants and acquisition processes within relevant funding agencies that would support undergraduate research. Finally, the science agencies can increase their outreach to MSIs and other institutions with low grant application rates for scientific research and corresponding undergraduate research opportunities, as well as grant applications for programs that specifically create research opportunities for students (e.g., research mentorship programs).[16]

2. **This Committee has taken steps to make graduate study more accessible to a broader array of students at some of our nation's finest research institutions. I applaud my colleagues' work on this issue, including the recent introduction of the STEM Opportunities bill. But I also know that there are many smaller Minority- and Hispanic- serving institutions in my home state of Illinois (such as Northern Illinois University, and Saint Xavier University, the College of DuPage, and Morton College). These schools have developed tremendous support systems to meet students where they are and help them succeed, regardless of their life situation.**
    - **In addition to efforts to make our institutions biggest research universities more accessible to students from diverse backgrounds, what else can we do to build up research programs at these smaller emerging research institutions? In effect, this would be bringing the research to the students, and meeting them where they are.**

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[14] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. DOI: 10.17226/25257.
[15] Ibid.
[16] Ibid.

A best practice in building up and expanding STEM research programs at such institutions is to invest in institutional infrastructure. As noted in the Academies' MSI report[17], capital and human resources matter in promoting STEM student of color success and achieving positive STEM student outcomes. At a time when MSIs are uniquely positioned to serve an increasingly diverse student population, they have markedly fewer financial resources than non-MSIs, including a lack of STEM infrastructure, such as equipment and laboratories. The below strategies will further attract and retain highly qualified, diverse STEM faculty, which is desirable given the associated positive student outcomes of having a diverse faculty body.

The federal government can target new education, research, and capacity-building grants to MSIs that have a demonstrated commitment to enhanced research and teaching infrastructure. This includes funds to support new and modern laboratories, advanced classroom technologies, core facilities for interdisciplinary research, and work-based learning programs that encompass state-of-the-art science, engineering, and medical equipment and facilities.[18]

The federal government can also support mutually beneficial public-private and other partnerships; this includes partnerships between smaller institutions and large research universities. Such partnerships further the capacity of STEM programs, and provide new pathways to funding and enhanced research capacity. A primary emphasis should be on giving MSI student access to high-quality research, mentoring, internships, and apprenticeships.[19]

Federal investment can further support programs that encourage innovative teaching, learning, and laboratory experiences in STEM on MSI campuses. This investment should include the requirement that any such programs include a strong and rigorous evaluation component, and provide the resources required to support high-quality evaluation, to measure the impact of new initiatives on student learning and career outcomes for STEM graduates.[20]

3. **The higher education system is built for full time, resident students which disadvantages non-traditional students, especially in STEM fields with demanding in-person laboratory requirements. How can the federal government build financial supports that specifically address the needs of first generation college students, financially disadvantaged students, and students with dependents within a higher education system built for full time, resident students?**

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[17] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. doi: 10.17226/25257.
[18] Ibid.
[19] Ibid.
[20] Ibid.

A primary way that the federal government can build financial supports for students is to increase funding for need-based financial aid, including scholarship aid tied to federally sponsored STEM retention and undergraduate research programs. Congress can further significantly increase annual appropriations to support need-based aid for individual students and capacity-building funds for MSIs (e.g., Pell Grants and Title III and V funding). This funding should include institutional endowment-building activities.[21]

Financial supports are critical, and are best implemented when accompanied by strategies that aim to increase retention and graduation in STEM disciplines. These include tailored academic and social supports, faculty and peer mentorship, undergraduate research experiences (which may themselves have financial component), flexible course schedules, and attention to campus and STEM disciplinary climate for students of color. Campus-wide or targeted transportation, housing, and food assistance (e.g., food pantries) are also recommended.[22]

4. **Many higher education institutions are under increasing financial pressure, especially those that are emerging research institutions that serve underrepresented groups. What is the role of the federal government in continuing to support STEM departments which are costly to operate but address critical workforce needs?**

The provision of STEM research and development grants is critical to sustain and strengthen STEM departments. Scientific agencies should review their portfolio of grantees and increase funding to those under-resourced institutions, including MSIs, which are in the best position to boost STEM teaching and learning. Previously discussed investments in STEM teaching and learning infrastructure are also important to sustain these programs, as is supporting student academic and social supports and faculty professional development. All of these efforts strengthen STEM departments and augment institutional dollars so that they go further.[23]

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[21] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. doi: 10.17226/25257.

[22] Ibid.

[23] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. doi: 10.17226/25257.

Question from Congresswoman Haley Stevens

1. **Can you speak about the importance to young women, and young people of color, of seeing role models in fields and positions that these young people may aspire to someday?**

Role models represent a powerful tool for increasing the representation of women in STEM. Role models help young women identify with and foster an interest in STEM,[24,25] change personal beliefs about these fields and break their masculine associations,[26] and allow women to picture themselves becoming scientists in the future.[27] When presenting women with role models to alter their future selves and spark self-efficacy, belonging, and interest in STEM, it is important that featured female scientists represent multiple identities aside from gender. Although white women have fewer role models, mentors, and sources of social support relative to their male counterparts, this experience is drastically intensified for women of color, who see even fewer people who look like them in STEM.

The presence of role models for students of color is equally important, with an abundance of evidence showing the importance of students seeing themselves in STEM professionals. While role models are critical, perhaps more important is the mentoring that can ensue. At predominantly White institutions, mentoring by faculty of color plays a significant role in the academic attainment and long-term success of students of color in STEM.[28] Indeed, students of color, including women of color, who are recognized as legitimate scientists by those they look up to are more confident about their academic abilities. Moreover, once students see

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[24] Ramsey, Laura R., Diana E. Betz, and Denise Sekaquaptewa. 2013. The Effects of an Academic Environment Intervention on Science Identification Among Women in STEM. *Social Psychology of Education: An International Journal* 16 (3): 377-397. DOI: 10.1007/s11218-013-9218-6

[25] Stout, Jane G., Nilanjana Dasgupta, Matthew Hunsinger, and Melissa A. McManus. 2011. "STEMing the Tide: Using Ingroup Experts to Inoculate Women's Self-concept in Science, Technology, Engineering, and Mathematics (STEM)." *Journal of Personality and Social Psychology* 100 (2): 255-270. DOI: 10.1037/a0021385

[26] Young, Danielle M., Laurie A. Rudman, Helen M. Buettner, and Meghan C. McLean. 2013. "The Influence of Female Role Models on Women's Implicit Science Cognitions." *Psychology of Women Quarterly* 37 (3): 283-292. DOI: 10.1177/0361684313482109

[27] Lockwood, Penelope, and Ziva Kunda. 1997. "Superstars and Me: Predicting the Impact of Role Models on the Self." *Journal of Personality and Social Psychology* 73 (1): 91-103. DOI: 10.1037/0022-3514.73.1.91

[28] Griffin, Kimberly A., David Perez, Annie P. E. Holmes, and Claude E. P. Mayo. 2010. "Investing in the future: The importance of faculty mentoring in the development of students of color in STEM." *New Directions for Institutional Research* (148): 95-103. DOI: 10.1002/ir.365

themselves as scientists, they are more likely to persist in STEM majors. [29,30,31] It is nonetheless important to note that while all faculty can become great mentors to students of color, faculty of color often possess an intrinsic ability to affirm and develop students of color and the perspectives and talents they bring to STEM disciplines.[32,33]

As we observed in our study of Minority Serving Institutions (MSIs),[34] mentorship, including sponsorship, peer mentorship, and tiered mentorship, was a common strategy used to promote student success in the STEM fields. During their site visits, the committee observed deep investment in infrastructures, both formal and informal, that support effective mentoring of MSI student populations. Moreover, many students and alumni reported that mentoring received from faculty and administrators was integral to their success, in many instances citing them as "sponsors" who not only advised them, but also actively advocated on their behalf in ways that advanced their careers.

