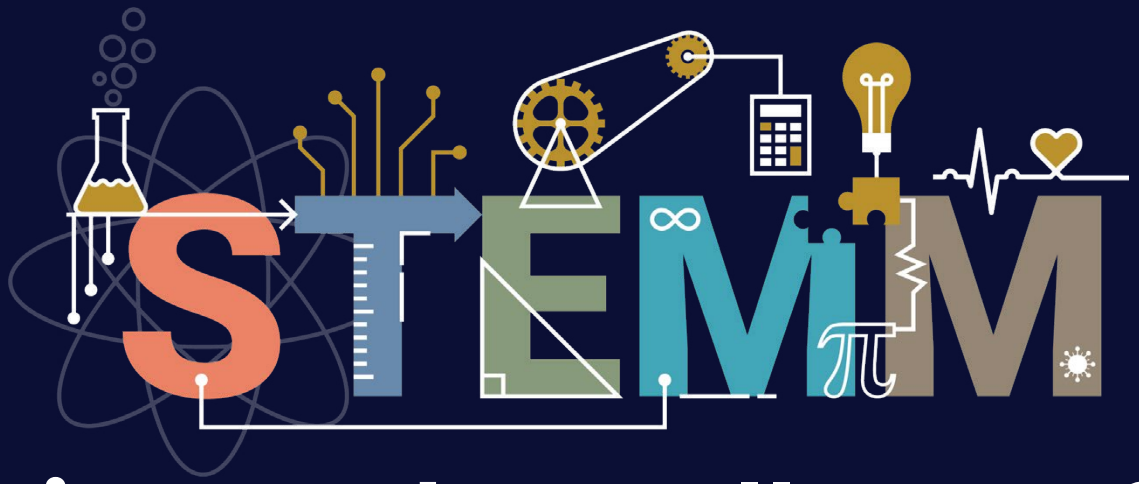


Equity and Excellence 2050

A National Strategy for Progress and Prosperity

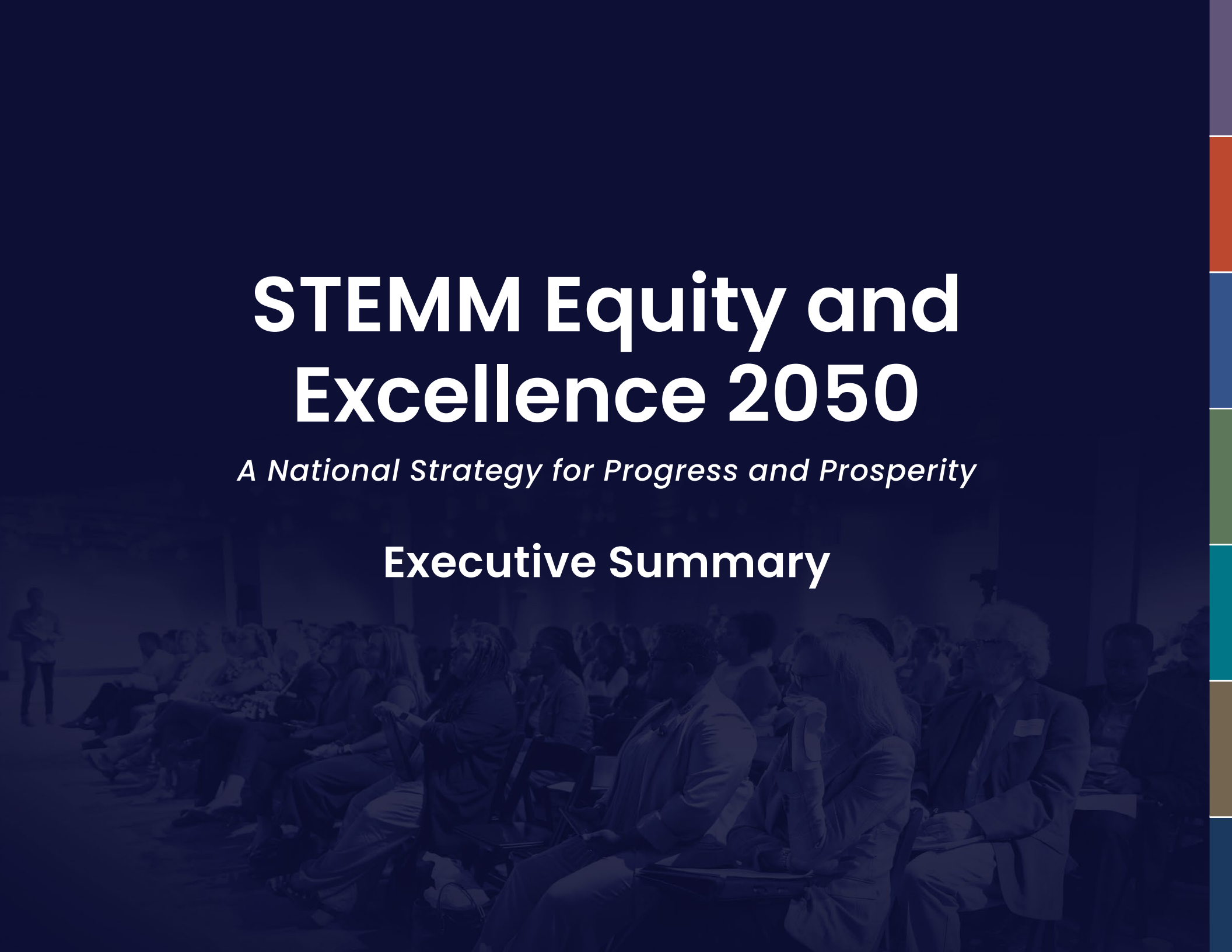
SOA STEMM OPPORTUNITY ALLIANCE

AAAS AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

STEMM Equity and Excellence 2050

A National Strategy for Progress and Prosperity

Executive Summary



Foreword

On our best days, we envision a world where science, technology, engineering, mathematics, and medicine help to heal the sick, feed the hungry, protect the planet, and improve the lives of all. This vision is not just a distant dream but a tangible reality that will be made manifest by a steadfast commitment to scientific excellence and fostering the diversity of thought, background, and identity that is essential to that excellence.

Imagine a world where every child, regardless of background, has the opportunity to discover the wonders of STEMM early in their lives, senses the encouragement of those around them to pursue their interests, and feels the support of the enterprise in achieving the success made possible by their hard work and talent. Skilled and diverse educators inspire a new generation, breaking down barriers and nurturing talents that might have gone unnoticed in the past. Picture a landscape where higher education becomes a powerful enabler, providing resources and opportunities for everyone.

As we look toward the horizon, innovation is the source of health and prosperity for our society. Diverse minds, representing varied experiences and perspectives, fuel groundbreaking research and development. Historic gaps in opportunities and investment are bridged, unlocking the full potential of the brainpower within our nation. At the core of this vision are the foundations of accountability and partnership, ensuring that progress is not just measured but felt across all our communities.

In this future we see thriving workplaces that reflect the rich tapestry of our nation and where everybody, regardless of background, finds the support and feels the belonging that fosters their contributions to STEMM innovation. If we are going to cure disease, feed the world, grow the economy, and explore our universe, we need the talents of the descendants of Native Americans, pilgrims, founding mothers and fathers, enslaved people, and immigrants from everywhere.

This future is not a far-off fantasy — it's within our grasp. The National Strategy presented here is a roadmap to this future. We look forward to traveling with you.

Sudip Parikh, Ph.D.
Chief Executive Officer, AAAS
Executive Publisher, *Science* Family of Journals

Executive Summary

STEMM Equity and Excellence 2050

A National Strategy for Progress and Prosperity

The 21st century has seen rapid and consequential advancements in science and technology that have led to innovative solutions to some of society's most pressing problems. Due to scientific breakthroughs in medicine, heart disease is no longer a death sentence, advancements in cancer research have propelled us closer to cures than ever before and a new class of vaccines improves our ability to fight infection.

Today, rapid advancements in artificial intelligence (AI) stir our imagination and offer a world of possibilities, from massive productivity gains and economic growth to the potential for generating new solutions to our most pressing issues, including climate and health. Whereas AI offers a myriad of positive possibilities, it also poses significant risks to people's employment security and economic well-being as well as potentially harming the civil liberties of various communities as a result of bias. While scientific progress and technological advancements carry many benefits, there is also great risk—including to civil and human rights—if they are not advanced with, by, and for all people.

The U.S. is uniquely poised to lead this movement toward inclusive excellence in science, technology, engineering, mathematics and medicine (STEMM), which is ultimately the only way to maintain and propel the U.S. as a global leader in these fields, as we have been in the past. The U.S. has leveraged this leadership to strengthen our national security, overcome diseases and power a robust economy. The future demands continued excellence in these areas—even as the opportunities and challenges that face our nation and the world remain daunting.

STEMM is needed for everyone, everywhere. To meet the challenges that lie ahead, the U.S. must greatly

expand our talent pool while also unleashing the brilliance and creativity of groups historically excluded from STEMM education and the workforce. To do this, the U.S. must achieve parity in our workforce by ensuring all people are treated equitably in terms of access to opportunities, education, salary, status and representation.

Ensuring the U.S. improves achievement and achieves greater equity in STEMM is not just the right thing to do but also paramount for our ability to meet today's challenges and for the U.S. to continue to lead into the future. Inequity in STEMM undercuts the flow of diverse ideas and perspectives, dims our collective knowledge base and quality of innovation, and blunts the STEMM community's ability to fully serve society. Given the intricacies and uniqueness of different communities, tailored solutions will be necessary to effect real change. As such, teams must be built that are reflective of myriad cultures, identities and demographics to meet these unique needs. STEMM fields that cannot reach their greatest potential threaten U.S. leadership on the global stage.

While important progress to broaden STEMM participation has been made, the effects have been uneven across groups, fields and sectors. Accelerating progress is critical, especially as policies and legal challenges continue to complicate the path to progress. If we are to achieve parity, everyone must be at the table across every state and territory, including all levels of government, industry, the workforce, higher education, pre-K-12, philanthropies, R&D enterprises, community organizations and more.

In December 2022, the American Association for the Advancement of Science (AAAS), in collaboration with the Doris Duke Foundation (DDF) and the White House Office of Science and Technology Policy (OSTP), launched the STEMM Opportunity Alliance (SOA) at the first-ever White House Summit on STEMM Equity and Excellence. SOA is designed to bring together cross-sector partners in a strategic effort to achieve equity and excellence in STEMM and to garner commitments to shared goals and metrics for accountability and progress.

This document outlines a broad national strategy for building a STEMM workforce that expands opportunities and reflects the diversity of our nation by 2050 as well as key progress metrics and intended goals. This co-constructed national strategy was crafted to leverage our country's talent reservoir. The bold goal is to add 20 million new diverse STEMM professionals to the U.S. workforce across all jobs and sectors by 2050. This vision requires decades of concerted, coordinated action beginning now.

Foundations for Progress:

Achieving long-term systems change will require not just doing the work but also grounding that work in the following foundations:

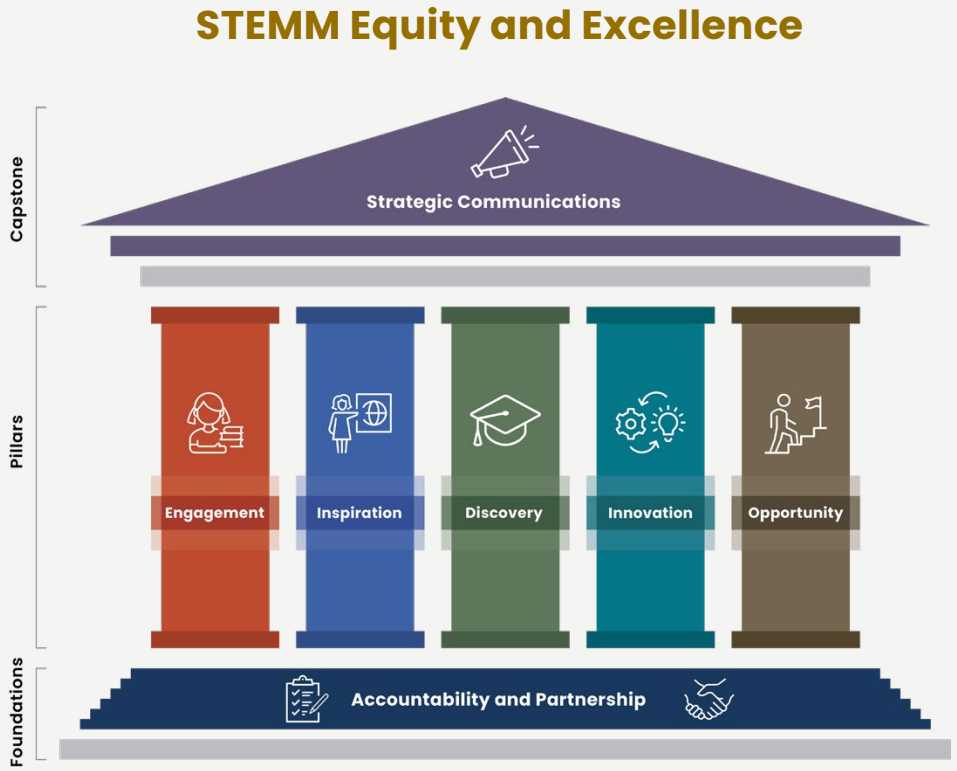
Accountability: Developing and implementing robust measures to track progress and align action.

Partnership: Fostering partnerships among public and private institutions and across sectors to improve education and career pathways and break down systemic barriers.

Key Strategy Pillars:

I. Engagement: Nurturing Curiosity in Every Child. Engagement with STEMM early and throughout childhood is essential to nurturing and harnessing curiosity and exploration and opening pathways to future opportunities.

II. Inspiration: Developing Skilled and Diverse Educators. The future of U.S. progress in STEMM is dependent on the quality and availability of diverse and skilled educators in both in- and out-of-school learning environments to meet demand.



III. Discovery: Creating Opportunity for All in Higher Education. Closing the opportunity gap in higher education is essential to ensuring that all individuals, including those from historically excluded and marginalized groups, receive appropriate access to postsecondary resources and opportunities for advancement.

IV. Innovation: Leveraging Diverse Minds in R&D. Diversity is a catalyst for innovation. Gaps exist in funding and opportunities for researchers from historically excluded communities, and our ability to fully tap into the unique brainpower hosted within the U.S. is stifled.

V. Opportunity: Ensuring All Workers Thrive. Employers, as well as education and training institutions, must provide workers with sufficient support in an inclusive environment that enables equitable opportunities to participate in and contribute to STEMM innovation.

Capstone:

A strong shared focus on strategic communications, storytelling and public awareness will be critical to driving success across all five pillars.

Strategic Communications: Shaping broad mindsets about who belongs in STEMM fields by highlighting the voices and stories of diverse STEMM professionals and STEMM contributions to society.

Structures for Implementation:

To drive implementation, SOA will work with its partners to create:

New and Renewed Commitments: Broaden and deepen the movement for change by bringing more partners to the table and collectively making new commitments aligned to the strategy.

A Coordinated Infrastructure: Strengthen the infrastructure for coordination and action by launching working groups led by anchor partners to drive efforts in discrete workstreams.

Public-Private Partnerships: Coordinate and align with government efforts to create an environment that enables and supports change.

As the world continues to grapple with new and unique challenges, it is essential that innovative solutions emerge. Innovation is rooted in the promotion and engagement of a wide range of ideas generated through people's creativity and informed by the diversity of their lived experiences and backgrounds. America has a wealth of diversity and talent to bring to bear.

To propel STEMM and rise to the challenges of tomorrow, it is imperative that committed actors collaborate across the public and private sectors to foster a new era of equity and inclusion in the American STEMM ecosystem. Who leads the scientific and technological advances of today will determine who leads the world tomorrow.

The STEMM Opportunity Alliance (SOA)

About SOA

The STEMM (Science, Technology, Engineering, Mathematics, & Medicine) Opportunity Alliance is a national effort by the American Association for the Advancement of Science (AAAS), with the support of the Doris Duke Foundation (DDF), that will galvanize stakeholders to achieve STEMM equity and excellence by 2050. Launched in December 2022 at the inaugural White House Summit on STEMM Equity and Excellence, SOA brings together organizations and entities from across sectors and scientific communities that are committed to developing and advancing a national strategy for achieving shared goals for equity in STEMM. To view SOA's growing list of partners committed to achieving STEMM equity and excellence, please visit **https://stemmopportunity.org/partners**.

Vision

Build a STEMM ecosystem rooted in equity, inclusion and scientific excellence to power progress, innovation and prosperity for all by 2050.

Mission

SOA will address key areas to attain fundamental, systemic change and ensure the diversity that is necessary for the increased performance and innovative ideas that are needed to keep the U.S. competitive.

Strategy

SOA will enable public and private institutions to work across silos to make substantive changes that can improve outcomes in STEMM for millions of Americans from historically excluded and marginalized groups. SOA will:

- **Elevate STEMM equity as a national priority** through the creation and implementation of this national strategy.
- **Support partner commitments** aligned with SOA's goals and critical to achieving STEMM equity and excellence.
- **Create and convene working groups** across key issue areas to organize and deepen relationships among a wide range of partners from the public, private and government sectors.
- **Host targeted events** where public, private and government leaders can discuss key challenges and opportunities for moving the needle on STEMM equity.

Hold the STEMM ecosystem accountable by developing progress accountability metrics to track progress against shared goals.

STEMM SOA OPPORTUNITY ALLIANCE

To keep in touch, visit the SOA site at www.stemmopportunity.org. On the website, there are opportunities to commit to becoming a partner, subscribe to the newsletter, connect on social media and more.

The Focus of This Strategy: STEMM Equity and Excellence

SOA is composed of organizations from across the scientific, technological, engineering, mathematical and medical fields. Our partners include universities, nonprofit organizations, philanthropies, professional societies, government entities and private companies representing sectors from entertainment to finance and more.

The inclusion of medicine, the second "M" in STEMM, is particularly relevant in these efforts given the long history of inequities in the field. For example, the health disparities experienced by historically excluded and marginalized communities during the COVID-19 pandemic are the result of centuries of mistrust and misrepresentation within the medical field as well as the failure of health systems and critical technologies. Historically excluded and marginalized communities have been inordinately dehumanized and exploited in the name of the scientific enterprise. Given this history, SOA is committed to the full and deliberate inclusion of medicine, and the health sciences more broadly, to create a more just society and a more excellent and equitable STEMM ecosystem.

STEMM equity is realized in two directions: by removing barriers and by increasing opportunities. People can be marginalized by any number of differences, such as race, ethnicity, gender, ability status, income, geography, religion, sexual orientation, and more. Research has demonstrated the impact of a lack of inclusion by persons with these various identities in the quality of the science and technology produced; whether intentionally or not, marginalization and exclusion from the scientific enterprise pose a major threat to research excellence, health and competitiveness. For SOA, equity simply means addressing these root causes of injustice while providing the necessary support to allow everyone to fully participate in the STEMM enterprise.

STEMM Equity and Excellence 2050

A National Strategy for Progress and Prosperity

Table of Contents

Introduction: Building a National Strategy for STEMM Equity and Excellence 2

The Imperative 4

The Call to Action 6

The Strategy: A Blueprint to Leverage America's Full Talent in the STEMM Workforce by 2050 8

Constructing an Equitable and Excellent Ecosystem 9

STEMM Equity and Excellence Foundations 17

STEMM Equity and Excellence Pillars 23

I. Engagement: Nurturing Curiosity in Every Child 25

II. Inspiration: Developing Skilled and Diverse Educators 31

III. Discovery: Creating Opportunity for All in Higher Education 37

IV. Innovation: Leveraging Diverse Minds in R&D 45

V. Opportunity: Ensuring All Workers Thrive 53

STEMM Equity and Excellence Capstone: Strategic Communications 60

Implementing the National Strategy 65

Conclusion: Realizing a More Perfect STEMM Ecosystem 68

Endnotes 69

Appendix 75

Key Terminology 75

SOA Network 76

Table 3: Strategy Summary 79

Introduction: Building a National Strategy for STEMM Equity and Excellence

The 21st century is proving to be one of the greatest eras of scientific and technological advancement in history—a period when such innovation is also critically needed to address global and national challenges.

U.S. leadership in science, technology, engineering, mathematics and medicine (STEMM) promises to serve as an engine for progress—with the power to build a stronger and more inclusive American economy and society for the future.

