

**Written Testimony of Dr. Shirley Malcom
American Association for the Advancement of Science
Before the Committee on Science, Space and Technology
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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.