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[29] Chang, Mitchell J., Jessica Sharkness, Sylvia Hurtado, and Christopher B. Newman. 2014. "What Matters in College for Retaining Aspiring Scientists and Engineers from Underrepresented Racial Groups." *Journal of Research in Science Teaching.* 51 (5): 555-580. DOI 10.1002/tea.21146

[30] Chang, Mitchell J., M. Kevin Eagan, Monica H. Lin, and Sylvia Hurtado. 2011. "Considering the Impact of Racial Stigma and Science Identity: Persistence Among Biomedical and Behavioral Science Students." *Journal of Higher Education* 82 (5): 564–597. DOI: 10.1353/jhe.2011.0030

[31]Espinosa, Lorelle L. 2011. "Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences that Contribute to Persistence." *Harvard Educational Review* 81 (2): 209–240. DOI: 10.17763/haer.81.2.92315ww157656k3u

[32] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. doi: 10.17226/25257.

[33] Museus, Samuel D., Robert T. Palmer, Ryan J. Davis, and Dina Maramba. 2011. "Factors that Influence Success Among Racial and Ethnic Minority College Students in the STEM Circuit." *ASHE Higher Education Report* 36 (6):53-84.

[34] National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce.* Washington, DC: The National Academies Press. doi: 10.17226/25257.

Responses by Dr. James L. Moore III

House Committee on Science, Space, and Technology
"Achieving the Promise of a Diverse STEM Workforce"
Questions for the record to Dr. James L. Moore III

CHAIRWOMAN EDDIE BERNICE JOHNSON

1.) Can you speak to the unique challenges facing LGBTQ students, researchers and STEM workers? What more can be done at universities and in government and private sector workplace settings to improve recruitment and retention of gender and sexual minorities in STEM?

Clearly, more research has been devoted to broadening participation among women and historically underrepresented groups, but a growing scientific literature has begun to focus on other diversity and inclusion concerns related to sexual orientation and gender identity/expression (National Academy of Sciences, 2007, 2011). Individual identity factors are often regarded insignificant to STEM professional achievement (Yoder & Mattheis, 2015), but the expanding literature base notes the frequent challenges that LGBTQ+ individuals experience in STEM (Ragins, Singh, & Cornwell, 2011). Many of these challenges are related to workplace processes and policies, such as lack of LGBTQ+ inclusive benefits and strict male/female binary professional references and norms. Because of such challenges, individuals who identify as LGBTQ+ experience difficulty integrating in the STEM community, and, when they do not feel a sense of belonging, they are less likely to persist. Like other underrepresented groups, LGBTQ+ individuals are confronted with many of the same challenges in STEM. Thus, Yoder and Mattheis (2015), in their workplace survey, asked LGBTQ+ participants to respond to questions about workplace climate, employer support, and disclosure and found that 92% of participants rated their workplaces as "safe" and forty percent described their workplaces as "welcoming." Further, they found that those who worked in academia were likely, compared to those working outside of academia, to not be aware of what support their workplaces provided to LGBTQA+ employees, indicating that university-based STEM workplaces may need to increase efforts to promote support resources available to LGBTQA+ personnel. The study also found that "participants who described their workplaces as safe and welcoming, and who said their employers provided support for LGBTQA-specific needs reported greater openness to their colleagues and students" (p. 22).

Another national survey data of more than 4,000 students, compiled by the National Education Research Institute, found that STEM fields are less accessible to LGBTQ+ students. This survey data even revealed that those students who identified as lesbian, gay or bisexual were about eight percent less likely to persist in a STEM major and were only 10 percent likely to get involved in undergraduate

research, which is usually correlated with a higher probability of staying in the STEM field. When the data were disaggregated by gender, queer women had higher retention rates than heterosexual women, while queer men had lower retention rates than heterosexual men. This same study also outlined possible solutions to this social quandary. Mentoring and support from LGQBT+ faculty has been shown to make a difference in retention rates for students. Frequent, high-quality interaction with faculty increases LGQBT+ students' chances of persisting in STEM.

The bottom line is that universities and governmental agencies need to broaden how diversity is conceived as they work to better develop the talents of all groups underrepresented and marginalized in STEM education. Equally as important, it is critical that the federal government places more emphasis on the LGBTQ+ population because it is important that the country maximize all of its talents by including those who have the potential to enter and contribute to the nation's STEM enterprise.

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National Academy of Sciences. (2011). *Expanding underrepresented minority participation: America's science and technology talent at the crossroads*: The National Academies Press.

Ragins, B. R., & Cornwell, J. M. (2001). Pink triangles: Antecedents and consequences of perceived workplace discrimination against gay and lesbian employees. *Journal of Applied Psychology, 86*, 1244-61.

Ragins, B. R, Singh, R., & Cornwell, J. M. (2007). Making the invisible visible: Fear and disclosure of sexual orientation at work. *Journal of Applied Psychology, 92*, 1103-1118

Yoder, J. B., & Mattheis, A. (2015). *Queer in STEM: Workplace experiences reported in a National survey of LGBTQA individuals in science, technology, engineering, and mathematics careers. Journal of Homosexuality, 63*, 1-27.

2.) Can you talk about the unique challenges facing persons with disabilities in the STEM workforce? What more can we be doing to support students and scientists with disabilities in STEM?

Extant National Science Foundation data shows that an equal number of students—approximately 25 percent—with or without disabilities enter college with the intention to major in a STEM field. However, a smaller percentage of them graduate from college compared to their peers without disabilities, and even fewer graduate with STEM degrees, according to the NSF (2018) study.

As we assess the reasons behind this drop-off, we must first recognize that the term disability captures a diverse array of diagnoses and experiences. Thus, there is no one size fits all solution across such a wide spectrum of disabilities. Present research indicates that both instructors and faculty members play a significant role in determining the sense of belonging for STEM majors with disabilities. In particular, an instructor's demonstrative support—or lack of—determines, in large measure, whether students with disabilities will persist in STEM classrooms.

Similar to students without disabilities, teaching styles can also play a considerable role for those with disabilities, particularly those with auditory processing disabilities. Such students can find large lecture halls difficult. Majors that rely on "weed out" courses can also be challenging when STEM instructors are unsympathetic about students' disabilities and/or when they use traditional teacher-centered practices.

Another STEM challenge can be accommodation systems designed to create optimal learning experiences for students with disabilities. Campus-based, disability service professionals often fail to offer STEM-appropriate accommodations guidance to students with disabilities. Equally as important, some instructors exhibit unfriendliness and hostility toward those seeking special learning accommodations. In such cases, students may refrain from requesting accommodations for fear of faculty backlash. Additionally, there can be physical accommodation issues with STEM laboratories.