This bright future, however, cannot be realized under the shadow of inequity that persists across STEMM fields today, denying opportunities for marginalized and historically excluded communities, stunting growth and progress for the nation as a whole, and risking as an outcome that the rapid advancement of science and technology will not be in service to all people. Improving equity and excellence in STEMM is a national priority—one that requires a shared national strategy for driving systemic change.

Equity and excellence are inextricably linked. American STEMM fields need to better support each and every student to be able to thrive in today's economy and be ready for the jobs of the future. We must pay particular attention to equity and inclusivity in order to increase innovation and make our nation more prosperous and secure. If achieved, a truly equitable and excellent U.S. STEMM ecosystem will ensure a brighter future for all Americans.

Both historically and currently, entrenched systemic barriers have led to unjust and antidemocratic inequities in STEMM fields across race, ethnicity, gender, ability status, income, geography, religion, sexual orientation and more. Barriers faced by those with intersecting identities are often only more pronounced. By nearly every measure, these historically excluded and marginalized communities find less opportunity and access and realize more limited outcomes.

Addressing these barriers and inequities is critical to creating better lives and a more just society, while also being essential to

ensuring excellence in STEMM. Taking action can fuel innovation and growth while allowing the nation to compete on the global stage. Moreover, STEMM jobs are some of the fastest-growing and highest-paying occupations. Improved equity in STEMM will help broaden economic opportunities for more Americans and ensure the country can meet its future talent needs and keep pace with the rate of economic and technological change.

These challenges are not new, and past and current initiatives to establish greater equity in STEMM have driven real progress. Yet opportunity gaps persist, and the pace of progress remains far too slow to be justified on either moral or economic grounds. For too long, organizations have been acting alone, trying to break down systemic barriers that cannot be addressed by single initiatives at single institutions. The change our nation needs requires shared responsibility and coordinated action across all actors throughout the STEMM ecosystem, including all levels of government, philanthropy, industry, educational institutions, professional societies, community leaders and others.

The current moment promises immense opportunity for change. Major government investments and focus have reinforced the role of the American scientific enterprise as a central pillar of the nation's economic strategy to win the future. But without fundamental changes across the STEMM ecosystem, these new investments threaten to reinforce and entrench persistent inequities. Never has the need to improve equity garnered as much interest and attention as it does today—with more and more institutions standing ready to do their part. Combined, these conditions offer great potential to remake the American society and economy for the better.

This document outlines a holistic national strategy for achieving equity in STEMM with a goal of reaching workforce parity in STEMM fields by 2050. This plan is ambitious and comprehensive because that is what is needed to meet the scale and scope of the challenge. It includes evidence-based approaches and action steps and offers metrics by which to track progress. Success will require not just deep cross-sector coordination but sustained commitment and action as well.

The stakes are high. Failure to create an equitable and excellent STEMM ecosystem will weaken U.S. economic competitiveness; exacerbate national and global challenges, like food insecurity and climate change; and slow scientific progress toward a safer, healthier and more connected world. **The time is now** for an innovative, aligned and concerted cross-sector effort to reimagine and redesign the U.S. scientific enterprise for a more prosperous future for all.

The Imperative

Diverse and equitable STEMM fields will better reflect the nation's fundamental values and produce tangible results critical to supporting key national priorities. Advancing STEMM equity will:

- **Expand Economic Growth and Opportunity:** The American economy and its people prosper most when opportunity is broadly shared. STEMM jobs are projected to grow more than other sectors, offer higher wages than non-STEMM careers, produce 69% of gross domestic product and generate over $2.3 trillion in federal tax revenue.[1] As jobs become increasingly more technical and technologically connected, the need for STEMM skills and expertise across the economy increases. Removing systemic barriers that keep historically excluded and marginalized populations out of STEMM jobs and strengthening pathways toward STEMM careers will promote economic growth while expanding opportunities for meaningful and well-paying occupations.
- **Promote Global Competitiveness and National Security:** Keeping pace and exceeding global competitors in STEMM output is essential for the U.S. to ensure economic growth and national security. But the U.S. is ceding ground to its nearest competitors, particularly China, on key indicators like the rate of production of STEMM graduates, Ph.D.s and patents filed.[2] Broadening access and participation in STEMM increases the capacity of the STEMM workforce to react to unique global challenges. Innovation would increase fourfold if women, minorities and children from low-income families became inventors at the same rate as men from high-income families.[3] Equity in STEMM is critical to achieving the excellence and eminence required to expand the nation's scientific power and remain competitive.
- **Advance Rather Than Impede Civil and Human Rights:** The rapid technological advancements expected in the coming years will profoundly shape the world and society we live in for generations to come, but whether that creates change for the better will depend on who is included. New technologies, such as AI, have great potential to solve the most pressing challenges facing our nation and the world. At the same time, biases built into these systems pose real harm to individuals from historically excluded and marginalized communities. For example, studies have found that AI chatbots such as OpenAI's ChatGPT and Google's Bard used to summarize doctors' notes and analyze health records perpetuated racist and debunked

medical ideas.[4] Who builds these technologies, whom they build them for and what values are embedded within their design will define who benefits and who is harmed. It is essential that diverse individuals and perspectives contribute to such advancements.

- **Strengthen Scientific Output:** A large body of research has demonstrated that diverse and inclusive teams produce the highest-quality, most innovative output.[5] In contrast, homogenous teams can lead to weak and ineffective science that fails to consider different needs and perspectives and increases the likelihood of bias—a problem that has contributed to distrust in science and produced dire consequences like disparate health outcomes and biased technologies. A more equitable and inclusive STEMM ecosystem with multiple pathways for development and use of diverse talent will enhance science's relevance, credibility and value.
- **Develop Healthy and Resilient Communities:** Our communities and our nation face unprecedented challenges, including improving access to quality education, providing comprehensive and equitable health care, ensuring access to drinkable water and achieving climate preparedness, among others. Our ability to overcome these challenges will depend on the problem-solving capacity of the STEMM ecosystem to support local and regional innovation, especially equipping communities facing the greatest burden of these challenges to engage in and with science to produce culturally relevant and accessible solutions. STEMM R&D will improve our communities' abilities to create innovative, inclusive solutions.

The Call to Action

At the first-ever White House Summit on STEMM Equity and Excellence, held on December 12, 2022, the White House Office of Science and Technology Policy (OSTP) called for the development of a national strategy for removing institutional barriers to STEMM participation and achieving America's full potential.[6]

This vision included the following five key elements for what a strategy might achieve:

- **Ensure that students, educators, workers, communities and others have adequate support** to participate in and contribute to science and technology throughout their lifetimes.
- **Address the STEMM teacher shortage** — which disproportionately harms underrepresented students — by investing in a high-quality and diverse teacher pipeline.
- **Close the funding gap** and support researchers and communities that have been historically excluded from access to key resources.
- **Scale solutions that root out bias, discrimination and harassment** in the classroom, laboratory and workplace.
- **Promote accountability** across the science and technology ecosystem.

The administration's message is clear: All actors must come together toward robust, measurable and ambitious actions that will help empower a new generation of American innovation and opportunity.

To help answer this call, the American Association for the Advancement of Science (AAAS), in collaboration with the Doris Duke Foundation launched the STEMM Opportunity Alliance (SOA) to serve as the vehicle for organizing and galvanizing cross-sector alignment and action. In 2023, SOA led a yearlong co-construction process to develop a national strategy for achieving STEMM equity and excellence. The effort began with the development of an initial framework that consolidated prevailing literature and effective practices.

Since then, SOA has held 11 STEMM equity summits across the country to solicit insights and feedback on the initial framework from more than 1,400 leaders across all sectors and all regions of the United States.

The summits were held in the following cities:

- **Baltimore, MD,** hosted by Morgan State University in February.[7]
- **Washington, DC,** at the AAAS Annual Meeting in March.
- **New York, NY,** hosted by the New York Hall of Science in April.[8]
- **Jacksonville, FL,** at the STEMM Ecosystems Learning Ecosystems Conference in STEM in May.[9]
- **Los Angeles, CA,** hosted by Snap Inc. in May.[10]
- **Boise, ID,** hosted by Micron Technology in June.[11]
- **St. Paul, MN,** hosted by 3M in August.[12]
- **Chicago, IL,** hosted by the Museum of Science and Industry, Chicago, in August.[13]

- **Atlanta, GA,** hosted by Spelman College in August.[14]
- **Dallas, TX,** co-hosted by Lyda Hill Philanthropies and the National Math and Science Initiative in October.[15]
- **Tempe, AZ,** hosted by Arizona State University in November.[16]

In addition to the feedback received from participants at the aforementioned events, SOA held a monthlong public open comment period to ensure that every stakeholder had a chance to make their voice heard. During the open comment period, SOA solicited written feedback online and held five virtual town halls, where more than 100 individuals provided feedback on the draft national strategy.[17]

Each town hall was dedicated to one of the five foundational pillars that make up the national strategy. Feedback received in SOA's convenings animated the strategy, infusing on-the-ground experiences and ensuring the representation of perspectives from across all sectors. Reactions gathered during the town hall meetings helped secure additional buy-in from the public regarding SOA's approach to advancing equity and excellence in the American STEMM enterprise.

Concurrently, OSTP worked across agencies to develop a five-year strategic plan for how the federal government will help advance these goals. The Administration's plan will serve as an important complement and corollary to the whole-of-ecosystem approaches outlined in this document.

STEMM Equity and Excellence Summits Across the Country

Top: Oona King, Chief Diversity and Inclusion Officer at Uber (formerly VP of DEI at Snap, Inc.) speaking at the White House Summit on Equity and Excellence in STEMM.

Credit: Ariana Perez/AAAS

Middle left: Russlyn Ali, XQ Institute Co-Founder and CEO, speaking at the Southwest STEMM Equity and Excellence Summit.

Credit: ASU/Arizona Board of Regents

Middle right: David Wison, President of Morgan State University; Shirley Malcom, Senior Advisor to the CEO and Director of SEA Change at AAAS; and Aruna Miller, Lieutenant Governor of Maryland, at the Achieving STEMM Equity and Excellence in Postsecondary Education Summit.

Credit: Office of the Governor of Maryland

Bottom: A breakout session at the Northwest STEMM Summit – Achieving Equity and Excellence.

Credit: Micron Technology

The Strategy: A Blueprint to Leverage America's Full Talent in the STEMM Workforce by 2050

This framework proposes a target of reaching parity in the STEMM workforce by 2050 by working together to help 20 million people from historically excluded and marginalized communities enter, contribute to and thrive within STEMM.[18]

In this context, parity is defined as access to and thriving within STEMM learning opportunities, fostering a sense of inclusion and belonging in the workplace, having pay equity, and much more. This goal is far in the future because it has to be, given the scale of the challenge; anything less would be insufficient. Yet, while our work takes a long-term strategic view on the creation of a truly excellent STEMM ecosystem, we engineer our vision into yearly and decadal milestones and goals through the lens of what Dr. Martin Luther King Jr. called the "fierce urgency of now."

This work must take a holistic approach to the populations, jobs and sectors it comprises. It must seek to improve access and opportunity for all historically excluded and marginalized communities, including across race, ethnicity, gender, ability status, income, geography, religion, sexual orientation and intersectional identities. It must target a wide range of occupations, from workers wearing white lab coats to those wearing steel-toed boots. Lastly, it must take a broad view of what defines STEMM sectors, including promoting equitable pathways toward industries that are regionally and culturally relevant, such as agriculture, fisheries, trades and forestry.

Achieving an equitable and excellent STEMM ecosystem will take time and require concerted effort and steady progress. The work of such societal infrastructure development, like community tapestry weaving or legacy construction projects, must be:

- **Long Term:** This strategic plan is a blueprint, but it will take generations for the full vision to manifest. That is why this strategy begins by setting a goal for the future that remains decades away, even as work begins immediately and progress is measured daily.
- **Brick by Brick:** In comparison to the size of the challenge, any individual action may seem small, but immense long-term change will be achieved through the combination of many actions at once and over time. This requires sustained focus, a concerted effort, a methodical approach and a shared strategy.
- **A Collective Responsibility:** The scale of this change cannot be achieved by any single individual or institution operating alone and will require engagement from all corners of the STEMM ecosystem. This extends beyond even SOA and its hundreds of partners that are committed to the cause. The advancement of equity requires all of us.

Constructing an Equitable and Excellent Ecosystem

The strategy includes three structural elements: foundations, pillars and a capstone.

As the work focuses on removing barriers and increasing opportunities via more and improved pathways throughout the entire ecosystem, the pillars target specific goals and strategies for supporting STEMM learners, educators and practitioners throughout their lives and careers.

For this work to be more than the sum of its parts, it must also be coordinated, aligned and sustained, requiring a foundation built on accountability and partnership with dedicated structures and processes. And the work must be brought together under a capstone of strategic communications: narrative change efforts that show excellence and inclusion in STEMM and tell the story of the important work needed and being done to achieve these.

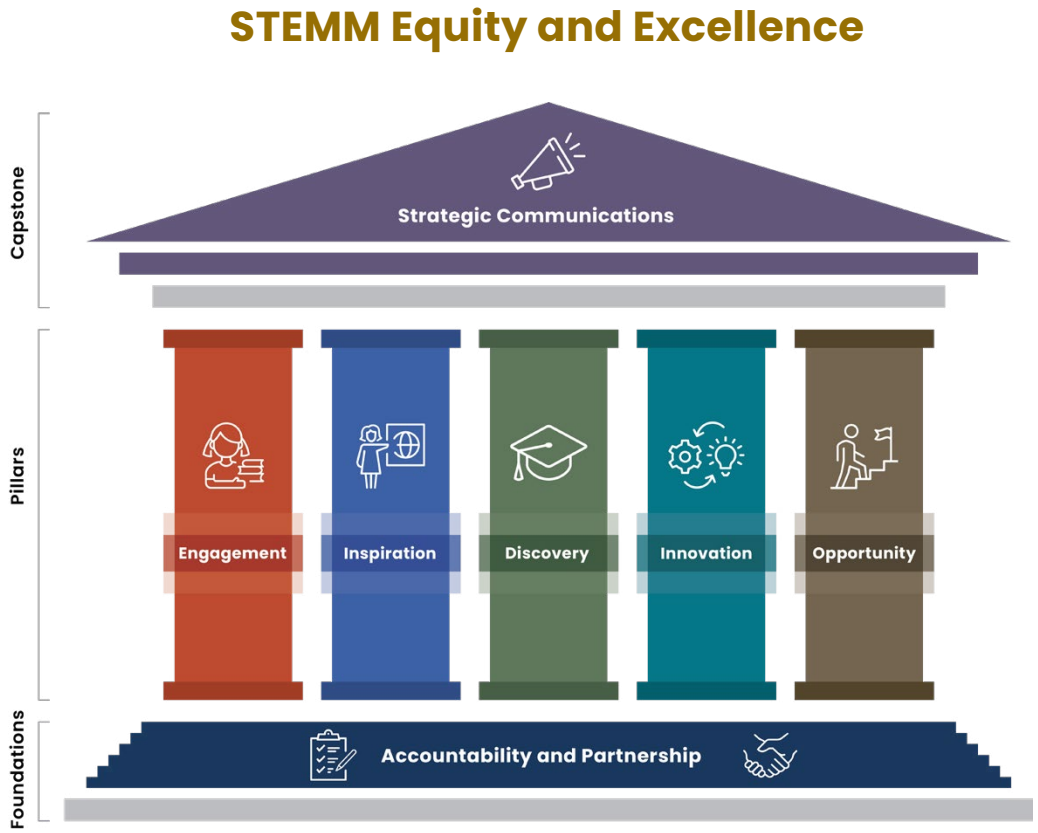


Figure 1: Elements of the National Strategy

Table 1: Strategy Overview

For the full strategy summary including key actors and steps, see Table 3: Strategy Summary on page 79.

Strategy Area	Goals	Key Metrics	Approaches
Accountability and Partnership **Groundwork for Collaborative Action**	**1. Develop strong systems and processes for measuring equity in STEMM to hold ourselves accountable for progress.**	• Annual reporting on the latest state for each of the progress metrics included in the national strategy is released each year, starting in 2025. • 100% of SOA partners have made public commitments aligned with at least one pillar of the national strategy by 2025. • SOA partners have launched a working group for each pillar with detailed metrics for public accountability for the working group's outcomes.	• Establish data-driven accountability structures that allow partners to report and easily understand progress and hold the community responsible for action. • Improve and coordinate data collection across the STEMM ecosystem to broaden, deepen, and strengthen key metrics.
	2. Establish key infrastructure for enabling coordination and collaboration across institutions and sectors, with a focus on building, strengthening and empowering partnerships.	• 50% of SOA partners have engaged in new collaborations to advance the goals of the national strategy by 2035. • SOA has grown to a total of 600 partners by 2042 to advance its goals.	• Facilitate knowledge sharing within and among communities of practice across all STEMM sectors. • Create and amplify opportunities for organizations to work together on concrete equity initiatives that are shared across institutions, regions and sectors.
Engagement **Nurturing Curiosity in Every Child**	**1. Ensure all schools provide rigorous, high-quality mathematics and science coursework with access to necessary learning supports.**	• All students have access to, and 75% of middle school students enroll in algebra courses by 2030. • All high school students have the opportunity to take calculus, physics and other advanced math and science courses by 2040.	• Increase the average amount of time that students spend learning STEMM subjects and the number of accessible, high-quality classes. • Ensure that all secondary school students have access to and are supported in registering for dual and concurrent enrollment classes, taking STEMM AP courses, or engaging in other rigorous academic program opportunities regardless of school district. • Provide access to modern technologies and resources within all pre-K-12 schools and other learning spaces to address the digital divide.
	2. Provide children and their families with equitable access to high-quality STEMM learning experiences, including in informal and technology-enabled settings.	• 3.5 million more youth, with at least 50% from marginalized communities, participate in out of school STEMM learning experiences by 2025. • 6.5 million more youth, with 70% from marginalized communities, participate in after-school STEMM learning experiences by 2030. • All Title I schools have access to after-school STEMM experiences by 2025.	• Increase access to and participation in high-quality informal and community-led STEMM learning opportunities — which have been proven to improve students' comfort with and desire to pursue STEMM education and careers — including equitable partnerships with schools and access to online learning platforms. • Provide ample opportunities for experiential learning so that theoretical and abstract concepts within curricula are better understood, retained and applied. • Introduce children and their parents to STEMM careers and augment the diversity of people in those careers across the range of preparation, from certificate to doctoral education.

Table 1: Strategy Overview *(continued)*

Strategy Area	Goals	Key Metrics	Approaches
Inspiration **Developing Skilled and Diverse Educators**	**1. End the persistent shortage of STEMM pre-K-12 educators.**	• Reduce the STEMM teacher shortage in the hardest to staff schools by one-third by 2035. • End the teacher shortage by 2045 with an increase in average teacher retention across all demographics.	• Expand on-ramps to the teaching profession, including mid- and late-career professionals with STEMM experience in other sectors. • Create regional systems to assess and track teacher workforce gaps, retention and representation.
	2. Diversify the STEMM educator workforce so that it reflects local and regional demographics.	• Double historically excluded and marginalized communities' participation in teacher preparation programs by 2035. • Double the retention of historically excluded and marginalized STEMM educators by 2040. • Provide at least three-quarters of out-of-school STEMM educators with a regular form of professional development, coaching and/or mentorship by 2030.	• Strengthen incentives and support structures to attract and retain educators from a wide range of diverse and intersecting backgrounds. • Align educational norms with evidence that defines excellent education as inclusive, culturally relevant, assessment-informed and delivered utilizing the most current evidence-based teaching and learning strategies.
Discovery **Creating Opportunity for All in Higher Education**	**1. Ensure higher education institutions and their STEMM programs are accessible, inclusive and designed to support the talent development of all people.**	• Cut the enrollment gap for historically excluded and marginalized groups in half by 2030. • Cut the degree-granting gap for historically excluded and marginalized groups in half by 2035.	• Ensure all STEMM programs of study are evaluated on the basis of learning effectiveness across all students and departments and that colleges establish and make progress toward eradicating achievement and opportunity gaps for their students. • Update and improve student admissions, transfer and financial aid processes to use legally sustainable and effective strategies to improve access and enrollment for students from historically excluded and marginalized or nontraditional backgrounds. • Enhance opportunities for students to pursue a broad range of STEMM pathways, including by taking advantage of CCs and RPUs and easing transfers for students with some postsecondary training. • Increase opportunities and support development and awareness of diverse STEMM pathways for nontraditional students and adult learners. • Establish proactive and inclusive educational cultures and environments that include transparency, accountability, ongoing measurement and assessment, and support for all students to ensure the success of students from historically excluded and marginalized populations.
	2. Create equitable and inclusive systems and policies for educating, developing, hiring, retaining and advancing STEMM faculty from historically excluded and marginalized populations across fields of study.	• 100% of R1 and R2 universities adopt evidence-based equity and inclusion strategies and practices for STEMM graduate programs and faculty hiring and advancement. • Historically excluded and marginalized communities comprise one-third of STEMM faculty by 2045.	• Increase equity in efforts to hire, retain and support diverse STEMM faculty across scientific disciplines.

Table 1: Strategy Overview *(continued)*

Strategy Area	Goals	Key Metrics	Approaches
Innovation **Leveraging Diverse Minds in R&D**	**1. Ensure researchers from historically excluded and marginalized communities receive equitable opportunities for funding, career navigation and support.**	• Invest $15 billion in research infrastructure and capacity building at HBCUs, TCUs and other MSIs by 2040. • Double the amount of research funding received by HBCUs, TCUs and other MSIs by 2045. • Close the funding gap for PIs from historically excluded and marginalized backgrounds by 2035.	• Remove barriers to both federal and private grant funding for researchers from diverse backgrounds, targeting opportunities to build research capacity in PIs from historically excluded and marginalized groups. • Build STEMM research capacity and infrastructure within HBCUs and other MSIs. • Expand the diversity of researchers and administrators working in scientific publishing and broader knowledge production. • Expand the understanding and adoption of community-led research, education and service initiatives and community-based organizations that are crucial to engaging underserved populations in advancing STEMM.
	2. Encourage entities in the STEMM R&D ecosystem to utilize robust plans for envisioning and implementing equity.	• Three-quarters of the top 100 U.S. patent-producing organizations commit to robust and actionable equity and inclusion plans by 2035. • The top 100 U.S. patent-producing organizations actively share their progress on equity and inclusion metrics by 2040.	• Develop a process for and continue to improve equity reviews of government, philanthropic and private funding for STEMM research at all decision points. • Implement processes in the public and private sectors that prioritize identifying and addressing disparities and impacts in STEMM R&D. • Expand the use of equitable and legally sustainable strategies for talent identification, recruitment, hiring, retention and promotion.
Opportunity **Ensuring All Workers Thrive**	**1. Remove barriers to identifying, hiring, retaining, developing and promoting persons from historically excluded and marginalized communities in the workplace.**	• 20 million new STEMM workers from historically excluded and marginalized groups are added to the STEMM workforce by 2050. • 10 million new STEMM professionals from historically excluded and marginalized groups by 2035.	• Create well-coordinated on-ramps that value a variety of educational backgrounds for an upwardly mobile STEMM career. • Support formal and informal workforce development strategies that can help workers more easily enter and advance in STEMM careers. • Remove barriers that keep historically excluded and marginalized communities from accessing capital, serving on boards and receiving career coaching. • Uplift and resource affinity programs for historically excluded and marginalized communities in the workplace.
	2. Ensure workplaces feel supportive of historically excluded and marginalized communities.	• All STEMM employers commit to transparent job descriptions and career mobility plans by 2025. • All STEMM employers adopt robust equity and inclusion plans by 2025.	• Root out bias, discrimination and harassment in all STEMM workplaces and support efforts to improve belonging. • Ensure all STEMM companies have robust benefits packages, including parental leave and other family-friendly policies to support workers. • Deploy rigorous and regular employer-sponsored upskilling programs with clear paths for upward mobility in the workplace.

Table 1: Strategy Overview *(continued)*

Strategy Area	Goals	Key Metrics	Approaches
Capstone **Strategic Communications**	**1. Ensure the demographics of STEMM professionals depicted in entertainment and media align with the demographics of the country.**	• Entertainment and media depictions of the STEMM field are inclusive and reflective of the population by 2030.	• Equip STEMM communicators across sectors and venues with the tools and expertise needed to deliver inclusive messages about the critical role of diverse people in STEMM.
	2. Effectively illustrate the importance of diverse perspectives in STEMM and how they are critical to achieving excellence in STEMM.	• All Americans understand the necessity of an inclusive and diverse STEMM enterprise as critical to the U.S.'s scientific, social and economic advancement, health and national security by 2040. • SOA partners have measurably improved media and entertainment content that reflects SOA STEMM inclusivity guidelines by 2035.	• Amplify the voices of individuals from historically excluded and marginalized groups and highlight how their contributions to STEMM positively impact the U.S.'s national security, economic well-being, global competitiveness and innovative capabilities. • Support the translation of STEMM learning materials and other resources to be more inclusive to multilingual individuals and their families.

Table 2: Key Milestones to STEMM Equity

The below timeline summarizes key milestones tied to the pillars described above.

2025

- **Accountability and Partnership:** 100% of SOA partners have made public commitments aligned with at least one pillar of the national strategy.
- **Accountability and Partnership:** Annual reporting on the latest state for each of the progress metrics included in the national strategy is released each year, starting in 2025.
- **Accountability and Partnership:** SOA partners have launched a working group for each pillar with detailed metrics for public accountability for the working group's outcomes.
- **Engagement:** 3.5 million more youth, with at least 50% from marginalized communities, participate in out of school STEMM learning experiences.
- **Opportunity:** All STEMM employers commit to transparent job descriptions and career mobility plans.
- **Opportunity:** All STEMM employers adopt robust equity and inclusion plans.

2030

- **Engagement:** All students have access to, and 75% of middle school students enroll in, algebra courses.
- **Engagement:** 6.5 million more youth, with 70% from marginalized communities, participate in after-school STEMM learning experiences.
- **Engagement:** All Title I schools have access to after-school STEMM experiences.
- **Inspiration:** At least three-quarters of out-of-school STEMM educators are provided with a regular form of professional development, coaching and/or mentorship.
- **Discovery:** 100% of R1 and R2 universities adopt evidence-based equity and inclusion strategies and practices for STEMM graduate programs and faculty hiring and advancement.
- **Discovery:** The enrollment gap for historically excluded and marginalized groups is cut in half.
- **Strategic Communications:** Entertainment and media depictions of the STEMM field are inclusive and reflective of the population.

Table 2: Key Milestones to STEMM Equity *(continued)*

2035

- **Accountability and Partnership:** 50% of SOA partners have engaged in new collaborations to advance the goals of the national strategy.
- **Inspiration:** The teacher shortage in the hardest to staff schools is reduced by one-third with a specific emphasis on STEMM subjects.
- **Inspiration:** Historically excluded and marginalized communities' participation in teacher preparation programs is doubled.
- **Discovery:** The degree-granting gap for historically excluded and marginalized groups is cut in half.
- **Innovation:** The funding gap for principal investigators (PIs) from historically excluded and marginalized backgrounds is closed.
- **Innovation:** Three-quarters of the top 100 U.S. patent-producing organizations commit to robust and actionable equity and inclusion plans.
- **Opportunity:** 10 million new STEMM professionals from historically excluded and marginalized groups are recruited.
- **Strategic Communications:** SOA partners have measurably improved media and entertainment content that reflects SOA STEMM inclusivity guidelines.

2040

- **Accountability and Partnership:** SOA has grown to a total of 600 partners by 2042.
- **Engagement:** All high school students have the opportunity to take calculus, physics and other advanced math and science courses.
- **Inspiration:** The retention of historically excluded and marginalized STEMM educators is doubled by 2040.
- **Innovation:** $15 billion is invested in research infrastructure and capacity building at Historically Black Colleges and Universities, Tribal Colleges and Universities, and other Minority-Serving Institutions by 2040.
- **Innovation:** The top 100 U.S. patent-producing organizations actively share their progress on equity and inclusion metrics.
- **Strategic Communications:** All Americans understand the necessity of an inclusive and diverse STEMM enterprise as critical to the U.S.'s scientific, social and economic advancement, health and national security.

Table 2: Key Milestones to STEMM Equity *(continued)*

2045

Inspiration: The teacher shortage is ended by 2045 with an increase in average teacher retention across all demographics.

Discovery: Historically excluded and marginalized communities comprise one-third of STEMM faculty.

Innovation: The amount of research funding received by HBCUs, TCUs, and MSIs is doubled by 2045.

Opportunity: Three-quarters of the top 100 STEMM employers adopt equity and inclusion plans.

2050

Opportunity: 20 million new STEMM workers from historically excluded and marginalized groups are added to the STEMM workforce.

Foundations
Accountability and Partnership

STEMM Equity and Excellence Foundations

Long-term systemic change is required to achieve equity and excellence in STEMM. This transformation cannot be pursued without (1) robust accountability measures to track progress and compel action, and (2) partnerships among institutions and sectors to improve education and career pathways and break down systemic barriers.

The STEMM ecosystem lacks meaningful data and progress accountability practices needed for actors to hold themselves accountable to each other and the public for progress. Some organizations don't track data at all, and others utilize their own metrics, leading to limited information overall and often an inability to compare across institutions and sectors. Moreover, subpar data collection and analysis can perpetuate harmful research practices antithetical to STEMM equity.[19,20] To collectively understand the challenges and track impact, the ecosystem must do a better job of measuring equity in STEMM. Leaders from across the STEMM ecosystem must collaborate to develop structures and processes across institutions and sectors to support the development of shared education, research and service metrics that the ecosystem collectively values and wants to improve upon.

Increased infrastructure that supports coordination and collaboration will also accelerate efforts for STEMM equity. Connections across institutions are critical to knowledge sharing, scaling of best practices and creation of more education and workforce pathways. Meaningful partnerships and collaborations, in which institutions and sectors from across the STEMM ecosystem and all levels of government cooperate and codesign action in pursuit of shared STEMM equity goals, are especially essential to the systematic transformation that will be necessary to break down entrenched systemic barriers.

Foundations Spotlight

Data-Driven Strategies that Build Better Access: Lessons from Hayward, CA[21]

> ***Achieving STEMM equity and excellence will require interventions to be aligned to community strengths and needs. The National Math and Science Initiative (NMSI), an SOA partner, collaborated with the Hayward Unified School District (HUSD) to align evidence-based programming to the context of a district that educates over 19,000 pre-K-12 students from a variety of diverse cultures, heritages, languages, and economic conditions.***

Working together with the NMSI team, HUSD leadership recognized students in the district were struggling and failing math and science courses—and something needed to change. Determined to solve the issue, the district worked with math leads from HUSD's three high schools to identify the root cause.

The math leads noticed students were failing their math courses heading into ninth grade. To address this gap, HUSD partnered with NMSI to align a solution to their specific context: a summer geometry acceleration program to prepare students for Algebra II. For five weeks during the summer, students from the three high schools at HUSD worked together with teachers for 5½ hours each day.

As a result of the data-driven solution, more Hayward students are going into AP courses and STEMM fields. In fact, 47% of the students who participated in a geometry acceleration program implemented during the partnership are taking an AP math course next school year. However, most importantly, students are recognizing their strengths and believing in themselves.

Foundations
Accountability and Partnership

To promote accountability and partnership in the ecosystem as the foundations of achieving STEMM equity and excellence, SOA recommends targeting the following goals:

Goals

1. **Develop strong systems and processes for measuring equity in STEMM to hold ourselves accountable for progress.**
2. **Establish key infrastructure for enabling coordination and collaboration across institutions and sectors, with a focus on building, strengthening and empowering partnerships.**

Key Actors/Responsible Parties

- **Public and private employers.**
- **Local, state and federal policymakers.**
- **Community and/or nongovernmental organizations.**
- **Media organizations.**
- **Philanthropies.**
- **Educational Institutions.**

Goal 1. Develop strong systems and processes for measuring equity in STEMM to hold ourselves accountable for progress. Shared indicators, more comprehensive and accessible data, and increased transparency will be essential to driving progress toward STEMM equity and excellence by providing the tools necessary to track progress against goals and hold institutions across the STEMM ecosystem accountable to each other.[22]

Key Progress Metrics

- **Annual reporting on the latest state for each of the progress metrics included in the national strategy is released each year, starting in 2025.** Presently, an annual reporting system does not exist and must be developed. Working with its partners, SOA plans to begin construction of an annual reporting process in 2024 to inform

Foundations
Accountability and Partnership

a public dashboard to communicate progress toward intended goals and metrics.

- **100% of SOA partners have made public commitments aligned with at least one pillar of the national strategy by 2025.** Many are already leading important work in this regard and might consider expanding or better aligning that work to the broader strategy, while others may embark on new initiatives informed and enabled by this strategy.
- **SOA partners have launched a working group for each pillar with detailed metrics for public accountability for the working group's outcomes by 2025.** Interested partners will have the opportunity to come together to establish shared metrics for tracking progress on the pillar(s) most relevant to their sectors.

Strategic Approaches and Key Steps

Approach. Establish data-driven accountability structures that allow partners to report and easily understand progress and hold the community responsible for action. Currently, we lack even the basic data available to understand the current state of the STEMM ecosystem let alone the reporting systems needed to track progress.23

- **Working Groups:** Establish cross-sector working groups of partners responsible for cocreating accountability structures and processes.
- **Shared Indicators:** Develop shared indicators of progress toward STEMM equity that include all key sectors and use benchmarks to measure the success of efforts.
- **Accessible Data Collection:** Increase accessibility of public and private data collection and analysis of progress toward shared goals. Provide increased attention to sharing information with the public in a disaggregated format, potentially in a national database, to determine the effectiveness of actions on all communities, especially those who have been historically excluded and marginalized in STEMM.
- **Accessible Data Analysis:** Publish and widely distribute annual reports assessing the progress made by various sectors in the STEMM ecosystem with callouts to high-impact opportunities. Increase attention to sharing information in a disaggregated format, potentially in a nation-wide database.

Approach. Improve and coordinate data collection across the STEMM ecosystem to broaden, deepen, and strengthen key metrics. The National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF) publishes a Diversity and STEM report biennially, offering the U.S. government's most comprehensive presentation of data on diversity in STEM.[24] However, new efforts must broaden, deepen and strengthen data collection across the STEMM ecosystem.

Foundations
Accountability and Partnership

- **Descriptive, Relevant Data:** Working with public and private stakeholders and data providers, collect qualitative and quantitative data in transparent, effective, and efficient methods that enable disaggregation by historically excluded and marginalized populations. Ensure that metrics are reviewed for relevance, efficacy, and efficiency to actively inform program implementation. Identify opportunities to automate data collection to ensure accurate and complete data are regularly collected without placing a high degree of additional burden on institutions and organizations.
- **Community Involvement:** Collaborate with targeted groups to formulate metrics and analyze data, integrating their perspectives into data collection, evaluation, sensemaking, and reporting.
- **Impact on Historically Excluded and Marginalized Communities:** Report on the short- and long-term impact of STEMM equity implementation strategies on targeted communities.

> **Goal 2. Establish key infrastructure for enabling coordination and collaboration across institutions and sectors, with a focus on building, strengthening and empowering partnerships.** Galvanizing coordinated action across all sectors and developing new partnerships will be key to making progress toward the ambitious goals and metrics targeted in the national strategy.[25]

Key Progress Metrics

- **50% of SOA partners have engaged in new collaborations to advance the goals of the national strategy by 2035.** In this context, a new collaboration refers to a new initiative or working group launched by at least two or more institutions that aims to address concrete equity goals in one or more pillars. SOA partners are already stepping up to act as anchor partners for working groups. Learn more about anchor partners on the following page.
- **SOA has grown to a total of 600 partners by 2042 to advance its goals.** In its first year since launch, SOA has already seen a more than 61% increase in partners.[26]

Foundations
Accountability and Partnership

Strategic Approaches and Key Steps

Approach. Facilitate knowledge sharing within and among communities of practice across all STEMM sectors. The insufficient structures for information sharing to date have limited the scaling of best practices and expansion of the most impactful solutions.

- **Collaborative Infrastructure:** Engage SOA partners in a collective impact network that facilitates their ability to collaborate on achieving the goals of the pillars.
- **Communities of Practice:** Anchor partners regularly convene communities of practice from a variety of STEMM sectors (e.g., industry, education, research) to discuss and promote effective steps taken to improve equity.
- **Centralized Platforms:** Establish centralized platforms, such as a shared database of programs implemented by SOA partners and improved national STEMM data systems, to facilitate knowledge sharing and cultivation across the STEMM ecosystem.

Approach. Create and amplify opportunities for organizations to work together on concrete equity initiatives that are shared across institutions, regions and sectors. Collaborations among multiple parties are key to breaking down systems-level barriers that no individual institution could achieve on its own.[27]

- **Working Groups:** Establish cross-sector working groups that meet on a regular basis to establish, utilize and iterate on equity action plans in different areas.
- **Multi-Partner Collaborations:** Launch and create dedicated support, funding and infrastructure for new equity initiatives that are led by two or more partners, especially those that bring together institutions from different sectors.

SOA Anchor Partners Explained

The implementation of this national strategy will be led by a set of anchor partners working with the support and infrastructure of SOA. Each foundation and pillar will have one or multiple SOA partner organizations serving as the anchor partner(s) that will be tasked with coordinating planning and aligned action among relevant stakeholders. The anchor partners will be enablers, power diffusers, conveners, and network weavers, with the SOA team providing key coordinating infrastructure and support.

STEMM Equity and Excellence Pillars

STEMM Equity and Excellence Pillars

This strategy for advancing STEMM equity and excellence centers around five key pillars: **Engagement, Inspiration, Discovery, Innovation** and **Opportunity**.

I. Engagement: Nurturing Curiosity in Every Child. To bring more diverse talent into STEMM requires starting early. Engagement with STEMM throughout childhood is essential to nurturing and harnessing curiosity and exploration and opening pathways to future opportunities. Strategies for impact include increasing time spent in STEMM learning experiences in and outside school; improving access to rigorous coursework, such as that provided in Advanced Placement (AP) and dual-credit classes; equipping parents and caregivers to support their children's engagement in STEMM; and expanding accessible technology-based learning opportunities.

II. Inspiration: Developing Skilled and Diverse Educators. Early engagement in STEM learning experiences can open opportunities, but educators provide the infrastructure that supports joyful, rigorous and relevant STEM learning. We need far more skilled math and science educators, in both in- and out-of-school learning environments, to meet demand. And we need those educators to reflect the demographics and identities of the students they teach. Strategies for impact include strengthening educator retention, creating opportunities for professional development and expanding on-ramps to the teaching profession.

III. Discovery: Creating Opportunity for All in Higher Education. Postsecondary education provides students with the opportunity to gain new skills, knowledge and experience that can lead to the jobs and industries of the future. However, students from historically excluded and marginalized groups are systemically disadvantaged. We must close the opportunity gap in higher education for all people. Strategies for impact include reinventing enrollment practices, advancing evidence-based pedagogy to research-based active learning and experiential models, especially research- or inquiry-based and service-learning teaching methods, and increasing financial support for HBCUs, Hispanic-Serving Institutions (HSIs), TCUs other MSIs, and Community Colleges (CCs).

STEMM Equity and Excellence Pillars

IV. Innovation: Leveraging Diverse Minds in R&D. Diversity is a catalyst for innovation. We need to bring diverse minds into our research community in order to drive innovation and solve the challenges of the future. Strategies for impact, which must work in concert to achieve change, include eliminating barriers to research funding faced by people from diverse backgrounds, developing processes for supporting community-led research and advancing equity in R&D—from supporting innovation infrastructure at HBCUs, HSIs, TCUs and other MSIs to furthering diverse community engagement in research and clinical trials.

V. Opportunity: Ensuring All Workers Thrive. True equity will require that all workers have opportunities to thrive in STEMM jobs and careers and in those non-STEMM jobs that employ STEMM skills. Strategies for impact include supporting workforce entry and reentry across STEMM pathways, elevating equity-centered entrepreneurs and businesses, and rooting out bias, discrimination and harassment in workplaces.

Each pillar is outlined below, with key goals, approaches for achieving them and specific steps that could be taken. Working in concert, all are required to stand up a robust and effective plan. Many will require action by all institutions, some will require policy change and most will demand greater public, private and philanthropic funding. The outlines provide short lists of potential key actors for each area.