Across the United States, many STEM laboratories do not have the modern accommodations needed for students with various disabilities. As a result, many students experience heartache challenges with acquiring the needed content and completing required assignments. As Program Director for Broadening Participation in Engineering in the Engineering Directorate, I worked very hard to fund projects that focus on improving education outcomes for engineering majors with disabilities. Dr. Sheryl Burgstahler of the University of Washington is one of the leading researchers and thought leaders in the area. In fact, she has received numerous NSF grants focusing on students with disabilities in STEM, and, while I was a program director at HSF, I had the pleasure to fund one of her projects.

Because disability impairments come in so many forms, educational institutions must employ a broad range of strategies to combat systemic bias towards student with disabilities, as well as pinpoint and address the access challenges that students with disabilities face in STEM in both pre-collegiate and collegiate settings. It is well documented that these access barriers, oftentimes, inhibit students with disabilities from persisting in STEM. Through her work, Dr. Burgstahler has documented these access

challenges, as well as pinpointed specific strategies to help learning institutions to help these students persist (see link for details: https://www.washington.edu/doit/making-science-labs-accessible-students-disabilities)

To this end, university leadership needs to consistently review campus facilities (e.g., classrooms, lecture halls and laboratories) and work to make them accessible for students with disabilities. Faculty development trainings should be offered to help instructors understand their legal obligations to students and to improve their instructional materials and to learn exemplary inclusive pedagogical practices that they could use in their courses.

At The Ohio State University, we will discuss exemplary practices in this area and foster a national dialogue on these issues at SciAccess, an international science accessibility conference that will take place at Ohio State in late June. We also offer scholarships for study in the STEM fields to students with disabilities through Ohio State's Disability Services programs, as well as creating the University Institute for Teaching and Learning "to promote and support the culture of teaching excellence at The Ohio State University." Through this new teaching institute, efforts have been made to create special training modules that foster greater inclusive excellence instruction. We believe that these modules help improve STEM instruction for students with disabilities and other underrepresented groups.

CONGRESSWOMAN HALEY STEVENS

1.) Can you speak about the importance to young women, and young people of color, of seeing role models in fields and positions that these young people may aspire to someday?

Role models for young women and people of color are not the only factor in improving diversity in STEM (Drury, Siy, & Cheryan, 2011). Thus, role models are a significant part of the overall solution. Salient throughout the scientific literature, role models positively affect student aspirations for science-related fields. Successful role models are able to help quell doubts about belonging that young women and people of color may have and can positively affect their academic performance by reducing stereotype threat (Moore, Flowers, Guion, Zhang, & Staten, 2004; Spencer, Steele, & Quinn, 1999).

Too often, women and historically underrepresented groups are confronted with negative stereotypes in STEM fields that sometimes make them question if they have the capability to excel in STEM (Spencer, Steele, & Quinn, 1999) and even when the evidence suggests that they are gifted and proficient (Moore et al., 2004). Untruthful tales of inferiority are proliferated, at early ages, about women and people of color, long before they enter particular STEM academic and career domains (Shavers & Moore, 2014a, 2014b). These negative messages depict women and historically underrepresented groups as having intellectual limitations in STEM (Moore et al., 2003).

These negative stereotypes may not only be detrimental to STEM success for women and people of color but also may cause harmful effects to their psychological and emotional wellbeing (Moore et al. 2003; Shavers & Moore, 2014a, 2014b). The psychological anxiety of disapproving the negative stereotypes, which Dr. Claude M. Steele (1997) and his colleagues (Steele & Aronson, 1995) refer as the stereotype threat, causes many women and historically underrepresented groups to disidentify or reduce their STEM commitment (Davies, Spencer, & Steele, 2005; Murphy, Steele, & Gross, 2007). Lessening these occurrences, many social and behavioral scientists believe that having STEM role models among women and people of color can lessen the consequences of negative stereotypes (Drury et al., 2011). In the scientific literature, the importance of role models of similar gender and racial backgrounds is consistently noted. Faculty interactions and recognition of students are important components of STEM-identity development in students. Students that think about themselves as a "STEM person" are far more likely to complete their studies and find employment in STEM fields than those that do not form that self-identity.

Across the STEM enterprise, there is a shortage of women and persons of color available to serve as STEM mentors. Therefore, it is critical that major efforts are offered to broadening participation in

STEM, as well as creating more broadening participation training models and support systems in which other demographic groups can be incorporated as STEM mentors and role models. Additionally, policymakers need to increase funding for National Science Foundation programs, such as Louis Stokes Alliance for Minority Participation (LSAMP), Research Experiences for Undergraduate Students (REU), and Alliances for Graduate Education and the Professoriate (AGEP). Each of these grant programs are designed to advance individuals' preparation and success in STEM, and each of the programs offer women and other underrepresented groups access to STEM role models and mentors. By expanding the funding for such programs, institutions of higher learning, such as The Ohio State University, would be able to reach even more underrepresented groups and provide them with necessary support.

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2.) How can the federal government build financial supports that specifically address the needs of first generation college students, financially disadvantaged students, and students with dependents within a higher education system for full time resident students?

While the federal programs currently in place do assist financially disadvantaged students, continued growth of these programs and providing increased allocations and flexibility for part-time and non-traditional students, when needed, would make reaching their educational goals more attainable. In addition, creation of more grant programs geared specifically to first-generation students would provide much needed resources for this population. Providing resources for programs that could assist in serving these students with additional student support through tutoring and mentoring programs, affordable childcare options on campus and career counseling would also be valuable in improving student success.

Federal financial aid packages make postsecondary education possible for so many Americans. But, the current financial aid system needs to be tweaked to accommodate the financial needs of today's students. The price tag of a postsecondary education has increased enormously over the last two decades. Because of these trends, many students, first-generation and low-income, find it increasingly difficult to attend college. Further, because of these difficulties, the country's ability to attract STEM talent may be compromised. In 1972, the Basic Education Opportunity Grant, now referred as the Pell Grant, was created as the country's largest need-based, financial aid program, but many scholars posit that minimum increases in the enrollment of traditional-age, low-income students have occurred over its 37 years. Thus, other scholars have noted some impact on college choice but little impact on college attendance.

Under the leadership of Dr. Michael Drake, president of The Ohio State University, the institution has placed major emphasis on making college more affordable and accessible. For example, it has ensured, through its Buckeye Opportunity Program, that Ohio students who qualify for Pell Grants receive a financial aid package that covers the full cost of tuition. Since 2015, The Ohio State University has committed $100M in additional need-based aid for Ohio students, which has affected more than 33,000 students. Even with these efforts, more financial support is needed for students, particularly those who are first-generation and who come from economically disadvantaged communities. Higher education is at major crossroads, where federal interventions are needed to overall the nation's current financial aid system. My Ohio State colleagues and I stand ready to assist our nation with creating a financial aid system that works for all Americans.

3.) What is the role of the federal government in continuing to support STEM departments which are costly to operate but address critical workforce needs?