Pillar 1
Engagement

I. Engagement: Nurturing Curiosity in Every Child

Engagement with STEMM throughout childhood is essential to nurturing curiosity and opening pathways to future opportunities.

Despite the proven benefits of increased STEMM engagement, not all children have equal access to high-quality STEMM learning opportunities. Half of U.S. high schools don't offer calculus, 40% don't offer physics and 35% lack other advanced math classes.[28] Schools with a high proportion of Black and Latino students are 10% less likely to offer these classes at all.[29] Access to high-quality learning experiences is similarly uneven outside school, leading children from low-resourced communities and minority backgrounds to be less likely to participate in STEMM-focused out-of-school activities.

This lack of access is the result of systemic problems such as inequitable investment in school systems and digital infrastructure, disparities in disciplinary actions, and health challenges affecting children of color, children with disabilities, young girls and those facing other structural disadvantages.

To nurture curiosity in every child, SOA recommends targeting the following goals:

Goals

1. **Ensure all schools provide rigorous, high-quality mathematics and science coursework with access to necessary learning supports.**
2. **Provide children with equitable access to high-quality STEMM learning experiences, including in informal and technology-enabled settings.**

Key Actors/Responsible Parties

- **Federal, state and local policymakers.**
- **Pre-K-12 institutions and educators.**
- **Community-based organizations.**
- **Museums, science centers and zoos.**
- **Local and regional businesses.**
- **Parents, guardians and caregivers.**
- **Out-of-School, after-school and summer learning programs.**
- **Leaders in the media and entertainment industry (e.g., screenwriters, producers, actors).**

Pillar 1
Engagement

Goal 1. Ensure all schools provide rigorous, high-quality mathematics and science coursework with access to necessary learning supports. U.S. student performance on international standardized tests has not improved in more than a decade, indicating an inability for students to retain and apply concepts.[30]

Key Progress Metrics

- **All students have access to, and 75% of middle school students enroll in, algebra courses by 2030.** At present, 80% of eighth grade students have access to Algebra I, but only about 24% of those students enroll in the course.[31]
- **All high school students have the opportunity to take calculus, physics and other advanced math and science courses by 2040.** Recent studies show that only 50% of high schools offer calculus, 60% offer physics and 65% offer advanced mathematics courses.[32]

Strategic Approaches and Key Steps

Approach. Increase the average amount of time that students spend learning STEMM subjects and the number of accessible, high-quality classes. Kindergarten-third grade students spend an average of 57 minutes per day learning math and 18 minutes studying science compared to 89 minutes dedicated to reading and language arts. Students in fourth-sixth grades spend 63 and 27 minutes, respectively, studying mathematics and science.[33]

- **Universal Design:** Invest in a universal design of STEMM curricula and learning spaces so that the greatest number of people can benefit.
- **Professional Support:** Create the support needed for school districts to develop and implement inclusive curricula for STEMM subjects, including, but not limited to, identifying and addressing funding, teacher quality and culturally responsive pedagogy.
- **Resource Sharing:** Create resources for open-source learning plans on STEMM materials and support more inclusive and learner-focused curricular development in pre-K-12 schools.

Pillar 1
Engagement

Approach. Ensure that all secondary school students have access to and are supported in registering for dual and concurrent enrollment classes, taking STEMM AP courses, or engaging in other rigorous academic program opportunities regardless of school district. Approximately four in 10 high schools offer AP biology or physics courses.[34] Though dual enrollment is offered at approximately 88% of schools, only 34% of students take dual enrollment college courses in high school.[35]

- **Access to Advanced Courses:** Remove barriers and increase encouragement for students of color, students with disabilities and students facing other structural obstacles to access and success in advanced STEMM courses (e.g., AP, dual enrollment and concurrent enrollment courses), including access to early learning experiences that prepare students for success.

Approach. Provide access to modern technologies and resources within all pre-K-12 schools and other learning spaces to address the digital divide. Approximately 23.5 million students attend schools that do not meet the Federal Communications Commission's bandwidth connectivity standards.[36]

- **Broadband Infrastructure:** Invest in high-speed internet infrastructure to build the capacity of schools, communities and families, especially in rural areas, districts, and national and regional nonprofit programs to support STEMM learning.
- **Tech Equipment:** Provide students with access to high-quality facilities and equipment, such as science and computer labs, and in-classroom tools, such as tablets and other learning technologies, and teach fundamental skills courses exploring how to best leverage these tools.

Goal 2. Provide children and their families with equitable access to high-quality STEMM learning experiences, including in informal and technology-enabled settings. An estimated 24.6 million children have expressed interest in but lack access to after-school programming.[37]

Key Progress Metrics

- **3.5 million more youth, with at least 50% from marginalized communities, participate in out of school STEMM learning experiences by 2025.** Nearly 25 million students were unable to participate in after-school programs in 2020.[38]
- **6.5 million more youth, with 70% from marginalized communities, participate in after-school STEMM learning experiences by 2030.** Though barriers remain, after-school STEMM

Pillar 1
Engagement

programs are becoming increasingly more available to girls and Black and Hispanic/Latinx students.[39]

- **All Title I schools have access to after-school STEMM experiences by 2030.** Current federal spending allocations for after-school programming do not meet the demand by parents and students for such programs.[40]

Strategic Approaches and Key Steps

Approach. Increase access to and participation in high-quality informal and community-led STEMM learning opportunities — which have been proven to improve students' comfort with and desire to pursue STEMM education and careers — including equitable partnerships with schools and access to online learning platforms.[41] Three out of four students enrolled in after-school programs have access to STEMM learning opportunities.[42]

- **Informal Learning Opportunities:** Identify ways to incorporate rigorous, research-based STEMM learning during childhood play and outside formalized learning settings and support parents and guardians in affirming, creating and participating in informal STEMM learning opportunities for children.
- **Early STEMM Introduction:** Greatly expand the focus of federal investment in the Head Start Program and 21st Century Community Learning Centers (21CCLC) programs to incorporate early childhood engagement and learning, inclusive of STEMM, that encourages discovery and social-emotional development.
- **Data Systems:** Leverage and strengthen national surveys of out-of-school STEMM participation, such as the Afterschool Alliance's America After 3PM survey, to better track program quality, access and reach.
- **Capacity Building:** Build the capacity and financial support for community-led organizations, both grassroots and national, to provide high-quality STEMM learning experiences.
- **Asset-Based Approaches:** Invest in efforts to collaborate with individuals to elevate human experiences and prioritize the cultural identities of various communities and identities within corporations, small businesses and government in an effort to deploy a wide array of youth-led, joyful STEMM learning experiences that nurture curiosity in children.

Approach. Provide ample opportunities for experiential learning so that theoretical and abstract concepts within curricula are better understood, retained and applied. Engaging in hands-on experiential learning opportunities enables students to develop real-world skills, better understand concepts and practice STEMM skills in a safe and supportive environment.[43]

- **Innovative Pedagogy:** Study, support and implement innovative pedagogical approaches,

Pillar 1
Engagement

including work-based, project-based and other experiential learning.

- **Experiential Learning:** Develop partnerships between local industry and educational institutions to increase access to relevant experiential learning opportunities.
- **Authentic STEMM Learning:** Empower students to engage in fruitful learning opportunities outside school hours at zoos, science centers, museums, state and national parks, national and federal laboratories, entertainment and media, and other such places that foster authentic STEMM learning experiences.

Approach. Introduce children and their parents to STEMM careers and augment the diversity of people in those careers across the range of preparation, from certificate to doctoral education. At present, 24% of the STEMM workforce is comprised of Black, Hispanic and Indigenous Americans, while 18% of STEMM workers are women and 24% have one or more disability.[44,45]

- **Career Exposure:** Expand and strengthen career fairs, in-class presentations, informative webinars and work-based learning opportunities to build applied knowledge and professional networks.
- **Uplift Historically Excluded and Marginalized Professionals:** Support specific efforts to highlight professionals from historically excluded and marginalized groups in order to redefine norms around who belongs in STEMM.
- **Connect to Regional Economies:** Support specific efforts to highlight professionals from local areas, tying culturally relevant relationships from a community's educational institutions to local economies and leveraging science and technology infrastructure to boost impact.
- **Expand STEMM Narratives:** Support efforts to expand STEMM narratives, ensuring trade, agriculture and other critical occupations are seen and highlighted as valued and viable STEMM career pathways open to all. Ensure that these work environments are inclusive, depicted as such in popular media and portrayed as being integral to the STEMM field.

Engagement Spotlight

Igniting Passion for STEMM in Girls from Historically Excluded and Marginalized Groups

> ***To achieve STEMM equity and excellence, we must educate and prepare generations of diverse talent to become the STEMM workforce of tomorrow. SOA partner Techbridge Girls is nurturing curiosity by re-engineering STEMM education for girls in ways that can help foster a sense of belonging in STEMM fields.***

Techbridge Girls develops curricula and trains out-of-school STEMM educators in a hands-on, story-based curriculum meant to ignite a passion in girls from historically excluded and marginalized groups and foster a sense of belonging in STEMM. As a result, girls get to tinker with big ideas in student-centered, collaborative environments and break down barriers, disrupt inequitable systems, and impact the next generation of scientists and engineers.

Sarah Misha, alumna of Techbridge Girls from 2006-2014 and current Ph.D. candidate in biomedical engineering at the Johns Hopkins School of Medicine, shared that Techbridge Girls "changed her life." Despite few resources at her school, the thrill of afterschool programs assisted her—a first-generation American, high school and college grad—to excel in STEMM. While engaging in unique experiments, she quickly learned that she, too, could be a scientist and engineer.

Through its national network, Techbridge Girls impacts over 25,000 girls like Sarah annually, and the organization looks to reach over one million by 2030 by equipping educators across the country to bring access-based frameworks into learning spaces and shaping a love for STEMM amongst young learners.

Pillar 2
Inspiration

II. Inspiration: Developing Skilled and Diverse Educators

Achieving STEMM equity and excellence will require large-scale efforts to educate and prepare generations of diverse talent to become the science and technology workforce of tomorrow.

To meet this demand, the U.S. needs far more skilled STEMM educators, from pre-K through postsecondary education, in addition to well-equipped after-school, out-of-school and informal education leaders. These educators need to prepare all learners, especially those as young as pre-K-third grade, to meaningfully engage with STEMM. Just as important, those educators need to reflect the demographics and identities of the students they teach.

Educator biases and lack of access to diverse educators sway many historically excluded and marginalized students from pursuing STEMM. Transforming our nation's STEMM education and learning ecosystem requires developing and being vigilant about recruiting, preparing and retaining a diverse pool of educators who can represent and inspire children from communities that have been historically excluded. These educators must also be prepared in a manner that reflects the latest educational research so that their students can be at the forefront of knowledge. We must set up these hardworking educators for success by providing them with the tools and working environment needed to nurture young talent.

To develop skilled and diverse educators, SOA recommends targeting the following goals:

Goals

1. **End the persistent shortage of qualified STEMM pre-K-12 educators.**
2. **Diversify the STEMM educator workforce so that it reflects local and regional demographics.**

Pillar 2
Inspiration

Key Actors/Responsible Parties

- **Federal, state and local policymakers.**
- **Local school districts.**
- **After-school, out-of-school and informal educators.**
- **Postsecondary teacher preparation programs.**
- **Parent-teacher associations and organizations.**
- **Teaching professionals.**
- **Teaching licensors.**

Goal 1. End the persistent shortage of STEMM pre-K-12 educators. Research estimates that there are at least 200,000 more teachers needed throughout the United States, with teachers of science and mathematics some of the hardest positions to fill; however, the quantity and quality of current educators need to be better understood for a complete picture.[46]

Key Progress Metrics

- **Reduce the STEMM teacher shortage in the hardest to staff schools by one-third by 2035.** Not only are under-resourced urban and rural schools reportedly harder to staff, but science and mathematics rank among the trickiest subjects to fill.[47]
- **End the teacher shortage by 2045 with an increase in average teacher retention across all demographics.** Current research indicates that only one-fifth of educators identify as people of color, and they have higher turnover rates than their white peers.[48]

Strategic Approaches and Key Steps

Approach. Expand on-ramps to the teaching profession, including mid- and late-career professionals with STEMM experience in other sectors. For instance, rigorous apprenticeship programs have been shown to boost access to teacher training and more closely match racial and linguistic diversity.[49] Aggregated research also shows that hiring reform can be an effective, low-risk intervention, but it requires proper coordination across schools, districts, governments and labor.[50]

Pillar 2
Inspiration

- **Preservice Teacher Preparation:** Significantly expand the types and number of opportunities for affordable, comprehensive and evidence-based on-ramps to teaching in order to increase access and excellence, especially including apprenticeships.
- **Expand Teacher Licensing:** Advocate for and implement policies that increase the flexibility of teacher licensing while maintaining quality standards.
- **Teaching Apprenticeships:** Scale effective teaching apprenticeship programs.
- **Reform Hiring:** Increase ability for school administrators to hire excellent and well-qualified teaching professionals for open positions, especially those from nontraditional educational pathways.

Approach. Create regional systems to assess and track teacher workforce gaps, retention and representation. National data sources are not considered comprehensive enough for a full understanding of these worker shortages, and it is difficult to compare state-level data due to differing metrics, methods and points of contact.[51] In full, it is difficult for leaders — especially policymakers — to take an evidence-based approach to solving the teacher shortage when there is a lack of data to drive their actions.

- **Measure Teacher Shortages:** Project and forecast teacher shortages and representation at the national, regional, state and local levels to proactively manage and inform workforce policy.
- **Clear Teaching Trajectories:** Create pathways for teacher career advancement and salary increases throughout the STEMM teacher career trajectory, including opportunities for externships to enable educators to gain STEMM industry experience. In addition, reward strategic educator career advancement, including for those who are teacher leaders, those who are mentors and those who serve in high-need settings.

Inspiration Spotlight

Get the Facts Out Teacher Recruitment Campaign

> ***To achieve STEMM equity and excellence, the nation will need more well-prepared educators that represent the future of the workforce. SOA partner Beyond100K mobilizes multi-sector networks to fill these vital gaps, especially for Black, Latinx, and Native American communities, by supporting programs like the Colorado School of Mines'*** **Get the Facts Out *campaign.***

In 2017, Wendy Adams, Research Professor and Teach@Mines Director at Colorado School of Mines, joined a Beyond100K Project Team to address causes of the STEMM teacher shortage. Data at that time showed that STEMM undergraduates rarely considered a teaching career.

Supported by Beyond100K's network, collaboration tools, and pilot funding, Adams and the Project Team developed the concept for the *Get the Facts Out* (GFO) recruitment campaign to dispel common negative myths about teaching. This work led to additional funding from the National Science Foundation and has engaged 6,500 undergraduate students and 3,000 faculty in workshops since 2017, with great results: one-third of students shift towards greater agreement with "I want to be a teacher" after a GFO workshop.

Many organizations are working toward inspiring and developing the next generation of diverse STEMM educators. By providing opportunities for connection, collaboration, and action, Beyond100K supports partner organizations to make and succeed at public commitments to end the STEMM teacher shortage.

Pillar 2
Inspiration

Goal 2. Diversify the STEMM educator workforce so that it reflects local and regional demographics. Evidence shows that K-12 teachers and out-of-school educators with similar backgrounds to their students have an enhanced ability to serve as mentors and role models, leading to improved student educational outcomes.[52,53,54,55]

Key Progress Metrics

- **Double historically excluded and marginalized communities' participation in teacher preparation programs by 2035.** Aggregated research shows that fewer racially diverse candidates are enabled to pursue such programs, about 150,000 of the nearly 500,000 candidates.[56]
- **Double the retention of historically excluded and marginalized STEMM educators by 2040.** Independent data analysis showed that teacher turnover rates continued to rise in recent years, hitting a five-year high in 2022.[57]
- **Provide at least three-quarters of out-of-school STEMM educators with a regular form of professional development, coaching and/or mentorship by 2030.** Studies on out-of-school educators show that some sort of professional development can enhance retention, satisfaction and student outcomes.[58]

Strategic Approaches and Key Steps

Approach. Strengthen incentives and support structures to attract and retain educators from a wide range of diverse and intersecting backgrounds. Barriers to a diverse workforce include ineffective debt relief programs, lagging wages and a lack of support for public schools.[59,60,61]

- **Debt and Tuition Relief:** Support educator-focused student loan forgiveness initiatives and expand the number and amount of STEMM educator scholarships.
- **Fair Public Finance:** Stabilize and increase funding for public schools, especially allocating funds for evidence-based STEMM programs and competitive teacher compensation.
- **Public Support for Teaching:** Increase positive public support for the teaching profession, including recognition through improved salaries and enhanced valuing of the roles of these professionals in society.

Pillar 2
Inspiration

Approach. Align educational norms with evidence that defines excellent education as inclusive, culturally relevant, assessment-informed and delivered utilizing the most current evidence-based teaching and learning strategies. Surveys of both employers and educators show a harrowing skills gap for today's students to succeed at work.[62] However, inclusive education has been shown to improve students' academic and social outcomes critical to bridging the gap.[63,64] School and district leadership play a critical role in shifting norms and increasing teacher retention.[65] Also, strategies like participation in communities of practice and professional societies deepen educators' relationships with students and course materials and continually ensure educators have the most contemporary evidence-based tools.[66,67]

- **Healthy Teaching Environments:** Provide students and educators with the services needed to promote and protect their total well-being, including mental health, and to support safe, inclusive and equitable learning and teaching environments. Implement widely accepted credentials for social-emotional learning and anti-bias teaching.
- **Collaborative Professional Development:** Create opportunities for professional learning and leadership along with the opportunity to work collaboratively within and across schools and community-led organizations through local communities of practice. Create opportunities to understand emerging and engaging teaching techniques and other education research trends.
- **STEMM Specialization:** Support advanced STEMM certifications and advanced credentials for educators who serve students across the elementary through postsecondary spectrum. Also, ensure that more STEMM students receive teaching skills and that students pursuing a degree in education have access to and can pursue STEMM concentrations.
- **Educator-Employer Dialogues:** Establish local, regional and national forums and channels that connect employers and educators to create shared curricula and employee expectations.
- **Forward-Thinking Leadership:** Develop and retain strong leadership at the school and district level, while providing professional development opportunities to existing and new leaders.
- **State of the Art Pedagogy:** Utilize professional societies for scientists, engineers, health professionals, educators and more to provide professional development opportunities, especially for new and emerging topics in STEMM pedagogy.

Pillar 3
Discovery

III. Discovery: Creating Opportunity for All in Higher Education

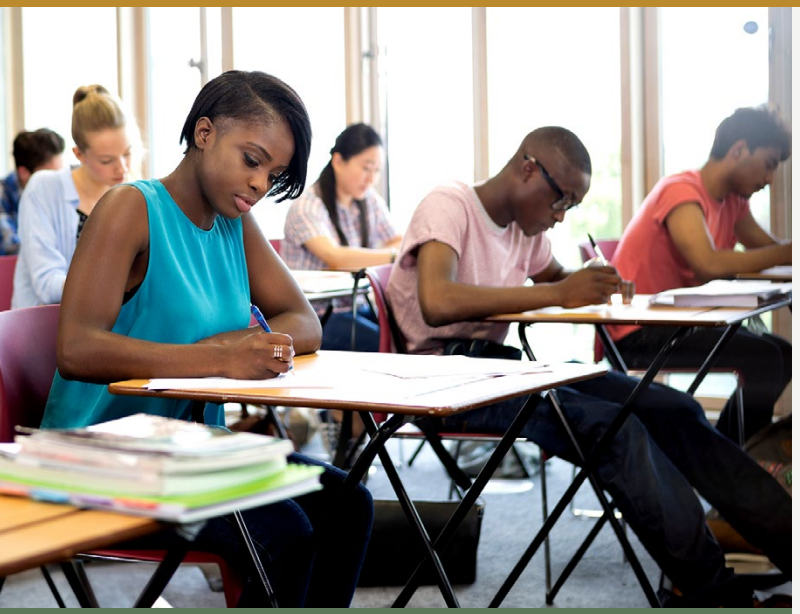
Postsecondary education provides students with the opportunity to gain new skills, knowledge and experience that can lead to jobs in the industries of the future.

However, students from historically excluded and marginalized groups are systemically disadvantaged in terms of access and support.[68,69,70] We must close the opportunity gap for all students in postsecondary education. The 2023 Supreme Court decision to narrow the consideration of race/ethnicity in admissions decisions, combined with legislative action in several states to limit diversity, equity and inclusion initiatives at the collegiate level, requires institutions to reconsider and reimagine biased historical practices that have been shown to exclude students on the basis of social identities.

The institutional change required for institutions to meet America's higher education needs must include navigating the updated legal parameters to create equitable pathways for all students. According to one model, the limitations placed on the consideration of race within college enrollment could lead to a 10% reduction in the representation of underrepresented minorities at U.S. four-year colleges, presenting a grave threat to our ability to expand the nation's workforce to meet the urgent challenges of tomorrow.[71]

Ensuring students from historically excluded and marginalized communities are guaranteed opportunities within higher education will require dedicated efforts and reforms across all types of institutions: from historically Black colleges and universities (HBCUs) and minority-serving institutions (MSIs) to predominantly white institutions (PWIs); from public and private universities to community colleges (CCs); and from regional public universities (RPUs) to R1 research institutions.

While all higher education institutions must play a role in driving opportunity for all, those that have historically and contemporaneously received more resources must do more to maintain and propel America's system of higher education as arguably the greatest in the world. Institutions that have traditionally reinforced barriers to equity and inclusion, such as elite PWIs and R1 universities, must make an intentional effort to tear down barriers to opportunity for prospective and current students from historically excluded and marginalized communities. Those that have traditionally been leaders in serving underrepresented communities, such as HBCUs, CCs, RPUs and other MSIs, must be given greater capacity and resources to expand their reach and scale proven models.



Discovery Spotlight

Innovative Solutions for Student Success: Academic Recovery Accelerator

> ***Achieving STEMM equity will require postsecondary institutions to rethink how they support students, especially those from historically excluded and marginalized communities. SOA partner University Innovation Alliance (UIA) — a leading coalition of public research universities — designs interventions to support students' academic success.***

Building on the success of Georgia State's Accelerator Academy, UIA developed the Academic Recovery model to mitigate the negative impacts of drop, fail, and withdraw grades. These grades tend to disproportionately affect academic progression for low-income students and students of color in postsecondary education. Under the model, institutions analyze course metrics to determine which courses have the largest impact on their campuses. Then, students who were unsuccessful in an academic attempt are recruited to a tailored section of that course designed to help them succeed on their next attempt.

Eleven universities implemented the Academic Recovery Accelerator, using support services like academic coaching, dedicated faculty, supplemental instruction, predictive analytics, and chatbot nudges. Nine UIA universities specifically chose STEMM courses, like math, computer science, and chemistry, given that STEMM courses can have the highest failure rates and an outsized impact on whether students persist in college.

Initial results from the pilot are promising: on average, 77% of students who participated in the accelerator succeeded upon retaking a course, compared to 55% of students who did not participate in the accelerator.

Pillar 3
Discovery

To create opportunity for all in higher education, SOA recommends targeting the following goals:

Goals

1. **Ensure higher education institutions and their STEMM programs are accessible, inclusive and designed to support the talent development of all people.**
2. **Create equitable and inclusive systems and policies for educating, developing, hiring, retaining and advancing STEMM faculty from historically excluded and marginalized populations across fields of study.**

Key Actors/Responsible Parties

- **Postsecondary institutions.**
- **State and local policymakers.**
- **Community organizations.**
- **Professional societies.**
- **Public and private funders.**

Goal 1: Ensure higher education institutions and their STEMM programs are accessible, inclusive and designed to support the talent development of all people. While Black, Hispanic and Native American students now aspire toward STEMM degrees at the same rate as white and Asian American students, there are persistent disparities in completion rates: One study found that only 22% of Black STEMM degree seekers complete their degree in six years compared to 52% of white STEMM degree seekers.[72]

Key Progress Metrics

- **Cut the enrollment gap for historically excluded and marginalized groups in half by 2030.** Following the 2023 Supreme Court decision to narrow the use of race in admissions decisions, ensuring equitable enrollment is now more urgent than ever before. In California, where the use of race in admissions decisions has been banned since 1996, the University of California saw a 23-percentage point gap between freshmen enrollment from underrepresented minorities and corresponding high school graduates in 2020.[73]

Pillar 3
Discovery

- **Cut the degree-granting gap for historically excluded and marginalized groups in half by 2035.** An analysis of U.S. Census Bureau data from 2013 to 2017 found that 23% of white adults (ages 25-64) held a bachelor's degree compared to 14% of Black adults, 11% of Latinx adults and 10% of American Indian and Alaska Native adults.[74]

Strategic Approaches and Key Steps

Approach. Ensure all STEMM programs of study are evaluated on the basis of learning effectiveness across all students and departments and that colleges establish and make progress toward eradicating achievement and opportunity gaps for their students. A growing body of research finds significant evidence that higher education institutions fail to support students from historically excluded and marginalized communities.[75]

- **Systemic Improvement Plans:** Ensure all higher education institutions implement evidence-based systemic improvement plans to improve outcomes for all, especially focusing on addressing the systemic barriers that have blocked access and success for persons from historically excluded and marginalized communities.

Approach. Update and improve student admissions, transfer and financial aid processes to use legally sustainable and effective strategies to improve access and enrollment for students from historically excluded and marginalized or nontraditional backgrounds. Following the recent Supreme Court decision on the use of race in admissions decisions, reinventing admissions and other processes is especially important now to ensure inequities do not expand and indeed can continue to decline within this new landscape.

- **Audit Recruitment Practices:** Audit student recruitment practices for separate enrollment processes into STEMM degree programs.
- **Holistic Review Enrollment:** Emphasize holistic reviews, including reconsidering the use of historical merit measurements like standardized test scores (e.g., school exams, ACT/SAT, GRE, MCAT) in the application process.
- **Partnerships for Student Support:** Build the capacity of community-led organizations to authentically partner in equitable relationships with institutions of higher education to support increased access to STEMM degrees for students from historically excluded and marginalized communities while engaging in research that mutually benefits students, community organizations and institutions of higher education.
- **Cost and Affordability Improvement:** Advocate for increased federal investments in financial aid and state-level systemic reforms aimed at increasing the affordability of higher education. Additionally, connect prospective and current higher education students to financial aid and scholarship resources.

Pillar 3
Discovery

Approach. Enhance opportunities for students to pursue a broad range of STEMM pathways, including by taking advantage of CCs and RPUs and easing transfers for students with some postsecondary training. Students from historically excluded and marginalized backgrounds are strongly represented in CCs: In 2023, 27% of CC students were Hispanic and 12% were Black.[76] Likewise, RPUs play an important role in closing university attainment gaps for students from historically excluded and marginalized communities: One study of Great Lakes RPUs found that 71% of Black students enrolled at a public university in the region were enrolled at an RPU.[77]

- **Seamless Student Transfer:** Create a nationwide system of articulation agreements that allow students to easily transfer in order to find effective STEMM degree pathways.
- **Two-year to Four-year Transfers:** Strengthen and simplify transitions from two-year and associate programs to four-year college degree programs.
- **Community Colleges:** Position CCs not only as a steppingstone for students aiming for four-year degrees but also as a viable educational mid- and endpoint for students. Support and scale programs that better connect STEMM talent at CCs with employers.
- **RPUs:** Increase funding for and awareness of RPUs and support efforts to encourage nontraditional students and students from historically excluded and marginalized backgrounds to enroll in RPUs.

Approach. Increase opportunities and support development and awareness of diverse STEMM pathways for nontraditional students and adult learners. Estimates show that nontraditional students make up 40% of undergraduates at U.S. colleges and universities.[78]

- **Military Credit Programs:** Bolster and scale programs that translate military service and training into academic credits at four-year institutions to create opportunities for veterans that will open the door to STEMM careers.
- **Nontraditional Postsecondary Learning:** Support and scale nontraditional postsecondary STEMM learning programs such as coding bootcamps, STEMM apprenticeship programs, badging and work-to-learn programs.
- **Increase Support for Nontraditional Students:** Provide access to learning opportunities, funding support, wraparound services and mentorship for older learners and other nontraditional students in their educational endeavors.

Pillar 3
Discovery

Approach. Establish proactive and inclusive educational cultures and environments that include transparency, accountability, ongoing measurement and assessment, and support for all students to ensure the success of students from historically excluded and marginalized populations. A 2023 report from the National Academies of Sciences, Engineering, and Medicine found that higher education institutions must not only increase the participation of students from historically excluded and marginalized communities but also take steps to adjust their environment and organizational culture to become welcoming and supportive of inclusion and belonging.[79]

- **School and Career Navigation:** Support students with robust one-on-one counseling to decide majors, identify academic supports and consider career pathways.
- **Suspend Exclusionary Courses:** Improve teaching in introductory courses with successful research-based approaches that foster STEMM learning for all at multiple learning levels.
- **Expand Academic Engagement:** Broaden the availability of curricular and cocurricular engagements, including corequisite remediation, bridge programs, internships, mentorships and sponsorships, peer support groups, undergraduate research opportunities and more.
- **Effective Reporting Structures and Consequences:** Create safe and reliable reporting structures and institute appropriate consequences for incidents of bias, discrimination and harassment.
- **Equity-Centered Professional Development:** Provide faculty with opportunities to learn skills that contribute to creating more inclusive learning environments and value and reward culturally responsive and effective mentorship.
- **Expand Undergraduate Research:** Create opportunities for all undergraduate students at two- and four-year institutions to substantially engage in research, both as credit toward degree-granting programs and to cultivate personal interests.
- **Strengthen Supports for Graduate Students:** Increase targeted support and mentorship for graduate students in STEMM disciplines to facilitate students' short- and long-term success in STEMM pathways, including developing interventions aimed at ensuring graduate students are retained in STEMM careers after completing their education. Additionally, encourage adding communications, pedagogy and curricular components to skills incorporated into STEMM graduate degree preparations.
- **Partnerships Between Institutions:** Foster authentic, sustainable and mutually beneficial partnerships between highly resourced PWIs and HBCUs and other MSIs that benefit both students and faculty. Partnerships may include teaching, research collaborations, co-operatives and internships, networking, mentoring, bridge programs to graduate education and more. Funding for these efforts should be invested directly in, or appropriately shared, by MSIs to enable authentic collaborations.

Pillar 3
Discovery

Goal 2. Create equitable and inclusive systems and policies for educating, developing, hiring, retaining and advancing STEMM faculty from historically excluded and marginalized populations across fields of study. Only 10.1% of STEMM faculty at four-year higher education institutions are from underrepresented minority groups, despite underrepresented minority students earning 21% of STEMM bachelor's degrees.[80]

Key Progress Metrics

- **100% of R1 and R2 universities adopt evidence-based equity and inclusion strategies and practices for STEMM graduate programs and faculty hiring and advancement.** A lack of STEMM faculty from historically excluded and marginalized communities may discourage a sense of belonging and decrease access to support and mentorship from institutional figures for students from similar backgrounds.[81] Equity and inclusion goals for graduate programs and faculty hiring and advancement are also key to sending a message to all that people from historically excluded and marginalized backgrounds belong in STEMM and have important perspectives to contribute.
- **Historically excluded and marginalized communities comprise one-third of STEMM faculty by 2045.** Only 10.1% of STEMM faculty at four-year higher education institutions belong to underrepresented minorities, meaning that an almost 20 percentage point increase is necessary to close the gap in representation between students and faculty.[82] For women, the gender representation gap among faculty is large in many STEMM fields, particularly in medicine: For instance, while women make up 48% of medical school graduates, only 25% of full professors in academic medicine are women.[83]

Strategic Approaches and Key Steps

Approach. Increase equity in efforts to hire, retain and support diverse STEMM faculty across scientific disciplines. Research shows increasing faculty diversity demands both efforts to hire more diverse candidates and intentional changes to departmental environments to create conditions that lead to faculty success and support retention.[84]

- **Pathways to Advanced Education:** Develop tailored and legally sustainable programs to increase diversity among graduate students, postdoctoral fellows and medical residents by preparing students and scholars for success, offering culturally relevant mentoring, introducing them to networks and providing early opportunities for residency programs and grants.

Pillar 3
Discovery

- **Increase Tenure Pathways:** Provide increased pathways to tenure for faculty from diverse backgrounds, including addressing inequities and barriers in graduate training and postdoctoral programs, especially regarding finances and debt accumulation. Additionally, increase emphasis on teaching, mentoring, field building and community engagement in tenure decisions to ensure service efforts are recognized.
- **Early-Career Supports:** Expand opportunities for early-career funding and holistic support for junior faculty and support them in establishing their research agendas, teaching practice and university service while advancing their careers in academic science.
- **Vibrant and Inclusive Professional Organizations:** Strengthen professional and affinity organizations to enhance support for tenured and nontenured faculty across all ranks.

Pillar 4
Innovation

IV. Innovation: Leveraging Diverse Minds in R&D

Diversity is a catalyst for innovation. We develop new ideas when a bright mind with different lived experiences perceives a problem in a novel way or identifies a creative solution.

The research community needs diverse experiences to drive innovation and solve the challenges of the future. But we cannot take advantage of these diverse perspectives unless there is better access to the research enterprise and fewer inequities in the distribution of research funding. Women, Black and Hispanic individuals and people with disabilities are exceedingly underrepresented in federally funded research.[85,86] And the colleges and universities that overwhelmingly support historically excluded and marginalized communities — especially HBCUs and TCUs — have far less funding and infrastructure to support research than predominantly white institutions. For instance, MSIs and CCs receive only a small fraction of all the STEMM R&D funds available each year.[87]

Innovation occurs not just in universities or laboratories but also in households, schools and communities, where rich yet undervalued knowledge and expertise so often reside. Without demonstrating the many diverse places from which important and undeniably rigorous information can come, the STEMM ecosystem cannot appreciate the important contributions of those who have not yet been deemed researchers.

To build and strengthen pathways for people from historically excluded and marginalized communities to contribute to technological and scientific advancement, funding and opportunity gaps must be closed. Overall, there must also be a commitment to ensuring that all entities in the STEMM R&D ecosystem have robust and sustainable diversity, equity, inclusion and accessibility goals and an achievable plan for meeting them.

To leverage diverse minds in R&D, SOA recommends targeting the following goals:

Goals

1. **Ensure researchers from historically excluded and marginalized communities receive equitable opportunities for funding, career navigation and support.**
2. **Encourage entities in the STEMM R&D ecosystem to utilize robust plans for envisioning and implementing equity.**

Pillar 4
Innovation

Key Actors/Responsible Parties

- **Public and private research funders.**
- **Professional societies.**
- **Postsecondary and other educational institutions.**
- **Community-based organizations and community-led science and research initiatives.**
- **Federal, state and local governments.**

> **Goal 1. Ensure researchers from historically excluded and marginalized communities receive equitable opportunities for funding, career navigation and professional support.** Studies on public funding for PIs show disparities across race, gender, physical ability and more.[88,89,90]

Key Progress Metrics

- **Invest $15 billion in research infrastructure and capacity building at HBCUs, TCUs and other MSIs by 2040.** Land Grant HBCUs have been deprived for decades of over $12 billion in governmental funds that could have been used for such purposes, not to mention missed industry and philanthropic opportunities due to those discrepancies.[91] While the federal government recently announced $50 million in grant funding for HBCU research infrastructure, relatively few dedicated federal funds are available for these purposes — and the scale of opportunity is much larger.[92] Federal, state and local governments along with philanthropies and industry can do far more to invest in critical research infrastructure at HBCUs and other MSIs.
- **Double the amount of research funding received by HBCUs, TCUs and other MSIs by 2045.** Exclusive opportunities have hindered many institutions from making their mark. For example, the prestigious R1 ranking for universities with the highest level of scientific output — of which just 30 MSIs and not a single HBCU or TCU are classified as[93,94] — have significantly more federal grants available to them. Obtaining these research funds has cascading effects on these institutions' faculty and students, like the aforementioned research infrastructure and the ability to attract graduate and postdoctoral students.
- **Close the funding gap for PIs from historically excluded and marginalized backgrounds by 2035.** Historically excluded and marginalized groups, all the way from early- through late-stage careers, are grossly underrepresented as recipients of public grants.[95] Research has shown that grant reviews often skew toward white and male applicants even when self-reported ethnic data is withheld.[96]

Pillar 4
Innovation

Strategic Approaches and Key Steps

Approach. Remove barriers to both federal and private grant funding for researchers from diverse backgrounds, targeting opportunities to build research capacity in PIs from historically excluded and marginalized groups.

- **Diversify Agency and Private Funder Leadership:** Include diverse voices in agency leadership positions and redefine agency, philanthropy and industry agendas in ways that reflect needs and issues across diverse communities. Pursue diverse voices to drive innovation and provide opportunities for a wider array of scientists and medical researchers to do both basic and applied/translational research.
- **Incubate Nascent Programs:** Provide resources to emerging research institutions, minority-serving institutions and community-based organizations that offer models and pathways for success, including entrepreneurial success.

Approach. Build STEMM research capacity and infrastructure within HBCUs and other MSIs. These colleges and universities overwhelmingly educate historically excluded and marginalized students and have been overlooked and underfunded for their research capabilities.[97] Not only do STEMM leaders cite that large public grants often disenfranchise MSIs, but institutional leaders ought to be better positioned to compete for such opportunities.[98] Higher education experts agree that expanded financial investment from public and private sources within MSIs would promote the capacity for innovation, experimentation and evaluation necessary for more STEMM equity.[99] Ultimately, efforts to build research capacity within HBCUs, TCUs and other MSIs should be aimed at enabling the excellent preparation of their students and the maximum impact of their scholars' research contributions to society.

- **Allocate Government Funding:** Increase federal and state funding to HBCUs, TCUs, other MSIs and two-year institutions with the aim of increasing these institutions' innovation, knowledge contribution and degree production of STEMM student majors from historically excluded and marginalized populations.
- **Increase HBCU and Other MSI Infrastructure:** Ensure that HBCUs and other MSIs have sufficient capacity and infrastructure, such as experienced grant writers, to make them more competitive for various public and private funding streams and more effective in providing students with research experiences directly and through partnerships.

Pillar 4
Innovation

- **Provide Access to Read and Publish Peer-Reviewed Work:** Create opportunities for authors from low-resource institutions to have increased access to peer-reviewed work, such as tiered pricing models, while also providing access to publish in peer-reviewed journals without being limited by excessive and cost-prohibitive charges as well as more options to self-publish or self-archive.
- **Sustainable Research Partnerships:** Foster mutually beneficial, sustainable and authentic research partnerships between highly resourced PWIs and HBCUs and other MSIs, including not only opportunities for internships and fellowships but also more substantial collaborations that build research capacity and infrastructure within HBCUs and other MSIs.

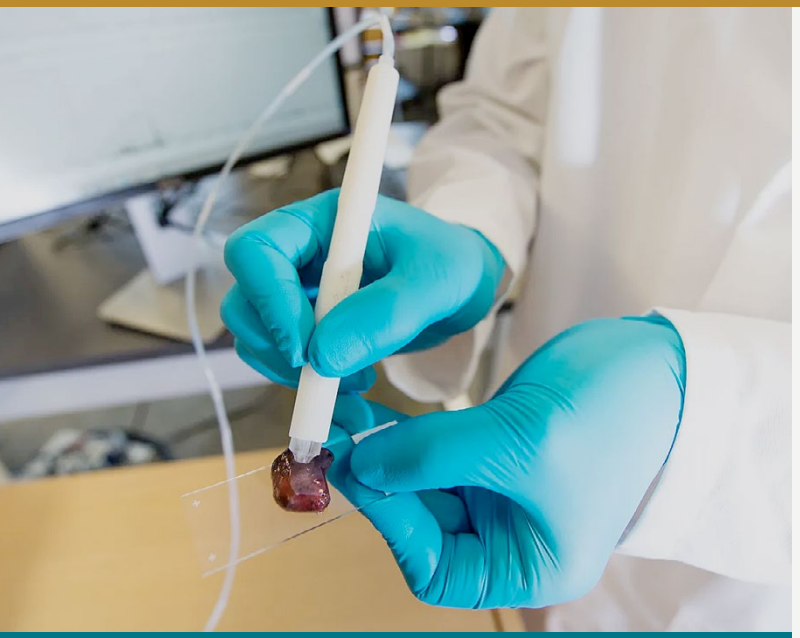
Approach. Expand the diversity of researchers and administrators working in scientific publishing and broader knowledge production. While federally funded research is being made increasingly more available to the public, private publishing has been slow to follow.[100] Students ought to be equipped with materials, but surveys have shown that HBCU libraries, for example, hold fewer volumes and titles than their non-HBCU counterparts.[101]

- **Scale Supportive Infrastructure and Institutions:** Incentivize and scale successful institutional strategies for supporting students and practitioners from diverse populations to fully participate in STEMM research and development, such as through undergraduate research experiences and self-directed research support.
- **Support Emerging Diverse Leadership:** Incentivize the inclusion of diverse perspectives among the leadership of academic research institutions, professional STEMM organizations and scientific journals.
- **Leverage Professional Societies:** Coordinate programs within and across professional societies to develop and provide training for both historically excluded and marginalized communities and other members.
- **Responsive and Inclusive Review:** Increase diversity among scientific review administrators while simultaneously providing cultural competence education to all scientific reviewers and program officers.
- **Incentivize Board Diversity:** Address the need for diversity among scientific advisers, editorial boards of journals, and boards of university-funded startups. Incentivize such diversity through investment policies and other terms for partnership and support.