Increasingly, the United States has become dependent on a STEM workforce of non-US citizens, and the demand for greater STEM participation among underrepresented groups (e.g. African Americans/Blacks, Hispanic Americans, American Indians, Alaska Native Hawaiians, Native Pacific Islanders, women, persons with disabilities, persons from LGBTQ+ communities, and persons from economically disadvantaged backgrounds) has become vital for acquiring the ended human capital in today's competitive, technical, and global marketplace. Therefore, it is imperative that the federal government continues to allocate sufficient funding to support innovative and enhanced STEM practices, programs, policies, partnerships, alliances, pathways, and studies that advance broadening participation among underrepresented demographic groups from all segments of American society (e.g., K-12 rural and urban settings, 2-year and 4-year institutions, minority serving institutions, low-income communities, industry, etc.). By broadening participation, the United States is able to increase its STEM domestic talent pool while lessening its dependency on non-U.S. populations and responding to the steady, declining population projections of white males, who have disproportionately occupied the STEM workforce.

Based on an earlier General Accounting Office report, the federal government spent, from 2010-2016, nearly $3 billion annually on STEM. From our perspective at The Ohio State University, the federal government needs to continue to make STEM a priority in funding allocations. We also believe that the Louis Stokes Alliance for Minority Participation (LSAMP) program is one of the nation's most significant broadening participation programs in STEM. LSAMP was established in 1991 by the National Science Foundation (NSF) in response to a Congressional mandate to increase the participation of historically underrepresented students who earned bachelor's degrees and who would later pursue graduate degrees in STEM.

Since 1992, LSAMP has assisted over 650,000 underrepresented students with obtaining their bachelor's degrees in STEM. LSAMP participants are afforded opportunities to participate in summer bridge programs, specialized tutoring and per study groups, undergraduate research, and scientific internships. Because of its national impact, LSAMP offers our nation an incredible "bang for the buck" with total federal expenditures of only $46 million per year, reaching over 600 institutions of higher learning and serving more than 42,000 students annually.

In our own Ohio LSAMP alliance, which consists of ten higher education entities, with Ohio State serving as the lead institution, we have collectively doubled, in just five years, the number of historically underrepresented minority students who obtained STEM degrees. Additionally, we are able to report that Ohio LSAMP Alliance enrollees have STEM retention rates 20 to 30 percent higher than non-LSAMP historically underrepresented students, and our LSAMP students are also more likely to devote considerable time conducting research, attending professional association meetings, and being engaged in important campus activities.

In closing, as decisions are made about what STEM programs deserve federal funding, we strongly urge our policy makers to prioritize LSAMP funding and strongly consider increasing the funding levels, so LSAMP can reach even more historically underrepresented students, across the nation.

RANKING MEMBER FRANK LUCAS

1.) In your time as Program Director for Broadening Participation in Engineering and NSF, what programs or program components did you find were particularly successful? How did the directorate measure and evaluate the performance of these programs?

Diversity is a critical driver of STEM excellence in research and innovation in the 21st Century. The National Science Foundation (NSF) has a long history of commitment to inclusion of people from all parts of society in science and engineering fields, and it has a comprehensive portfolio of programs and projects aimed at addressing various aspects of the broadening participation challenges. These programs span across all NSF Directorates and Offices. However, despite very strong efforts by many people and institutions, progress remains uneven and slower than desired.

As program director for Broadening Participation in Engineering (BPE), within the Engineering Directorate, I focused my efforts on funding projects that advance our understanding on how to improve preparation, participation, and advancement of those who are often underserved in engineering. It helps the nation lead in engineering by giving all students and citizens the opportunity to participate, regardless of their ethnicity, gender, or income. There are too many students in America not afforded opportunity access to a quality education. Because the nation is losing students at every educational juncture (e.g., elementary, secondary, and postsecondary) and even in the workplace, BPE funded projects that aimed at advancing diversity and inclusive excellence throughout the engineering enterprise. Stated differently, I funded research and demonstration projects that contributed to the knowledge base and science of broadening participation in engineering (K to Gray) and focused on diversifying the engineering enterprise, including the professoriate.

BPE promotes the future of the nation's engineering workforce by responding to its need for engineering talent and diversity. It helps the nation lead in engineering by giving all students and citizens the opportunity to participate, regardless of their ethnicity, gender, or income. To this end, I reached out to individuals from a wide range of underrepresented groups: institutions with diverse research and instructional goals and practices, including community colleges, minority serving institutions, women's colleges, and institutions for people with disabilities; and geographic areas with lower rates of participation in NSF programs. These efforts yielded an increase in the number of awards, focused on K-12 student populations, minority serving institutions, and women of color. Further, during my tenure at NSF, I funded the first, second, third, and fourth early CAREER awardees, funded solely by BPE. Each of these PIs have consistently published in top-tier, peer-reviewed journals and received numerous prestigious awards, honors, and recognitions for their research.

NSF has an established process in evaluating its investments, including BPE. Outside review teams are invited to evaluate units' portfolios. External evaluation firms are also contracted to conduct similar evaluations. NSF INCLUDES, a major broadening participation activity, includes such a component.

2.) Can you elaborate on how the LSAMP program operates and why you feel it is the best investment in STEM diversity the government makes each year? How would you propose the federal government leverage this program to make an even greater impact?

We also believe that the Louis Stokes Alliance for Minority Participation (LSAMP) program is one of the nation's most significant broadening participation programs in STEM. LSAMP was established in 1991 by the National Science Foundation (NSF) in response to a Congressional mandate to increase the participation of historically underrepresented students who earned bachelor's degrees and who would later pursue graduate degrees in STEM. Strategies proven to increase retention and graduation rates for underrepresented STEM students have been incorporated into LSAMP: peer support, mentoring, undergraduate research experiences and role models.

Since 1992, LSAMP has assisted over 650,000 underrepresented students with obtaining their bachelor's degrees in STEM. LSAMP participants are afforded opportunities to participate in summer bridge programs, specialized tutoring and per study groups, undergraduate research, and scientific internships. Because of its national impact, LSAMP offers our nation an incredible "bang for the buck" with total federal expenditures of only $46 million per year, reaching over 600 institutions of higher learning and serving more than 42,000 students annually.

Our Ohio LSAMP Alliance works collaboratively with industry and community partners to institutionalize effective recruitment and retention programs. Driven by the objectives, programming includes the following alliance-wide activities: articulation agreements and credit transfers, Ohio LSAMP Alliance Conference, innovative curricular reforms in mathematics, interactive web site, sharing of online courses, cyber-enabled sharing of workshops, diversity sensitivity training, collaborative faculty mentoring, and production of Ohio LSAMP Alliance brochures, programs, and other materials. In addition, each institution will provide programming that includes advisement and counseling, residential summer bridge and early arrival programs, undergraduate research internships with stipends, faculty and peer mentoring, and tutoring or supplemental instruction.

The Ohio LSAMP Alliance will significantly enhance the STEM infrastructure within Ohio and will serve as a catalyst for change, innovation, and resource enhancement throughout the state. Underrepresented minority students will learn from faculty and peer mentors within Alliance partners, produce research, and participate in scientific conferences. Alliance partners will share resources through cyber-enabled activities, including online courses, interactive web site, and videoconferencing. Institutions of higher education, community partners, and industry will work collaboratively to determine best practices and share resources, avoiding duplication of efforts. Data evaluation will contribute to evidence-based best practices in STEM education for student recruitment, retention, persistence, and attainment of STEM degrees.

Within the Ohio LSAMP Alliance, which consists of ten higher education entities, with Ohio State serving as the lead institution, we have collectively doubled, in just five years, the number of historically underrepresented minority students who obtained STEM degrees. Additionally, we are able to report that Ohio LSAMP Alliance enrollees have STEM retention rates 20 to 30 percent higher than non-LSAMP historically underrepresented students, and our LSAMP students are also more likely to devote considerable time conducting research, attending professional association meetings, and being engaged in important campus activities.

In closing, as decisions are made about what STEM programs deserve federal funding, we strongly urge our policy makers to prioritize LSAMP funding and strongly consider increasing the funding levels, so LSAMP can reach even more historically underrepresented students, across the nation.

CONGRESSMAN DANIEL LIPINSKI

1.) **What more could the federal government do to support researchers from underrepresented groups, particularly students, who may want to translate their results and discoveries into new products or services?**

It is vital that scientific discoveries, through technical transfer, are translated into practical applications. One barrier to this transfer is that many academic researchers know little about how to bring their new technology to market. Another barrier can be the lack of funding and expertise to test their ideas to see if they are transferable into products as well as a lack of funding devoted to transfer activities. Authorized by Congress, in 2015 the National Institutes of Health created Research Evaluation and Commercialization Hubs (REACH) to help lower the these barriers that slow the transfer of academic research. The hubs work to help fund, train, and provide access to a nation-wide network to work with researchers on promising technologies. Having other federal agencies use this model that would work with all STEM discoveries would be beneficial, especially for underrepresented researchers.

Additionally, federal agencies can form partnerships with universities that will leverage the vast resources of those agencies, promoting efficiency and removing duplication of effort. They can also help to disseminate published research to other researchers not only provide a foundation to further research, but to ensure the results are reproducible.

As many undergraduate students doing research in higher education are doing so under the guidance of faculty members, providing faculty with technical transfer resources can also make those resources available to their undergraduate students.

2.) **In addition to efforts to make our institutions biggest research universities more accessible to students from diverse backgrounds, what else can we do to build up research programs at these smaller emerging research institutions? In effect, this would be bringing the research to the students, and meeting them where they are.**

Broadening participation for URM students, who may not have access to research facilities at their university or college can be achieved by connecting them to federal research agencies through scientific research internships; connecting them research centers that are sponsored by federal agencies, including the Engineering Research Centers program; and linking them to corporation scientific research activities. National Science Foundation programs, such as Non-Academic Research Internships for Graduate

Students (INTERN) and Graduate Research Internship Program (GRIP), are excellence resources for funding the aforementioned activities.

GRIP extends professional development opportunities to NSF Graduate Research Fellowship Program (GRFP) Fellows by offering internships developed in collaboration with federal agencies, such as NIH, NASA, NOAA, Smithsonian, and USDA to name a few. GRFP Fellows are extended unique experiences to work with cutting-edge research, while having steady access to top researchers and scientists at federal agencies. Such experiences give GRFP Fellows a first-hand count to life as a scientist or researcher outside of higher education.

NSF INTERN is somewhat similar to GRIP, but the only major difference is that a PI of an active NSF award initiates INTERN on behalf of one or more graduate students. The funds are issued as a supplement to the PI's original award. Generally speaking, the overall premise of INTERN is for the graduates to augment their STEM graduate experience by obtaining advance STEM knowledge, skills, and experiences through an internship in a non-academic context, such as for-profit scientific laboratories, start-up businesses, policy think tanks, industries, etc.

Overall, there are number STEM programs that students can participate to jump-start or advance their academic studies and/or careers. Thus, more effort is needed to make students more aware of the different STEM opportunities available to them through the federal government and beyond. In closing, I recommend that the various federal agencies work more closely together to create a one-stop, online portal that highlight the various research opportunities available to students, as well as faculty. Additionally, it is critical that such federal agencies work to develop greater partnerships with minority serving institutions and diversity-based organizations, such as the NSBE, SWE, SACNAS, etc.

3.) Can you speak to how these tightened science funding lines affect diversity in the research pipeline?

As the United States looks to increase the number of underrepresented students who are graduating with degrees in STEM fields, more resources will be needed. As funding is decreased for science education, there are fewer opportunities for students to participate in undergraduate research or to receive grants or scholarship funding. Less funding means that companies have fewer opportunities for internships or for labs to offer valuable practical experiences. When funding to federal agencies such as the NSF are cut, their ability to offer K-12 science education programs and grants for K-12 science

educators is also reduced. For underrepresented students who come from inner-city schools, without such funding, schools struggle to keep science education in place. For many underrepresented students, this is their only opportunity to become exposed to STEM majors and careers.

4.) How does your university account for efforts that lead to these "fundable, but not funded" proposals in the tenure and promotion process? Do these experiences seem to affect your faculty and trainees from underrepresented groups more?

Grant activity is a central aspect of tenure and promotion at The Ohio State University. In some disciplines (e.g., natural and biological sciences, physical sciences, social and behavioral sciences, engineering, etc.), strong grant activity is expected. Faculty of color are often affected by these expectations because they are not always afforded strong mentorship early in their careers or have mentorship networks that give them access to important information for seeking grants. As program director for Broadening Participation in Engineering, this trend became apparently clear. As a result, I funded many mentorship workshops for historically underrepresented faculty, as well as funded special travel grants so underrepresented can have access to major conferences and meetings, where they can establish meaningful peer and faculty relationships, as well as have access to career-informative information.

Responses by Ms. Barbara Whye

Questions for the Record
Submitted by Chairwoman Eddie Bernice Johnson

1. Much of the discussion about diversity in STEM is focused on increasing representation of women and minorities. Can you speak to the unique challenges facing LGBTQ students, researchers, and STEM workers? What more can be done at universities and in government and private sector workplace settings to improve recruitment and retention of gender and sexual minorities in STEM?

The challenges faced by LGBT+ communities are varied and cannot be painted with a broad brush. Dispelling myths, treating people with respect, education, and action are all ways organizations, universities and governments can improve recruitment and retention of LGBT+ in STEM disciplines.

- **Dispelling myths:** Start with transparency and tough conversations which are uncomfortable but necessary. Create a safe space where people can not only share their experiences but listen to other's perspectives to help educate each other.
- **Create a sense of community:** Include visible leadership from these communities in leadership roles and positions. Companies can tap into Employee Resource Groups that create a sense of belonging and a place to gain support.
- **Make it easy:** for employees to seek help when challenges occur and train leaders on how to increase their competency of inclusive leadership.
- **Respect:** Treat people with respect. This is the most basic principal.
- **Education:** Use learning and development departments as an opportunity to focus on inclusion and inclusive behaviors (be visible, challenge, reflect, listen and learn and advocate) as well as training (unconscious bias, micro-aggression).
- **Action:** Set a goal, be transparent about the goal, and hold people accountable.

Recruitment and retention of potential employees is grounded in their feeling a sense of belonging and adding value to the business. Companies need to be forward looking in their recruiting and their retention programs to create an inclusive environment for all employees.