Pillar 4
Innovation

Approach. Expand the understanding and adoption of community-led research, education and service initiatives and community-based organizations that are crucial to engaging underserved populations in advancing STEMM. As community research is increasingly growing in academic and nonacademic communities, well-intentioned partnerships have not had the support and alignment needed to achieve their highest potential.[102] But when executed well, community research can make research more relevant, translatable and sustainable for the populations involved.[103]

- **Uplift Community Organizations:** Incentivize investment in diverse and inclusive community organizations and scale up successful community-led initiatives focused on supporting STEMM pathways and the overall research enterprise.
- **Resource Community Scientists:** Create opportunities for community scientists to learn about and apply for funding solicitations and grants.
- **Connect Researchers and Communities:** Increase funding for programs and initiatives that facilitate connections and engagement between researchers and communities through citizen science, crowdsourcing, prize competitions, challenges, clinical trials and university-community research partnerships.
- **Embed Within Organizations:** Create and deepen opportunities for researchers to be placed into and support community and civil society organizations, including fellowships, workshops and joint-staffing positions, especially to deepen STEMM instruction and learning in both in- and out-of-school settings.



Innovation Spotlight

Supporting Women Innovators: Awarding Excellence

Achieving STEMM equity and excellence will require the U.S. to tap into the brainpower of a diverse research network and uncover innovative solutions to tomorrow's challenges. Brilliant women researchers like Dr. Livia Schiavinato Eberlin bring invaluable perspectives, ideas, and innovations to STEMM R&D.

At the beginning of Dr. Eberlin's career at University of Texas Austin, she was awarded the Marion Milligan Mason Award—a grant award with professional development and mentorship opportunities focused on women in chemical sciences. Two years later, Dr. Eberlin was awarded the MacArthur Genius Grant for her translational research on mass spectrometers, a tool to differentiate healthy tissues from cancerous ones during surgery. The landmark finding led her to other innovations using mass spectrometry for issues as wide-ranging as thyroid cancer diagnosis and counterfeit money detection.

In addition to conducting groundbreaking research, Dr. Eberlin is an active mentor for other women in STEMM. With assistance from the L'Oreal *Changing the Face of STEM* program, she runs the "My Science <-> My Life" program for undergraduate and graduate students interested in STEMM careers. Dr. Eberlin uses her platform to encourage other women to balance work and life while being ambitious professionals.

Dr. Eberlin's impact on translational health research highlights the importance of early career funding and supports for underrepresented researchers. Financial support and mentoring programs give early-career scientists the resources needed to pursue their passions and develop innovations that can change the world.

Photo credit: Vivian Abagiu / University of Texas Austin

Pillar 4
Innovation

Goal 2. Encourage entities in the STEMM R&D ecosystem to utilize robust plans for envisioning and implementing equity. Without clear and ambitious plans in place, organizations cannot contribute to a more diverse and equitable STEMM ecosystem.

Key Progress Metrics

Three-quarters of the top 100 U.S. patent-producing organizations commit to robust and actionable equity and inclusion plans by 2035. Among the Forbes 500, many of which are also the top patent-producing organizations, only 154 companies have released reports on their internal DEI needs and progress.[104] Even among those that have, many fail to report on disability and sexual orientation, among other identities.[105]

The top 100 U.S. patent-producing organizations actively track and share their progress on equity and inclusion metrics by 2040.

Strategic Approaches and Key Steps

Approach. Develop a process for and continue to improve equity reviews of government, philanthropic and private funding for STEMM research at all decision points. For instance, the federal government began the Justice40 initiative in 2021 to focus 40% of federal investments on disadvantaged communities, but the effort does not extend to all federal, state and local governments.[106] On the private side, philanthropies and private funders are actively trying to build better funding models, but many organizations feel that their portfolios don't have an expansive equity approach yet.[107]

- **Funding Sustainability:** Ensure the long-term durability of funding and program maintenance, investing in culture change over time with a focus on retention and continuous improvement and building on opportunities to confront and respond to emerging challenges and scale successful efforts.
- **Evidence-Based Funding:** Analyze the distribution of current public and private grantmaking for efficacy and evidence, aligning funders with scientifically based approaches that support a representative pool of STEMM professionals from historically excluded and marginalized groups.

Pillar 4
Innovation

Approach. Implement processes in the public and private sectors that prioritize identifying and addressing disparities and impacts in STEMM R&D. For example, community research is often misunderstood by higher education institutional review boards, stifling the ability to get projects off the ground.[108,109] In the private sector, for-profit research ethics boards have propped up research efforts that do not fully protect human rights.[110]

- **Working Groups for Equity:** Establish a working group to develop processes to advance equity in R&D, including agenda setting, needs assessments, resource allocation and the implementation of equity checks and reviews.
- **Equity-Centered Research Oversight:** Support institutions that vet academic and industry research practices, especially adding capacity to educate organizations about equity-centered research practices and organizations holding themselves accountable when they fall short of their goals or fail to comply.

Approach. Expand the use of equitable and legally sustainable strategies for talent identification, recruitment, hiring, retention and promotion. Following the recent Supreme Court decision on the use of race in admissions decisions, many organizations even outside higher education have tended to overreact when pursuing adjustments to their institutional approaches. But organizations can still pursue robust strategies for DEI and belonging in both hiring and day-to-day operations.[111]

- **Adopt Race-Neutral Strategies That Promote Access:** The benefits associated with student and faculty diversity are a priority for many, if not all, institutions of higher education. In addition to defining clear educational aims and rationales associated with inclusion and diversity, leaders should hasten to adopt race-neutral strategies shown to broaden access and reduce barriers to all students.[112,113]
- **Legally Sustainable Hiring:** Connect legal experts to organizational leaders and recruiters for training and consultations on equitable talent identification, hiring and retention, and advancement strategies.
- **Share Legal Guidance:** Provide opportunities to learn legally sustainable strategies that can support equitable talent pathways.

Pillar 5
Opportunity

V. Opportunity: Ensuring All Workers Thrive

All jobs are increasingly becoming STEMM jobs, and true equity will require that all workers have opportunities to acquire STEMM skills and knowledge and to thrive in careers in all sectors of the economy.

Yet, individuals from various gender, sexual orientation, racial, ethnic and disability backgrounds, in addition to working parents, are often locked out of high-quality STEMM jobs due to deep and entrenched gaps in opportunity, while also facing inequitable treatment, bias and discrimination on the job. For example, studies show that women and Black Americans both report higher rates of discrimination in STEMM workplaces than in non-STEMM workplaces.[114]

Practices like inclusive mentorship have been shown to be effective at ensuring all workers have personal ties to other employees and reinforcing broader DEI initiatives.[115] And emerging technologies and sectors like AI, machine learning and advanced manufacturing can be leveraged in ways that support and empower historically excluded and marginalized communities when used responsibly. To address these disparities, employers as well as education and training institutions must ensure that workers have relevant support to attend to their needs as well as equal opportunities to participate in and contribute to STEMM innovation throughout their careers.

To ensure all workers thrive in the economy and workforce of tomorrow, SOA recommends targeting the following goals:

Goals

1. **Remove barriers to identifying, hiring, retaining, developing and promoting persons from historically excluded and marginalized communities in the workplace.**
2. **Ensure workplaces act supportively of persons from historically excluded and marginalized communities.**

Key Actors/Responsible Parties

- **Public and private employers.**
- **Federal, state and local policymakers.**
- **Regional workforce boards.**
- **Worker advocates and unions.**
- **Community organizations.**

Pillar 5
Opportunity

Goal 1. Remove barriers to identifying, hiring, retaining, developing and promoting persons from historically excluded and marginalized communities in the workplace. According to the *People of Science* report by Science Is US, the U.S. STEMM ecosystem employs over 67 million workers today.[116] Based on available data, SOA estimates that as many as 15 million more women and underrepresented minorities would be needed to reach gender and racial parity in this workforce today. Data for representation of other historically excluded and marginalized populations is less widely available.

Key Progress Metrics

- **20 million new STEMM workers from historically excluded and marginalized groups are added to the STEMM workforce by 2050.** Given expected workforce growth overall and accelerated growth of the STEMM workforce in particular, SOA estimates the gap needed to achieve gender and racial parity to be as many as 20 million women and underrepresented minorities in 2050.
- **10 million new STEMM professionals from historically excluded and marginalized groups are added to the STEMM workforce by 2035.**

Strategic Approaches and Key Steps

Approach. Create well-coordinated on-ramps that value a variety of educational backgrounds for an upwardly mobile STEMM career. For example, skills-based credentialing and hiring approaches can expand job pools and challenge employers to be critically aware of their talent needs.[117] Coordinated or "hub" approaches bring together the needs and abilities of education, government and industry in a way that better supports career awareness and job navigation.[118]

- **Commonsense Benchmarks:** Adopt and implement shared definitions for terms, data collection and data sharing across employers and industries.

Pillar 5
Opportunity

- **Company-wide Equitable and Inclusive Hiring:** Implement equitable and inclusive hiring practices at all company levels so that company diversity is reflected at all levels of leadership.
- **Skills-Based Hiring:** Scale skills-based hiring practices and similar routines across the whole talent journey that demonstrate proficiency as part of the evaluation of candidates for employment.
- **Support Non-traditional Backgrounds:** Encourage employers to hire candidates without traditional educational or previous work experience and provide on-the-job training to orient workers to new job skills and responsibilities. Additionally, honor previous job experiences, especially military service, that can be translated into on-the-job skills.
- **Place-Based Workforce Coordination:** Create coordinated STEMM workforce hubs where education, industry and the civil social sector can strategically coordinate knowledge and allow organizations and individuals to access resources.

Approach. Support formal and informal workforce development strategies that can help workers more easily enter and advance in STEMM careers. For example, mentoring is widely regarded to be important for retention, development and career satisfaction.[119] In instances where medical students received mentorship, they picked career pathways that suited them more.[120] However, research showed that more mentorship was needed, especially for women.[121] In an example from a different sector, graduates of coding bootcamps saw raises in income across the board for considerably less cost than the cost of a traditional degree.[122]

- **Expand Company Mentorship:** Introduce or scale up mentorship programs for all employees, particularly those from historically excluded and marginalized backgrounds, through programs sponsored by both employers and cross-sector organizations.
- **Employer-Sponsored Upskilling:** Encourage employers to sponsor employees' continued education or upskilling.
- **Nontraditional Pathways and Credentialing:** Increase access to technology apprenticeships, badging and bootcamps that augment traditional learning environments and align with workforce needs.
- **Expand Access to Career and Technical Education:** Increase access to industry-informed STEMM two-year and certificate/technical programs to upskill America's workforce as well as provide support for graduate credentialing.

Pillar 5
Opportunity

Approach. Remove barriers that keep historically excluded and marginalized communities from accessing capital, serving on boards and receiving career coaching. For instance, some innovative accelerator programs are shown to be successful in increasing access to technical assistance and financial capital for underrepresented entrepreneurs.[123]

- **Equity-Centered Accelerators:** Expand startup, incubator and accelerator programs, especially ones aimed at expanding and financially supporting entrepreneurship in service of historically excluded and marginalized communities.
- **Demystify Financial Supports:** Enhance education regarding pathways to accessing venture capital and establish programs to connect innovators from historically excluded and marginalized communities with startup incubators and accelerators. Additionally, monitor program participants to ensure those benefiting from such programs include those from the intended audiences.

Approach. Uplift and resource affinity programs for historically excluded and marginalized communities in the workplace. Workers resoundingly share that affinity-based employee-resource groups (ERG) feel necessary, improve retention and create more inclusive cultures.[124] Many ERG leaders also say that the value of being financially compensated for their leadership matters to them, illustrating that the work being done internally at their company is still work.[125]

- **Authentic Leadership Buy-In:** Garner and demonstrate organizational leadership buy-in and responsiveness to affinity programs.
- **Concretize Affinity Connections:** Compensate and recognize leadership and attendees for time spent building and participating in affinity and service programs.

Pillar 5
Opportunity

Goal 2. Ensure workplaces feel supportive of persons from historically excluded and marginalized communities. Supportive workplaces contribute to not only employee satisfaction and retention but improved employer satisfaction and customer experience.[126]

Key Progress Metrics

- **All STEMM employers commit to transparent job descriptions and career mobility plans by 2025.** Transparent job descriptions and pay ranges largely help low-wage earners make more educated decisions about job opportunities and improve overall labor market competition across firms.[127]
- **All STEMM employers adopt robust equity and inclusion plans by 2025.** Companies that use strong DEI measures are more likely to inspire belonging and retain their workforces, yet less than a 10th of HR professionals consider their company's DEI program to be effective at its stated goals.[128,129]

Strategic Approaches and Key Steps

Approach. Root out bias, discrimination and harassment in all STEMM workplaces and support proactive efforts to improve belonging. A wide range of research suggests that organizations with good career mobility have more collaboration, cooperation, innovation and cohesion.[130]

- **Just Job Descriptions:** Include salary ranges and remove gendered, ableist and ageist language from job descriptions and advertisements to recruit a broader range of applicants.
- **Just Career Mobility:** Mitigate bias in performance evaluations, promotion decisions and award and recognition selection to promote equitable career advancement and access to leadership positions.
- **Proactive Anti-Harassment:** Establish proactive and inclusive anti-harassment structures that promote transparency, accountability, ongoing measurement and assessment, and support for individuals who have been targets of harassment. Implement consequences for perpetrators of harassment and discrimination while supporting those who've demonstrated allyship.

Opportunity Spotlight

Dodanim Romero's STEMM Journey: The Vital Role of Trades in STEMM[131]

> ***Achieving STEMM equity will require employers, as well as education and training institutions, to provide workers with supports that enable equitable opportunities to contribute to STEMM. Science is US, an SOA partner through AAAS, highlights stories, like Dodanim Romero's, that demonstrate the importance of investing in human capital across all STEMM professions, to the benefit of not only individuals, but also the greater public good.***

Dodanim Romer is a commercial plumber and technician living in Maryland. Growing up, he was exposed to trade opportunities by his father, also a plumber. Following high school, Dodanim worked several trade positions until he became an apprentice at a regional plumbing company. As he worked, he continued to pick up certifications like his Gas Fitter license and Journey Plumber license. He has continued to grow in his career, now taking on a managerial role and expanding his work servicing government buildings, schools, hospitals, airports, and more.

Dodanim shared that, "People sometimes underestimate the responsibilities plumbers have when it comes to public safety… they're helping to ensure that harsh chemicals and toxic contaminants don't end up in your water supply."

Trade positions like Dodanim's often go overlooked in the STEMM ecosystem, but these occupations are vital for supporting critical industries. Investing in infrastructure occupations like Dodanim's is more important now than ever, with estimates projecting 17 million critical infrastructure workers like plumbers and electricians leaving their jobs by 2031.[132]

Pillar 5
Opportunity

Approach. Ensure all STEMM companies have robust benefits packages, including parental leave and other family-friendly policies to support workers. Only 27% of workers have access to paid family leave, one of many critical pieces to feeling supported by one's workplace.[133]

- **Total Employee Well-Being:** Provide support for critical life events that can occur throughout the course of a career, such as caregiving, chronic illness, disability and accessibility, mental health and pandemic recovery services. Offer comprehensive wraparound services to employees juggling multiple responsibilities and/or challenges.
- **Protections From Technological Advances:** Outline protections and plans for employees' job security and dignity in light of displacements that may be needed with the incorporation of new technologies such as AI and machine learning.

Approach. Deploy rigorous and regular employer-sponsored upskilling programs with clear paths for upward mobility in the workplace. In a recent study, 65% of workers cited upskilling as a very important job benefit, and those who had recently participated in upskilling programs reported earning $8,000 more in wages on average.[134] Workers note a lack of time as a major reason for not taking advantage of employer-provided training programs.[135] Business experts resoundingly share that well-defined career paths improve employee retention and are an easy step to being a more transparent and forthcoming employer.[136,137]

- **Options for Career Advancement:** Implement regular training during work hours for employees interested in upskilling programs.
- **Clear Job Pathways:** Document and publicize pathways and requirements for career growth in the workplace. Moreover, assess the outcomes and impact of such pathway programs on employees of diverse and intersecting identities.

Capstone
Strategic
Communications

STEMM Equity and Excellence Capstone: Strategic Communications

The importance of representation in media and on other platforms has become abundantly clear in recent decades.

For many individuals, seeing themselves reflected in the economic and social fabric of society serves to break down fears of failure and inferiority and tame unease at the prospect of pursuing ventures traditionally believed to be closed to them. This is especially true in STEMM fields, where even today the lack of representation among STEMM professionals depicted in television and film, among other mediums, continues to reinforce harmful and deterring messages to individuals from historically excluded and marginalized communities. To better promote the values of inclusivity and equity, we must deepen our commitment to representation not only in STEMM itself but also in depictions of STEMM. This requires a strong shared focus on strategic communications, storytelling and public awareness efforts to ensure all individuals can see themselves as valued members of the American STEMM ecosystem.

To promote the critically needed narrative change, SOA recommends targeting the following goals:

Goals

1. **Ensure the demographics of STEMM professionals depicted in media and other venues align with the demographics of the country.**
2. **Effectively illustrate the importance of diverse perspectives in STEMM and how they are critical to achieving excellence in STEMM.**

Key Actors/Responsible Parties

- **STEMM leaders and communicators across sectors.**
- **Leaders in the media and entertainment industry (screenwriters, producers, actors, etc.)**
- **Local and national news outlets.**
- **Communications professionals.**
- **Policymakers and other influential individuals.**
- **STEMM textbook and informational resource distributors.**

Capstone
Strategic Communications

Goal 1. Ensure the demographics of STEMM professionals depicted in entertainment and media align with the demographics of the country. STEMM professionals in entertainment media are overwhelmingly portrayed as white men, whereas women, people of color and other marginalized identities are portrayed less frequently. When historically excluded and underrepresented communities are represented in these depictions of STEMM, it is often in ways that serve to reinforce rather than break down stereotypes and barriers. For instance, women in STEMM are often depicted as having to sacrifice their familial aspirations for career advancement.[138]

Key Progress Metrics

- **Entertainment and media depictions of the STEMM field are inclusive and reflective of the population by 2030.** Men outnumber women approximately two to one in media portrayals of STEMM professionals. Most (71.2%) STEMM characters are depicted as white while only 16.7% are depicted as Black, 5.6% as Asian, 3.9% as Latinx and 1.7% as Middle Eastern.[139]

Strategic Approaches and Key Steps

Approach. Equip STEMM communicators across sectors and venues with the tools and expertise needed to deliver inclusive messages about the critical role of diverse people in STEMM. Effectively shifting narratives around the role of people from historically excluded and marginalized communities in STEMM will require comprehensive, cross-sector action on the part of STEMM communicators.

- **Informed Media Training:** Demonstrate effective ways to utilize narrative instruments (film, TV, literature, etc.) to accurately and impactfully depict the experiences of persons from historically excluded and marginalized backgrounds as accepted and valued members of the STEMM ecosystem.
- **Leadership and Communications Training:** Provide education on effective leadership and strategic communications to leaders from all parts of the STEMM ecosystem to help them identify and amplify compelling stories of individuals from marginalized backgrounds and their experiences in STEMM.
- **Public Awareness Campaigns:** Employ traditional and nontraditional marketing tools (billboards, ads, podcasts, etc.) to effectively highlight the diversity of the STEMM workforce and showcase diverse individuals in varied roles. This can also include a focus on updating textbooks and other STEMM-related materials in schools to ensure diverse individuals and stories are included and uplifted.