2. A big concern for me when discussing what is needed to expand access to STEM studies and careers is how can we better support students and scientists with disabilities. The barriers persons with disabilities face can vary widely depending on their individual needs and the field of research they are in. Can you talk about the unique challenges facing persons with disabilities in the STEM workforce? What more can we be doing to support students and scientists with disabilities in STEM?

Companies are challenged to identify people with disabilities in the workforce. Most employ the self-ID process and more often than not employees feel a stigma associated with disclosing a disability. There is also an inherent mistrust of how companies collect the data and what it will be used for. It is critical to be transparent in how the data will be used and what solutions will be provided to create an equitable workforce. At Intel, we have an accessibility team that creates solutions for people with

disabilities. When people have the right tools and resources they are more productive employees, feel valued, and have a sense of equity with their peers. To retain employees with diverse abilities in corporations will require ensuring access to opportunities, building of communities so that employees can experience a sense of belonging, and creating a culture and environment where employees can raise concerns that can be heard and resolved.

Research shows that curricula and programs that are designed to be accessible for students with disabilities can actually serve all students better. Congress should invest in research to understand the role disabilities and learning differences play in student success in STEM. Congress can also support teacher professional development to adequately prepare educators to deliver high quality STEM content for students with disabilities. Finally, Congress should encourage the development of more adaptive technologies for students with physical disabilities to access quality STEM education.

Questions for the Record
Submitted by Congressman Daniel Lipinski

1. As you might know, I'm a long time champion of promoting tech transfer of innovations developed through fundamental research, such as I-Corps program. One barrier I've heard from students institutions of higher education in my district is that scientists and engineers from underrepresented groups, especially non traditional students, might not have a financial safety net or family situation conducive to take the risk of pursuing tech transfer through entrepreneurship.
What more could federal government do to support researchers from underrepresented groups, particularly students, who may translate their results and discoveries into new products or services?

Although not my area of expertise, one suggestion would be to create a grant program that invests in entrepreneurs supporting innovative solutions for governmental organizations to help them improve effectiveness and efficiency.

2. The higher education system is built for full-time, resident students which disadvantages non-traditional students, especially in STEM fields with demanding in-person laboratory requirements. How can the federal government build financial supports that specifically address the needs of first generation college students, financially disadvantaged students and students with dependents within a higher education system built for full time, resident students?

One option: A lot of systems are rooted in old norms. To support students where they are, there is a need to be flexible and accepting of new opportunities to support traditional and non-traditional students. Access to technology allows students to study in non-traditional ways. That is why access and opportunity are critical. The federal government could increase access to technology to support first generation college students. At Intel, we realize that small changes in how we think about solutions are key, so we remain flexible and strive to innovate because there is more than one solution.

3. Many higher education institutions are under increasing financial pressure, especially those that are emerging research institutions that serve underrepresented groups. What is the role of the federal government in continuing to support STEM departments which are costly to operate but address critical workforce needs?

To create the workforce of the future and continue to grow the U.S. economy, we need a robust system of support to continue to drive STEM engagement. Critical jobs will rely on STEM workers with all levels of competencies. From smart cars to smart cities, there is a need for people with tech skills that expands beyond your traditional tech company. Thus, we need a commitment from the federal government to continue to invest and support educational pathways for traditional and non-traditional STEM degrees.

Question for the Record
Submitted by Congresswoman Haley Stevens

Can you speak about the importance to young women and young people of color, of seeing role models in fields and positions that these young people may aspire to someday?

It is critical for students to see role models in STEM to grasp what is possible for their own future. Role models not only have the opportunity to share their own experiences, they can prepare women and underrepresented minorities about having courageous conversations, barriers to success and how they have overcome them. Role models can also have the real conversations about what the STEM workforce looks like, how to work with others that do not look like you, how to network effectively, and how to identify mentors and sponsors to reach their full potential. As Justice Sonia Sotomayor has stated: "A role model in the flesh provides more than inspiration; his or her very existence is confirmation of possibilities one may have every reason to doubt, saying, yes, someone like me can do this."

Question for the Record

Submitted by Representative Michael Waltz

I am very interested in your idea to leverage the Department of Defense's ROTC program to assist in building up our STEM workforce. Can you please elaborate on this proposal and any other ideas you have for programs or existing infrastructure that could be tapped into?

As I testified, Intel's goal is to increase the potential STEM workforce. Through our programs and partnerships, we are helping to increase student participation and maintain interest in STEM. However, we realize that the United States Government has more resources and the ability to reach more students nationwide. Through our collaboration with CSforALL, we realized that the JROTC program is underutilized. The JROTC infrastructure represents an accessible, high ROI/low-cost opportunity to accelerate preparation of the future defense workforce in critical areas such as computing, cyber security, defense technologies, and AI.

With about 500,000 students at about 3400 high schools nationwide, JROTC is a diverse talent pool of young people preparing for military careers. The students are majority-minority and over 40% of participants are female. Further, JROTC is strongly represented in schools serving economically disadvantaged populations.

We know that defense is becoming more technical in nature and the demand for cyber security talent is also increasing. Thus, we need to develop students in computer science and cyber security as early as possible. JROTC provides that opportunity. However, less than 20% of JROTC schools (and students) have access to a computer science course while in high school. Students who take AP Computer Science are more likely to take computer science in college than those who do not. We believe that by leveraging the JROTC infrastructure, participation in AP Computer Science in the United States could increase substantially. And as a result, we would likely see an increase in students continuing their education in computer science, and STEM generally. Thus, they become potential STEM employees.

Current Department of Defense STEM funding being invested in computer science education is primarily limited to schools that serve children of existing military personnel. Congress could direct more funds to JROTC specifically to increase computer science, AI, or cyber security education, or Congress could encourage the Secretary of Defense to elevate STEM education in JROTC programs. Either way, we will see an increase in access to computing education for the incoming military workforce. And a larger STEM talent pool for the United States.

Appendix II

Additional Material for the Record

POLICY RECOMMENDATIONS SUBMITTED BY REPRESENTATIVE EDDIE BERNICE JOHNSON

INVEST IN PEOPLE

Policy Recommendations

America needs to build a diverse, modern and world-class workforce for innovation across all sectors of the economy. The country should have the best education system and the most skilled workforce globally. Over the next decade, the United States needs to significantly reduce the shortage of highly skilled workers. The United States should have an education system that fully unlocks the potential of its human capital and boosts its rank in science and math education to the elite, top 10 level.

Build a pipeline of students with globally competitive 21st-century skills.

The public and private sector should work together to create and maintain partnerships among educational institutions, employers, state and local leadership, and the federal government to promote work-based learning and meet shifting and increasingly dynamic workforce demands.

RECOMMENDATION 1

Increase training at educational institutions for in-demand skills. The United States should expand opportunities for students to gain exposure to and training and/or retraining in the high-demand technical and foundational skills needed to thrive in the new economy in the following ways:

a. Congress should ensure that the Higher Education Act reauthorization includes expanded Workforce Pell Grants and opens the Federal Pell Grant system to short-term skilled worker education programs.

b. Employers and educational leaders should engage with Congress and educational policymakers to align funding priorities with labor market realities. This effort should include partnering with the U.S. Department of Education to ensure that career and technical education programs culminate in meaningful credentials or industry certifications in high-demand, high-skill fields.

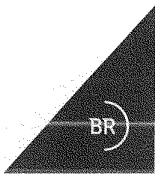
c. Congress should reform the Federal Work-Study system to allow for off-campus, work-based learning opportunities.

RECOMMENDATION 2

Partner with the education system to shorten pathways to jobs for individuals with recognized skills. Education policymakers should ensure that federal and state workforce preparedness policies, developed in partnership and collaboration with employers, promote standardized credentials that reflect proof-of-skill attainment in high-demand skillsets and are portable across industries. Students and workers should receive credit for mastery achieved in a range of professional careers (e.g., military). They should also have access to high-quality certificate programs that efficiently deliver training resources beyond the framework of bachelor's degree programs.

RECOMMENDATION 3

Align education with job opportunities. Education policymakers should create new linkages between educators and employers so that students receive the most up-to-date, relevant education in the foundational and technical skills that are needed in today's workplace. Education systems need resources and incentives to constantly shift their offerings to realign with the workforce of the future and increase the transparency of their employment-related outcomes.



RECOMMENDATION 4

Bolster STEM education and digital proficiency at all levels. U.S. leaders across the public and private sectors should build a national culture that strongly values STEM education.

- **a.** Policymakers should update and expand STEM education offerings and graduation requirements, including those in computer science and information technology, and work to increase student participation and representation in STEM.
- **b.** State policymakers and educators should strengthen preparation and professional development programs using research-based practices to improve STEM instruction in K–12 education.

RECOMMENDATION 5

Invest in foundational skills and proficiencies. Education policymakers should focus education programs and investments on the building blocks of strong educational performance by working to boost proficiency in fundamental skills such as teamwork, communication and adaptability, as well as literacy, digital skills and mathematics.

Design workforce training and preparedness for the future.

Policymakers should make investments in workforce training that reflect the needs of the changing workforce by emphasizing flexible and portable resources that meet workers at any stage of their careers.

RECOMMENDATION 6

Expand pathways between education and the workplace. Congress and state and local policymakers should expand the use of well-proven models of skilled worker training and education, such as community college partnerships and other private-public models, that provide pathways between high school, postsecondary education and training, and entry-level positions. These programs should be responsive to local economies and align training and education with the needs of the evolving labor market.

RECOMMENDATION 7

Expand apprenticeships and work-based learning. Congress and state and local policymakers should support private-sector efforts to expand apprenticeships and work-based learning opportunities, such as internships. These learning and training programs should be continuous and available to workers not just at the start of but throughout their careers.

RECOMMENDATION 8

Leverage company investment in worker training. Congress and state and local policymakers should encourage and facilitate partnerships to leverage private company investments in worker training and life-long learning programs that are consistent with shifts in high-demand skillsets and are customizable to workers' needs and interests, such as portable workforce training accounts.

RECOMMENDATION 9

Leverage technology to improve training options. Employers and credentialing organizations should increase acceptance of digital platforms that award and track certifications to facilitate a skills marketplace for the workforce of the future, enabling the efficient delivery of useful and high-quality skill-building resources (e.g., through massive open online courses).

Attract and retain the best and the brightest global talent.

The United States should build a globally competitive workforce and become the top global destination for talent with 21st-century technical and job skills.

RECOMMENDATION 10

Increase visas for skilled workers. The federal government should increase the availability of H-1B temporary visas for high-skilled professionals and maintain the employment authorization for H-4 dependent spouses.

RECOMMENDATION 11

Improve the predictability of adjudications of skilled worker visa petitions. The federal government should improve the transparency and consistency of adjudication processes to ensure predictable treatment of petitions for high-skilled workers.

RECOMMENDATION 12

Retain highly skilled international students. The U.S government should retain highly skilled international students who have advanced degrees in a STEM field from a U.S. institution by:

a. Providing an automatic green card for graduates in STEM fields, exempting individuals with special skills (e.g., STEM) from the 140,000-visa cap and eliminating the per-country limit for employment-based immigration.

b. Maintaining authorization for the Optional Practical Training period for student visas in qualifying STEM fields.

PURSUE INCLUSIVE INNOVATION

Policy Recommendations

America cannot continue to be a country where a few groups prosper while many others experience economic uncertainty. Innovation activity in the United States needs to be pursued inclusively and its benefits shared broadly across diverse groups and communities throughout society. Innovation needs to provide access to quality goods and services for all socioeconomic and demographic groups.

RECOMMENDATION 1

Revise degree requirements for hiring. Companies should reform hiring practices to open opportunities for "new collar" workers, focusing on skills and credential-based hiring for positions that do not require a bachelor's degree. Many low- and middle-income individuals and workers in rural areas have difficulty attaining bachelor's degrees in today's higher education systems but possess the necessary skills and experience to fill jobs — particularly when work-based learning and shorter education pathways are available.

Develop partnerships to scale inclusive innovation programs.

The government should partner with private-sector and local stakeholders to support effective and replicable program models for revitalizing local innovation ecosystems and fostering inclusive economic growth, particularly in low-income and rural areas of the country.

RECOMMENDATION 2

Support and expand innovation "residency" programs in underserved areas. The government should explore ways to scale up and support efforts to bring new opportunities to traditionally underserved regions (including rural, noncoastal and lower-income areas) and incentivize entrepreneurial activity. This work includes making competitive grant funding available to programs that match talent with start-ups in areas that lack a well-established start-up community or culture, as well as supporting regional development initiatives that aid entrepreneurial activity.

RECOMMENDATION 3

Deliver training resources more effectively. The federal government should identify and support organizations that have successfully replicated training programs that deliver industry-aligned skill-training and job-matching services to high-need groups across multiple sites or using online platforms. This action helps maximize the impact of workforce training resources by supporting delivery models that meet the range and extent of local resource needs.

Support diversity in entrepreneurship.

The government should collaborate with private actors to support diverse entrepreneurial ecosystems and build a national network of inclusive incubators and accelerators beyond traditional innovation hubs such as New York and Silicon Valley. Such ecosystems should promote entrepreneurship among disadvantaged and underrepresented groups.

RECOMMENDATION 4

Facilitate access to finance. Industry should partner with federal, state and local governments to increase the availability of and access to credit to empower entrepreneurs from disadvantaged and underrepresented groups.

RECOMMENDATION 5

Provide mentorship and networking. The public and private sectors should collaborate to provide coaching and mentoring to strengthen business and entrepreneurial skills among diverse entrepreneurs. They should build and bolster networks that enable frequent and enduring interaction between these entrepreneurs and the wider business community.

LETTER SUBMITTED BY REPRESENTATIVE HALEY STEVENS

National Science Foundation
Office of the Director

May 8, 2019

The Honorable Haley M. Stevens
Chairwoman
Subcommittee on Research and Technology
Committee on Science, Space and Technology
United States House of Representatives
Washington, DC 20515

Dear Chairwoman Stevens:

It was a pleasure to meet you today and to talk with you about the importance of the National Science Foundation's (NSF) mission and our priorities for the future. As we discussed, ensuring diversity in the science and engineering enterprise is critical to our nation's long-term success. Diversity of ideas, methods, and experiences adds to our ability to innovate, and innovation is the key to progress and economic growth. That is why it is important that we not only encourage women and other underrepresented groups to participate in science and engineering, but that we also foster an environment that supports them. To that end, NSF, as the primary funder of basic research in the United States, is taking steps to stamp out harassment in the scientific environment.