Capstone
Strategic Communications

- **Strategic Communications Callouts:** Utilize SOA's network and resources to highlight key areas where more progress can be made and disseminate information about effective communications strategies that can effectively build public awareness and spur pressure for change.
- **Ongoing Assessment and Measurement:** Conduct assessments to measure the impact and effectiveness of collective efforts to systemically alter STEMM narratives and storytelling.

> **Goal 2. Effectively illustrate the importance of diverse perspectives in STEMM and how they are critical to achieving excellence in STEMM.** Though there is a growing consensus within the STEMM community that diversity and equity are necessary to meet today's challenges and achieve continued STEMM excellence, this idea must be reinforced with the broader public. A dedicated effort is needed to ensure that all Americans are made aware of how achieving equity in STEMM can positively impact their daily lives and contribute to societal advancement.

Key Progress Metrics

- **All Americans understand the necessity of an inclusive and diverse STEMM enterprise as critical to the U.S.'s scientific, social and economic advancement, health and national security by 2040.** Americans viewing diversity and equity in STEMM may lead to the cultivation of more inclusive work environments where members of historically excluded and marginalized groups feel valued and supported, and may lead to a reduction in workplace harassment. Presently, half of women and a majority of Black Americans in STEMM jobs have reported harassment in the workplace.[140]
- **SOA partners have measurably improved media and entertainment content that reflects SOA STEMM inclusivity guidelines by 2035.** Ensuring that media and entertainment content is inclusive and welcoming of individuals from all backgrounds and statuses will work to reinforce SOA's mission of improving equity and excellence in STEMM.

Capstone
Strategic Communications

Strategic Approaches and Key Steps

Approach. Amplify the voices of individuals from historically excluded and marginalized groups and highlight how their contributions to STEMM positively impact the U.S.'s national security, economic well-being, global competitiveness and innovative capabilities. Though they make up 31% of the population, Hispanic, Black, Indigenous and Alaska Native individuals are only 24% of the STEMM workforce and are more likely to hold jobs requiring technical skills than to hold jobs requiring a bachelor's degree or higher. Women make up only 35% of the STEMM workforce despite representing 50% of the population, and only 3% of the STEMM workforce is comprised of individuals with disabilities.[141]

- **Public Campaigns:** Encourage the dissemination of videos and other narrative pieces where individuals from historically excluded and marginalized backgrounds share their STEMM experiences with audiences.
- **Studies: Produce studies that center around the importance of diversity and perspectives in STEMM.** Such studies would highlight contributions to STEMM by individuals from historically excluded and marginalized communities and how they impact our everyday lives as well as national security and the U.S.'s economic well-being.
- **Remodel Textbooks:** Ensure that textbooks depict images of members from historically excluded and marginalized backgrounds at parity and that these books are stripped of the use of "race taxons" that have been shown to cause misdiagnoses and improper care.[142,143] Overlooked historical figures who made impactful contributions to STEMM should also be highlighted in textbooks.
- **Develop Entertainment and Media Guides:** Work with SOA partners to develop resources and guidance for members of the entertainment and media industry that highlight the ways in which they can drive toward greater equity and access by promoting depictions of an inclusive STEMM ecosystem and workforce. These portrayals should underscore the roles and contributions of individuals from historically excluded and marginalized backgrounds.

Approach. Support the translation of STEMM learning materials and other resources to be more inclusive to multilingual individuals and their families.

- **Translation Services:** Encourage distributors of STEMM textbooks and other educational resources to produce multilingual content to foster accessibility and equity of outcomes.

Capstone Spotlight

Mission Unstoppable: Inspiring Girls through Representation in TV

> ***To achieve true STEMM equity and excellence, mindsets about who belongs in STEMM fields must be shaped by highlighting the stories of diverse STEMM professionals. SOA partners Lyda Hill Philanthropies IF/THEN® Initiative and The Geena Davis Institute on Gender in Media (GDI) create engaging multi-platform content like* Mission Unstoppable*, which inspires girls to pursue STEMM careers.***

Mission Unstoppable, hosted by Miranda Cosgrove, spotlights and celebrates a wide array of female STEMM professionals to inspire the next generation of STEMM leaders and innovators. Currently in its fifth season, the hit series airs every weekend to more than a million viewers as part of CBS's Saturday morning "Dream Team" educational and informational block.

Mission Unstoppable has been very successful in engaging girls to think differently about how they see themselves and their career trajectories. Data from a Screen Engine panel of girls between ages 10-12 demonstrated that those who had seen *Mission Unstoppable* were 16% more likely to state they will take STEMM courses in high school and college to help them pursue a career in STEMM than those who had not seen the show. In addition, girls who watched the show agreed with the statement "I would like to have a career in a STEM field" at a rate 17% higher than those who had not watched the show.

Entertainment media and onscreen representation play a significant role in inspiring girls to pursue and succeed in STEMM and other careers. Multi-platform programming like *Mission Unstoppable* provides a window into the world of STEMM careers and shows girls pathways they may have never considered.

Photo: Dr. Jaye Gardiner while shooting a segment for *Mission Unstoppable.*
Photo Courtesy of the IF/THEN® Collection

Implementing the National Strategy

To create the national strategy, SOA methodically engaged people of diverse backgrounds and experiences from across the country, giving them the opportunity to share their perspectives on how best to drive equity in STEMM.

Partners from a multitude of sectors and communities have signed on to SOA and are committed to driving STEMM equity in their respective fields. Those stories and ideas have been carefully accounted for and synthesized into this broader document, pointing to ways that barriers can be removed and opportunities can be widened for historically excluded and marginalized communities.

However, none of these efforts and commitments matter if SOA and its partners do not turn these ideas into strategic action. To fully implement the national strategy, SOA will need:

New and Renewed Commitments: While hundreds of organizations have pledged nearly $2 billion toward advancing STEMM equity, new and current SOA partners must ensure that their contributions match the strategic priorities and sequencing of actions established in the strategy. SOA's main purpose is to drive alignment of existing work and funding across the ecosystem, growing the base by generating new and expanded contributions from engaged actors and compelling more partners and actors to the table.

Moreover, public and private actors at the local, state, regional and national levels must use their financial resources to advance the strategy. This includes public and private funders and industry actors that collectively support the current scientific ecosystem and seed the future directions of STEMM. All actors must lean into innovative approaches to STEMM equity and excellence, demonstrating the willingness and courage to create systemic change.

Coordinating Infrastructure:
Transforming the entire system will surely require everyone to change, but a core set of nonprofits, businesses, philanthropies, educational institutions and others will need to be assembled to lead coordinated progress toward the specific goals. To drive progress on the strategy's foundations, five pillars and capstone, SOA will work with leading organizations in different regions and sectors to launch working groups and partnerships that will serve as organizing infrastructure for deeper planning and action in each workstream. Moreover, existing STEMM equity working groups will be invited into SOA's network to bolster and align efforts. With help from SOA's Advisory Council, these working groups can drive action while tracking and reporting on progress against this plan's key goals and action steps. In tandem, the entire alliance will identify gaps, effective strategies and opportunities to build on what works and remove barriers that impede action.

Public-Private Partnerships:
Government entities, especially at the federal level, must play a central role in these efforts in order for success to be feasible. Policies and supports at the federal, state, regional and local levels are essential prerequisites for action in many areas, while alignment and coordination between public and private efforts are critical for us all to achieve greater shared impact. This plan was developed with consideration for the parallel STEMM equity work that the White House OSTP is leading across the federal government to help build alignment from the outset. Likewise, there will be a need for field stakeholders to align on potential policy priorities that may need to be advanced at the federal, state and local levels in order to best support and enable STEMM equity efforts. Alignment of public and private efforts must endure across decades, demanding that it rise above politics and extend beyond the priorities of current leaders.

When SOA, its partners and working groups, the government, and the STEMM ecosystem at large work in tandem, action can be taken comprehensively and at a large-enough scale to effect change and achieve STEMM equity and excellence. From 2024 onward, a handful of anchor partners will lead respective workstreams to carry out the goals of the national strategy. Organizations will facilitate connections and deepen partnerships across the foundations, five pillars and capstone, serving as the leaders that make collective impact possible.

Creating an equitable and excellent STEMM ecosystem will take generations to achieve, and that requires us to use a long-term strategy. It is crucial that we plan now to sustain these collective efforts so that progress continues into the future through changing circumstances: as leadership changes or ages out; as there is the need for refining and re-defining direction; as demographics shift; as the political landscape changes; as new technologies come online; as new challenges emerge. Not only will all of these things undoubtedly occur, but other unknown variables also mean that this strategy must be a living document that is re-visited on a regular basis. As we all take on the transformative goals and actions listed throughout the document, implementation will require a concerted commitment from all sectors of the STEMM ecosystem.

STEMM Equity and Excellence Summits Across the Country

Top: A breakout session at the Chicagoland Summit on STEMM Equity and Excellence.

Credit: Museum of Science and Industry, Chicago

Middle left: Travis York, Director of Inclusive STEMM Ecosystems for Equity and Diversity at AAAS, speaking at the Chicagoland Summit on STEMM Equity and Excellence.

Credit: Museum of Science and Industry, Chicago

Middle right: A panel discussion at the Southwest STEMM Equity and Excellence Summit.

Credit: ASU/Arizona Board of Regents

Bottom: A panel discussion at Northwest STEMM Summit – Achieving Equity and Excellence

Credit: Micron Technology

Conclusion: Realizing a More Perfect STEMM Ecosystem

Equity and excellence in STEMM are inextricably linked. As science and technology rapidly advance, continued leadership in STEMM promises to serve as a powerful driver of prosperity and progress for the American economy and society for generations to come.

But innovation is borne of diverse minds, as different thinkers see problems with different lenses and offer a range of solutions. America's globally distinct and sustainable competitive advantage is the diversity of its people. Only by leveraging this advantage — centering equity not just as a goal but as a core strategy for driving excellence and growth — can the country truly reach its full potential.

The bright future STEMM equity offers cannot be attained without coordinated collective action. Meeting the ambitious goals laid out in this nationwide strategy demands everyone be at the table, including government, philanthropy, industry, educational institutions, communities and more. Across the STEMM equity and excellence pillars outlined in this document are myriad opportunities for change. All these demand action, and more measures must be considered as well. Actions must be bold and immediate but also sustained and strategic. Organizations must advance initiatives within their own structures while also seeking partnerships across institutions and sectors. STEMM equity leaders must serve as evangelists, bringing ever more actors to the movement for change.

Efforts to advance equity in STEMM have for too long been sidelined as a nice-to-have at the organization level rather than a need-to-have across the ecosystem. Today, we must embrace equity as essential to achieving shared national priorities.

To keep in touch, visit SOA's website at www.stemmopportunity.org. On the website, there are opportunities to commit to becoming a partner, subscribe to the newsletter, connect on social media and more.

Endnotes

1 Science is US. (2020, January 28). STEM supports two thirds of U.S. jobs. https://scienceisus.org/stem-supports-two-thirds-of-us-jobs/.

2 Zwetsloot, R. (2021, October). (rep.). *Winning the tech talent competition: Without STEM immigration reforms the United States will not stay ahead of China*. Center for Strategic and International Studies. https://www.csis.org/analysis/winning-tech-talent-competition.

3 Linke, R. (2018, February 16). Lost Einsteins: The US may have missed out on millions of inventors. MIT Sloan. https://mitsloan.mit.edu/ideas-made-to-matter/lost-einsteins-us-may-have-missed-out-millions-inventors.

4 Omiye, J. A., Lester, J. C., Spichak, S., Rotemberg, V., & Daneshjou, R. (2023, October 20). Large language models propagate race-based medicine. npj Digital Medicine, 6, Article 195. https://doi.org/10.1038/s41746-023-00939-z.

5 Dixon-Fyle, S., Dolan, K., Hunt, D. V., & Prince, S. (2020, May 19). Diversity wins: How inclusion matters. McKinsey & Company. https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters.

6 Office of Science and Technology Policy. (2022, December 12). Equity and excellence: A vision to transform and enhance the U.S. STEMM ecosystem. The White House. https://www.whitehouse.gov/ostp/news-updates/2022/12/12/equity-and-excellence-a-vision-to-transform-and-enhance-the-u-s-stemm-ecosystem/.

7 STEMM Opportunity Alliance & Morgan State University. (2023, February 24). Morgan State University convening summary: Achieving STEMM equity and excellence in postsecondary education. https://stemmopportunity.org/resources.

8 STEMM Opportunity Alliance & New York Hall of Science. (2023, April 18). Achieving STEMM equity & excellence: Communities and schools. https://stemmopportunity.org/resources.

9 Teaching Institute for Excellence in STEM & STEMM Opportunity Alliance. (2023, May 1). Achieving STEMM equity & excellence: Learning ecosystems community of practice 2023 convening. https://stemmopportunity.org/resources.

10 STEMM Opportunity Alliance & Snap Inc. (2023, May 23). Achieving STEMM equity & excellence in the tech industry. https://stemmopportunity.org/resources.

11 Micron Technology & STEMM Opportunity Alliance. (2023, June 12). Northwest STEMM Summit — Achieving Equity & Excellence. https://stemmopportunity.org/resources.

12 3M & STEMM Opportunity Alliance. (2023, August 3). Building an equitable and excellent STEMM workforce summit. https://stemmopportunity.org/resources.

13 Museum of Science and Industry, Chicago & STEMM Opportunity Alliance. (2023, August 5). Chicagoland Summit on STEMM Equity and Excellence. https://stemmopportunity.org/resources.

14 Spelman College & STEMM Opportunity Alliance. (2023, August 25). Summit on Building STEMM Capacity Within HBCUs. https://stemmopportunity.org/resources.

15 Lyda Hill Philanthropies, National Math and Science Initiative, & STEMM Opportunity Alliance. (2023, October 24). Cross-Sector STEMM Equity and Excellence Summit. https://stemmopportunity.org/resources.

16 Arizona State University & STEMM Opportunity Alliance. (2023, November 3). Southwest Equity and Excellence Summit. https://stemmopportunity.org/resources.

17 STEMM Opportunity Alliance. (2023, October). National strategy for STEMM equity and excellence: Open comment period town halls. https://stemmopportunity.org/resources.

18 Science is US. (2023, March). (rep.). People of science: An inclusive analysis of the U.S. STEM workforce and its economic impact. https://scienceisus.org/wp-content/uploads/2023/11/people-of-science-economic-impact-report-2023.pdf.

19 Organisation for Economic Co-operation and Development *(OECD)*. (2018). (rep.). *Development co-operation report 2018: Joining forces to leave no one behind*. OECD Publishing. https://doi.org/10.1787/dcr-2018-en.

20 Palid, O., Cashdollar, S., Deangelo, S., ChuChu, & Bates, M. (2023). Inclusion in practice: A systematic review of diversity-focused STEM programming in the United States. International Journal of STEM Education, 10, Article 2. https://doi.org/10.1186/s40594-022-00387-3.

21 California School District Rethinks STEM Education to Set Every Student Up for Success. National Math and Science Initiative. (n.d.). https://www.nms.org/getmedia/fee83387-09e8-4c32-b0bd-4483a79f6191/Hayward-Case-Study.pdf.aspx

22 Office of Science and Technology Policy. (2022, December 12). Biden-Harris Administration announces historic actions to advance national vision for STEMM equity and excellence. The White House. https://www.whitehouse.gov/ostp/news-updates/2022/12/12/biden-harris-administration-announces-historic-actions-to-advance-national-vision-for-stemm-equity-and-excellence/.

23 Office of Science and Technology Policy. (2022, December 12). Biden-Harris Administration announces historic actions to advance national vision for STEMM equity and excellence. The White House. https://www.whitehouse.gov/ostp/news-updates/2022/12/12/biden-harris-administration-announces-historic-actions-to-advance-national-vision-for-stemm-equity-and-excellence/.

[24] National Center for Science and Engineering Statistics (NCSES), National Science Foundation (NSF). (2023, January 30). Diversity and STEM: Women, minorities, and persons with disabilities 2023. https://new.nsf.gov/news/diversity-and-stem-2023.

[25] Office of Science and Technology Policy. (2022, December 12). Biden-Harris Administration announces historic actions to advance national vision for STEMM equity and excellence. The White House. https://www.whitehouse.gov/ostp/news-updates/2022/12/12/biden-harris-administration-announces-historic-actions-to-advance-national-vision-for-stemm-equity-and-excellence/.

[26] York, T. (2023). Celebrating a fruitful year as SOA moves to the next chapter. STEMM Opportunity Alliance Blog. https://stemmopportunity.org/blog.

[27] Catalyze Tech Working Group. (n.d.). Action to Catalyze Tech: A paradigm shift for DEI. https://www.actreport.com/wp-content/uploads/2021/11/The-ACT-Report.pdf.

[28] *Civil Rights Data: U.S. Department of Education*. Civil Rights Data | U.S. Department of Education. (n.d.). https://civilrightsdata.ed.gov/.

[29] Ibid.

[30] National Science Board. (2022). The U.S. must improve K-12 STEM education for all. Science & Engineering Indicators 2022. https://www.nsf.gov/nsb/sei/one-pagers/K-12-Indicator-2022.pdf.

[31] U.S. Department of Education. (2018). A leak in the STEM pipeline: Taking Algebra early. https://www2.ed.gov/datastory/stem/algebra/index.html.

[32] U.S. Department of Education, Office for Civil Rights. (2018). 2015-16 Civil Rights Data Collection: STEM course taking. https://ocrdata.ed.gov.

[33] Jones, S. (2019, January 08). STEM instruction: How much there is and who gets it. Education Week. https://www.edweek.org/teaching-learning/stem-instruction-how-much-there-is-and-who-gets-it/2019/01.

[34] Jones, S. (2019, January 08). STEM instruction: How much there is and who gets it. Education Week. https://www.edweek.org/teaching-learning/stem-instruction-how-much-there-is-and-who-gets-it/2019/01.

[35] U.S. Department of Education. (2022, September 1). The power of dual enrollment: The equitable expansion of college access and success. ED.gov Blog. https://blog.ed.gov/2022/09/the-power-of-dual-enrollment-the-equitable-expansion-of-college-access-and-success/.

[36] *Connect K-12's 2022 report shows 67% of U.S. school districts now meet FCC Internet Connectivity Benchmark*. Connected Nation. (n.d.). https://connectednation.org/press-releases/connect-k-12s-2022-report-shows-67-of-us-school-districts-now-meet-fcc-internet-connectivity-benchmark.

[37] Afterschool Alliance. (2021). AA3PM STEM report 2021: STEM learning in afterschool on the rise but barriers and inequities exist. Afterschool Alliance. http://afterschoolalliance.org/AA3PM/.

[38] *2020 America after 3PM data*. Afterschool Alliance. (n.d.). https://afterschoolalliance.org/AA3PM/data/geo/National/demand?question=2&year=2020.

[39] Afterschool Alliance. (2021). National AA3PM STEM 2021 fact sheet: STEM learning in afterschool on the rise but barriers and inequities exist. http://afterschoolalliance.org/AA3PM/.

[40] Rinker, B. (2022, March 30). *Congress approves more afterschool funding, but advocates say it isn't enough*. Youth Today. https://youthtoday.org/2022/03/congress-approves-more-afterschool-funding-but-advocates-say-it-isnt-enough/.

[41] Rinker, B. (2022a, March 30). *Congress approves more afterschool funding, but advocates say it isn't enough*. Youth Today. https://youthtoday.org/2022/03/congress-approves-more-afterschool-funding-but-advocates-say-it-isnt-enough/.

[42] Afterschool Alliance. (2021). STEM learning in afterschool on the rise but barriers and inequities exist. America After 3PM. http://afterschoolalliance.org/AA3PM/.

[43] 21stCentEd. (2023, March 4). *The benefits of hands-on, experiential learning in STEM education*. 21st Century Education. https://21stcented.com/the-benefits-of-hands-on-experiential-learning-in-stem-education/.

[44] Deitz, E. G. and S. (n.d.). *Report*. NSF. https://ncses.nsf.gov/pubs/nsf23315.

[45] Deitz, E. G. and S. (n.d.). *Report*. NSF. https://ncses.nsf.gov/pubs/nsf23315.