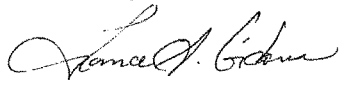
In September 2018, NSF announced a new award term and condition that applies to the nearly 2,000 U.S. institutions of higher education and other organizations that receive NSF funds. This new term and condition requires awardees to notify NSF within 10 days of any findings or determinations of sexual harassment, other forms of harassment, or sexual assault regarding an NSF funded principal investigator (PI). The term and condition also require notification if the PI or co-PI is placed on administrative leave relating to a harassment finding or investigation. Individuals can also submit harassment complaints directly to the NSF Office of Diversity and Inclusion, which will then conduct an investigation. NSF may initiate action, as necessary, to protect the safety of all grant personnel, to include suspending or terminating an award or requiring the grantee to replace or remove personnel.

NSF has also made clear that we expect all awardee organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces wherever science is conducted. This expectation includes activities at all research facilities and field sites and during conferences and workshops. NSF also requires organizations that request funding for conferences to have a policy or code-of-conduct that addresses sexual harassment and that includes clear and assessible means of reporting violations of the policy or code-of-conduct. NSF is providing the community with promising practices of codes of conduct, training, and reporting policies. NSF's actions on this complex and challenging issue will not stop here. As these steps are implemented, NSF will continue to evaluate the needs of the community to ensure that we are doing our part to ensure a harassment free environment for our scientists and engineers.

These are also not the only steps we are taking to nurture women and other underrepresented groups in the STEM fields. We have also worked to make the awarding of prestigious prizes fairer by recognizing that not every career path follows the same trajectory and that the qualification requirements should not favor one group over another. Finally, recognizing just how important diversity is to our success, one of NSF's 10 Big Ideas is squarely focused on broadening participation in science and engineering. The vision for NSF's INCLUDES program, which builds on the existing robust portfolio of broadening participation initiatives, is to catalyze the STEM enterprise to collaboratively work for inclusive change, which will result in a STEM workforce that reflects the population of the Nation.

Thank you again for your support of NSF's mission and for your leadership on this important issue. If you have any questions, or if you would like any additional information, please contact Amanda Hallberg Greenwell, Head of NSF's Office of Legislative and Public Affairs at 703-292-8070.

Sincerely,



France A. Córdova
Director

Enclosure: NSF Fact Sheet: Next Steps Against Harassment

NATIONAL SCIENCE FOUNDATION: NEXT STEPS AGAINST HARASSMENT

WHAT NSF IS DOING:

The National Science Foundation (NSF) will release a term and condition requiring awardee organizations to report findings of sexual harassment. It will be posted in the Federal Register Sept. 21, 2018 and go into effect Oct. 21, 2018.

WHY NSF IS DOING THIS:

As the primary funding agency for fundamental science and engineering research in the United States, NSF is committed to promoting safe, productive research and education environments for current and future scientists and engineers.

NSF will not tolerate harassment, including sexual or sexual assault within the agency, at awardee organizations, field sites, or anywhere NSF-funded science and education is conducted.

NSF considers the Principal Investigator (PI) and any co-PI(s) identified on an NSF award to be in positions of trust. The PI, any co-PI(s), and all personnel supported by an NSF award must comport themselves in a responsible and accountable manner during the award period of performance whether at the awardee institution, online, or outside the organization, such as at field sites or facilities, or during conferences and workshops.

WHO THIS AFFECTS:

The 2,000 U.S. institutions of higher education and other organizations that receive NSF funds are responsible for fully investigating complaints and for compliance with federal non-discrimination laws, regulations, and executive orders.

The reporting requirement currently applies to PIs and co-PIs. The term and condition affects PIs or co-PIs who receive awards or funding amendments on or after the Oct. 21 date of implementation. However, it covers conduct by those PIs or co-PIs that may have occurred prior to them receiving those awards.

NSF does not consider this a final step. This is a part of our continued efforts. NSF expects all award personnel to act in a respectful and professional manner at all times.

NEW NOTIFICATION REQUIREMENTS:

Upon implementation, the new term and condition will require awardee organizations to notify NSF of any findings/determinations of sexual harassment, other forms of harassment, or sexual assault regarding an NSF funded PI or co-PI.

The new term and condition also will require the awardee to notify NSF if the PI or co-PI is placed on administrative leave or if the awardee has imposed any administrative action on the PI or any co-PI relating to any finding/determination or an investigation of an alleged violation of awardee policies or codes of conduct, statutes, regulations, or executive orders relating to sexual harassment, other forms of harassment, or sexual assault. Finally, the award term and condition specifies the procedures that will be followed by NSF upon receipt of a notification.

Notifications must be submitted by an authorized organizational representative within 10 business days from the date of the finding/determination, or the date of the placement of a PI or co-PI by the awardee on administrative leave or the imposition of an administrative action, whichever is sooner.

The new term and condition will be effective for any new award, or funding amendment to an existing award, made on or after the effective date.

NSF will consider in its review of each notification submitted:

1. Safety and security of personnel supported by the NSF award;
2. Overall impact to the NSF-funded activity;
3. Continued advancement of taxpayer investments in science and scientists; and
4. Whether the awardee has taken appropriate action to ensure the continuity of science and that continued progress under the funded project can be made.

NSF has developed an electronic capability for submission of the required notifications that will be available on NSF's harassment page. The information will go directly to the Office of Diversity and Inclusion.

Upon receipt and review of the information provided, NSF will consult with the authorized organizational representative, or designee. Based on the results of this review and consultation, the Foundation may, if necessary, assert its programmatic stewardship responsibilities and oversight authority to initiate the substitution or removal of the PI or any co-PI, reduce the award funding amount, or where neither of those previous options is available or adequate, to suspend or terminate the award.

DEFINITIONS:

For purposes of the term and condition, the following definitions apply:

Sexual harassment: May include but is not limited to gender or sex-based harassment, unwelcome sexual attention, sexual coercion, or creating a hostile environment, as set forth in organizational policies or codes of conduct, statutes, regulations, or executive orders.

Other Forms of Harassment: Non-gender or non-sex-based harassment of individuals protected under federal civil rights laws, as set forth in organizational policies or codes of conduct, statutes, regulations, or executive orders.

Finding/Determination: The final disposition of a matter involving sexual harassment or other form of harassment under organizational policies and processes, to include the exhaustion of permissible appeals exercised by the PI or co-PI, or a conviction of a sexual offense in a criminal court of law.

Administrative Leave/Administrative Action: Any temporary/interim suspension or permanent removal of the PI or co-PI, or any administrative action imposed on the PI or co-PI by the awardee under organizational policies or codes of conduct, statutes, regulations, or executive orders, relating to activities, including but not limited to the following: teaching, advising, mentoring, research, management/administrative duties, or presence on campus.

RELATED WEBSITES

NSF.gov/harassment

The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. In fiscal year (FY) 2018, its budget is $7.8 billion. NSF funds reach all 50 states through grants to nearly 2,000 colleges, universities and other institutions. Each year, NSF receives more than 50,000 competitive proposals for funding and makes about 12,000 new funding awards.

For more information, contact:

NSF Media, 703-292-8070, nlpamedia@nsf.gov