[46] Nguyen, T. D., Lam, C. B., & Bruno, P. (n.d.). *Is there a national teacher shortage? A systematic examination of reports of teacher shortages in the United States*. EdWorkingPapers.com. https://edworkingpapers.com/ai22-631.

[47] Pennington McVey, K., & Trinidad, J. (2019). Nuance in the noise: The complex reality of teacher shortages. Bellwether Education Partners. https://bellwethereducation.org/publication/nuance-noise-complex-reality-teacher-shortages.

[48] Milgrom-Elcott, T. (2023, September 14). *Are teacher shortages turning around? The surprising answer is yes*. Forbes. https://www.forbes.com/sites/taliamilgromelcott/2023/09/13/are-teacher-shortages-turning-around-the-surprising-answer-is-yes/?sh=4bb69de31b42.

[49] How teacher apprenticeship is changing teacher preparation. New America. (2023, October 26). https://www.newamerica.org/education-policy/edcentral/how-teacher-apprenticeship-is-changing-teacher-preparation/.

[50] Papay, J. P., & Qazilbash, E. K. (2021). What do we know about teacher hiring? Using early, open, and intensive hiring processes to build the teacher workforce. Center for the Study of Educators. Annenberg Institute at Brown University. https://annenberg.brown.edu/educators/teacher-hiring.

[51] *Improving data collection could be one key to solving the teacher shortage crisis*. New America. (2023b, February 21). https://www.newamerica.org/education-policy/edcentral/improving-data-collection-could-be-one-key-to-solving-the-teacher-shortage-crisis/.

[52] Quebec Fuentes, S., & Bloom, M. A. (2023). The intricacies of the STEM teacher shortage. Electronic Journal for Research in Science & Mathematics Education, 27(2), i-vii. https://ejrsme.icrsme.com/article/view/23733/14924.

[53] National Research Council; Division of Behavioral and Social Sciences and Education; Board on Science Education; Center for Education; Committee on Learning Science in Informal Environments; Philip Bell. (2009, January 14). *Learning science in informal environments: People, places, and pursuits*. People, Places, and Pursuits | The National Academies Press. https://nap.nationalacademies.org/catalog/12190/learning-science-in-informal-environments-people-places-and-pursuits.

[54] Bratsch-Hines, M., Cohen-Vogel, L., Little, M., Lindsay, C., & Carr, R. (2023). Teacher-child racial/ethnic match from prekindergarten through first grade: Understanding early exposure and outcomes. Early Childhood Research Quarterly, 63, 145-155. https://doi.org/10.1016/j.ecresq.2022.12.004.

[55] Bratsch-Hines, M., Cohen-Vogel, L., Little, M., Lindsay, C., & Carr, R. (2023). Teacher-child racial/ethnic match from prekindergarten through first grade: Understanding early exposure and outcomes. Early Childhood Research Quarterly, 63, 145-155. https://doi.org/10.1016/j.ecresq.2022.12.004.

[56] U.S. Department of Education, Office of Postsecondary Education. (2015). Enrollment in teacher preparation programs. Higher Education Act Title II Reporting System. https://title2.ed.gov.

[57] Barnum, M. (2023, November 9). *Teacher turnover hits new highs across U.S.* Chalkbeat. https://www.chalkbeat.org/2023/3/6/23624340/teacher-turnover-leaving-the-profession-quitting-higher-rate/.

[58] Huang, D., & Cho, J. (2010). Using Professional Development to Enhance Staff Retention. *Afterschool Matters*, 9–16. https://eric.ed.gov/?id=EJ1068369.

[59] Hansen, M., Breazeale, G., & Blankenship, M. (2019, June 17). *STEM teachers are most in need of additional pay*. The Brookings Institution. https://www.brookings.edu/articles/stem-teachers-are-most-in-need-of-additional-pay/.

[60] Jacob, B., Jones, D., & Keys, B. (2023). The value of student debt relief and the role of administrative barriers: Evidence from the Teacher Loan Forgiveness Program. *National Bureau of Economic Research*. https://doi.org/10.3386/w31359.

[61] Allegretto, S., García, E., & Weiss, E. (2022). (rep.). *Public education funding in the U.S. needs an overhaul*. Economic Policy Institute. Retrieved January 22, 2024, from https://www.epi.org/publication/public-education-funding-in-the-us-needs-an-overhaul/.

[62] Fuller, J. B., & Raman, M. (2022). (rep.). *The Partnership Imperative: Community Colleges, Employers, and America's Chronic Skills Gap*. Harvard Business School. Retrieved January 22, 2024, from https://www.hbs.edu/news/releases/Pages/partnership-imperative.aspx.

[63] Schoolwide Integrated Framework for Transformation Center. (2013). *Benefits of Inclusive Education for ALL Students*. Schoolwide Integrated Framework for Transformation. University of New Hampshire. https://iod.unh.edu/sites/default/files/media/InclusiveEd/researchsupport-final.pdf.

[64] Molina Roldán, S., Marauri, J., Aubert, A., & Flecha, R. (2021). How Inclusive Interactive Learning Environments Benefit Students Without Special Needs. *Frontiers in psychology, 12*, 661427. https://doi.org/10.3389/fpsyg.2021.661427.

[65] Learning Policy Institute. (2017). *The Role of Principals in Addressing Teacher Shortages* (research brief). Palo Alto, CA: Learning Policy Institute. https://learningpolicyinstitute.org/product/role-principals-addressing-teacher-shortages-brief.

[66] Jimenez-Silva, M., & Olson, K. (2012). A Community of Practice in Teacher Education: Insights and Perceptions. *International Journal of Teaching and Learning in Higher Education, 24*(3), 335–348. https://files.eric.ed.gov/fulltext/EJ1000686.pdf.

[67] Morris, V. R., & Washington, T. M. (2018). The role of professional societies in STEM diversity. *Notices of the American Mathematical Society, 65*(02), 149–155. https://doi.org/10.1090/noti1642

[68] Phillip Levine, S. R., Sarah Reber, G. G., & Katharine Meyer, A. P. (2022, March 9). *Black-white disparity in student loan debt more than triples after graduation*. The Brookings Institution. https://www.brookings.edu/articles/black-white-disparity-in-student-loan-debt-more-than-triples-after-graduation/.

[69] Sanabria, T., & Penner, A. (2017). Weeded out? gendered responses to failing calculus. *Social Sciences, 6*(2), 47. https://doi.org/10.3390/socsci6020047.

[70] Thompson, M. E. (2022, March 9). Who's getting pulled in weed-out courses for STEM majors? The Brookings Institution. https://www.brookings.edu/articles/whos-getting-pulled-in-weed-out-courses-for-stem-majors/.

[71] Meyer, K. (2023, July 5). *The end of race-conscious admissions*. The Brookings Institution. https://www.brookings.edu/articles/the-end-of-race-conscious-admissions/.

[72] National Academies of Sciences, Engineering, and Medicine. (2016). (rep.). *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways*. Washington, DC: The National Academies Press. https://doi.org/10.17226/21739.

[73] University of California. (2021). (rep.). *Accountability Report 2021*. Retrieved January 22, 2024, from https://accountability.universityofcalifornia.edu/2021/welcome.html.

[74] Carnevale, A. P., Campbell, K. P., Cheah, B., Fasules, M. L., Gulish, A., Quinn, M. C., Sablan, J. R., Smith, N., Strohl, J., & Barrese, S. (2021, May). (rep.). *The Monetary Value of Economic and Racial Justice in Postsecondary Education: Quantifying the Potential for Public Good*. Postsecondary Value Commission. https://www.postsecondaryvalue.org/wp-content/uploads/2021/05/PVC-GUCEW-FINAL.pdf.

[75] Palid, O., Cashdollar, S., Deangelo, S., Chu, C., & Bates, M. (2023). Inclusion in practice: A systematic review of diversity-focused STEM programming in the United States. *International Journal of STEM Education, 10*(1). https://doi.org/10.1186/s40594-022-00387-3.

[76] Loyd, A. (2023, April 19). Celebrating our Nation's Community Colleges. Homeroom, U.S. Department of Education. https://blog.ed.gov/2023/04/celebrating-our-nations-community-colleges/.

[77] Maxim, R. & Muro, M. (2020, June 17). Restoring regional public universities for recovery in the Great Lakes. The Brookings Institution. https://www.brookings.edu/articles/restoring-regional-public-universities-for-recovery-in-the-great-lakes/.

[78] Hittepole, C. (2016). Nontraditional Students: Supporting Changing Student Populations: A Guide for Chief Academic Officers & Chief Student Affairs Officers. NASPA, Student Affairs Administrators in Higher Education. https://naspa.org/images/uploads/main/Hittepole_NASPA_Memo.pdf.

[79] National Academies of Sciences, Engineering, and Medicine. (2023, February 14). (rep.). *Higher Ed Institutions, STEMM Organizations Should Act to Change Cultures to Support Inclusive Excellence and Dismantle Barriers Created by Systemic Racism and Implicit Bias*. National Academies of Sciences, Engineering, and Medicine. https://www.nationalacademies.org/news/2023/02/higher-ed-institutions-stemm-organizations-should-act-to-change-cultures-to-support-inclusive-excellence-and-dismantle-barriers-created-by-systemic-racism-and-implicit-bias.

[80] Nietzel, M. (2020, October 30). Nineteen Universities Join Large-Scale Effort to Diversify STEM Faculty. Forbes. https://www.forbes.com/sites/michaeltnietzel/2020/10/30/nineteen-universities-join-large-scale-effort-to-diversity-stem-faculty/?sh=49a3424e440b.

[81] Palid, O., Cashdollar, S., Deangelo, S., Chu, C., & Bates, M. (2023). Inclusion in practice: A systematic review of diversity-focused STEM programming in the United States. *International Journal of STEM Education, 10* (1). https://doi.org/10.1186/s40594-022-00387-3.

[82] Nietzel, M. (2020, October 30). Nineteen Universities Join Large-Scale Effort to Diversify STEM Faculty. Forbes. https://www.forbes.com/sites/michaeltnietzel/2020/10/30/nineteen-universities-join-large-scale-effort-to-diversity-stem-faculty/?sh=49a3424e440b.

[83] Lautenberger, D. & Dandar, V. (2020). (rep.). 2018-2019 The State of Women in Academic Medicine: Exploring Pathways to Equity. Association of American Medical Colleges. https://www.aamc.org/data-reports/faculty-institutions/report/state-women-academic-medicine.

[84] Griffin, K. (2023, February) Redoubling Our Efforts: How Institutions Can Affect Faculty Diversity. American Council n Education. https://www.equityinhighered.org/resources/ideas-and-insights/redoubling-our-efforts-how-institutions-can-affect-faculty-diversity/.

[85] Lauer, M. & Bernard, M. (2022, June 14). Research Project Grant Funding Rates and Principal Investigator Race and Ethnicity. National Institutes of Health. Office of Extramural Research. https://nexus.od.nih.gov/all/2022/06/14/research-project-grant-funding-rates-and-principal-investigator-race-and-ethnicity/.

[86] National Institute of Allergy and Infectious Diseases. (2023, February 1). NIH Shares Data on Investigators with Disabilities. https://www.niaid.nih.gov/grants-contracts/nih-shares-data-investigators-disabilities.

[87] National Center for Science and Engineering Statistics. (2021, July 15). (rep.). *Growth in Federal S&E Support to HBCUs Continue to Lag Behind Increases to All Institutions in FY 2019*. National Science Foundation. https://ncses.nsf.gov/pubs/nsf21332.

[88] Chen, C. Y., Kahanamoku, S. S., Tripati, A., Alegado, R. A., Morris, V. R., Andrade, K., & Hosbey, J. (2022). Systemic racial disparities in funding rates at the National Science Foundation. *eLife, 11*. https://doi.org/10.7554/elife.83071.

[89] Oliveira DFM, Ma Y, Woodruff TK, Uzzi B. Comparison of National Institutes of Health Grant Amounts to First-Time Male and Female Principal Investigators. *JAMA*. 2019;321(9):898–900. doi:10.1001/jama.2018.21944.

[90] Swenor BK, Munoz B, Meeks LM (2020) A decade of decline: Grant funding for researchers with disabilities 2008 to 2018. PLoS ONE 15(3): e0228686. https://doi.org/10.1371/journal.pone.0228686.

[91] Department of Education. (2023, September 18). *Secretaries of education, agriculture call on governors to equitably fund land-grant hbcus*. Secretaries of Education, Agriculture Call on Governors to Equitably Fund Land-Grant HBCUs | U.S. Department of Education. https://www.ed.gov/news/press-releases/secretaries-education-agriculture-call-governors-equitably-fund-land-grant-hbcus.

[92] Department of Education. (2023, October 2). *White House initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Hispanics*. HSIs Application Deadline: Historically Black Colleges or Universities, Tribally Controlled Colleges or Universities, and Minority-Serving Institutions Research and Development Infrastructure Grant Program. https://www2.ed.gov/programs/rdi/index.html.

[93] National Center for Science and Engineering Statistics. (2021, July 15). (rep.). *Growth in Federal S&E Support to HBCUs Continue to Lag Behind Increases to All Institutions in FY 2019*. National Science Foundation. https://ncses.nsf.gov/pubs/nsf21332.

[94] Chen, C. Y., Kahanamoku, S. S., Tripati, A., Alegado, R. A., Morris, V. R., Andrade, K., & Hosbey, J. (2022). Systemic racial disparities in funding rates at the National Science Foundation. *eLife, 11*. https://doi.org/10.7554/elife.83071.

[95] Nordling, L. (2023). Scientists with multiple NIH grants are overwhelmingly male and white. *Nature*. https://doi.org/10.1038/d41586-023-01297-2.

[96] Ibid.

[97] Ruzycki, S. M., & Ahmed, S. B. (2022). Equity, diversity and inclusion are foundational research skills. *Nature human behaviour*, 6(7), 910–912. https://doi.org/10.1038/s41562-022-01406-7.

[98] National Academies of Sciences, Engineering, and Medicine. (2019). (rep.). *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

[99] National Academies of Sciences, Engineering, and Medicine. (2019). (rep.). *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

[100] Holdren, J. P. (2013, February 22). Increasing Access to the Results of Federally Funded Scientific Research. Washington, D.C. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf; The United States Government. (2022, August 25). *OSTP issues guidance to make federally funded research freely available without delay*. The White House. https://www.whitehouse.gov/ostp/news-updates/2022/08/25/ostp-issues-guidance-to-make-federally-funded-research-freely-available-without-delay.

[101] Nyberg, S. & Idleman, L. (2005 September). (rep.). *The State of Libraries at Historically Black Colleges and Universities: A Comparative Analysis Using Data Collected through the Academic Libraries Survey*. HBCU Library Alliance. https://hbculibraries.org/docs/Stats-report.pdf.

[102] Han, H.-R., Xu, A., Mendez, K. J., Okoye, S., Cudjoe, J., Bahouth, M., Reese, M., Bone, L., & Dennison-Himmelfarb, C. (2021). Exploring community engaged research experiences and preferences: A multi-level qualitative investigation. *Research Involvement and Engagement, 7*(1). https://doi.org/10.1186/s40900-021-00261-6.

[103] Ibid.

[104] Purpose Brand. (2023, December 11). *Corporate Diversity Data: What Fortune 500 DEI Reports Reveal*. https://purposebrand.com/blog/diversity-report-examples-fortune-2023/.

[105] Ibid.

[106] The United States Government. (2023, November 29). *Justice40 initiative*. The White House. https://www.whitehouse.gov/environmentaljustice/justice40/.

[107] The Milken Institute. (2021, June 24). (rep.). *Ensuring Equity in Philanthropy: Philanthropist's Field Guide*. The Milken Institute. https://milkeninstitute.org/article/ensuring-equity-philanthropy.

[108] Cargill, S. S., DeBruin, D., Eder, M., Heitman, E., Kaberry, J. M., McCormick, J. B., Opp, J., Sharp, R., Strelnick, A. H., Winkler, S. J., Yarborough, M., & Anderson, E. E. (2016). Community-Engaged Research Ethics Review: Exploring Flexibility in Federal Regulations. *IRB, 38* (3), 11–19.

[109] Brown, P., Morello-Frosch, R., Brody, J. G., Altman, R. G., Rudel, R. A., Senier, L., Pérez, C., & Simpson, R. (2010). Institutional review board challenges related to community-based participatory research on human exposure to environmental toxins: a case study. *Environmental health : a global access science source, 9,* 39. https://doi.org/10.1186/1476-069X-9-39.

[110] Gilbert, Daniel & Johnson, Mark. (2023, February 16). Investigation spotlights rise of for-profit ethics boards in research. The Washington Post. https://www.washingtonpost.com/business/2023/02/16/irb-research-ethics-private-equity/.

[111] Bohannon, M. (2023, July 29). Affirmative Action Decision Could Create 'Chilling Effect' for Companies. Forbes. https://www.forbes.com/sites/mollybohannon/2023/06/29/affirmative-action-overturned-in-college-admissions-companies-diversity-efforts-not-directly-impacted-but-there-could-be-chilling-effect/?sh=26afe0283c0c.

[112] Coleman, A., Keith, J., & Webb, E. (2019, December 4). (rep.). *The Playbook: Understanding the Role of Race Neutral Strategies in Advancing Higher Education Diversity Goals* (2). Collegeboard. https://highered.collegeboard.org/media/pdf/playbook-understanding-race-neutral-strategies.pdf.

[113] Clarke, K. & Lhamon, C. (2023, August 14). Dear colleague letter. Washington, DC: U.S. Department of Justice, Civil Rights Division & U.S. Department of Education, Office for Civil RIghts. https://www2.ed.gov/about/offices/list/ocr/letters/colleague-20230814.pdf.

[114] Funk, C., & Parker, K. (2018, January 9). Women and Men in STEM Often at Odds Over Workplace Equity. Pew Research Center. https://www.pewresearch.org/social-trends/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/.

[115] Reeves, Matthew. (2022, December 2). Four Ways Mentorship Programs Can Meaningfully Promote Workplace Diversity and Inclusion. Forbes. https://www.forbes.com/sites/forbeshumanresourcescouncil/2022/12/02/four-ways-mentorship-programs-can-meaningfully-promote-workplace-diversity-and-inclusion/?sh=3528fbcd98db.

[116] Science is Us. (2023). (rep.). *People of Science: An inclusive analysis of the U.S. STEM workforce and its economic impact*. https://scienceisus.org/people-of-science/.

[117] Hancock, B., Higgins, C., Law, J., Olson, S., Patel, N., & Dusen, K. V. (2022, November 15). *Taking a skills-based approach to building the future workforce*. McKinsey & Company. https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/taking-a-skills-based-approach-to-building-the-future-workforce.

[118] McKenzie, S. (2023, October 26) Empowering Communities: The Impact of Tech Hubs on Economic and Workforce Development. Economic Impact Catalyst. https://economicimpactcatalyst.com/tech-hubs-communities/.

[119] Tu, M & Li, M. (2021, May 12). What Great Mentorship Looks Like in a Hybrid Workplace. Harvard Business Review. https://hbr.org/2021/05/what-great-mentorship-looks-like-in-a-hybrid-workplace.

[120] Bhatnagar, V., Diaz, S., & Bucur, P. A. (2020). The Need for More Mentorship in Medical School. *Cureus, 12*(5), e7984. https://doi.org/10.7759/cureus.7984.

[121] Bhatnagar, V., Diaz, S., & Bucur, P. A. (2020). The Need for More Mentorship in Medical School. *Cureus, 12*(5), e7984. https://doi.org/10.7759/cureus.7984.

[122] Ray, J. (2022, April 26). Study Shows 2U Tech Boot Camp Grads See Quick ROI. Gallup. https://news.gallup.com/opinion/gallup/391994/study-shows-tech-boot-camp-grads-quick-roi.aspx.

[123] Ioannou, L. (2023, May 17). Why Amazon, Google, and Other Big Businesses Have Launched Accelerators to Help Minority-Owned Startups. US Chamber of Commerce. https://www.uschamber.com/co/good-company/launch-pad/big-businesses-launch-accelerators-for-minority-owned-startups.

[124] Frankel, B, & Kennan, D. (2022, November 11). The Future of ERGs: Are Affinity-Based Groups Still Necessary. Seramount. https://seramount.com/articles/the-future-of-ergs-are-affinity-based-groups-still-necesary/.

[125] Costa, M. (2023, October 1). Why more companies are starting to pay ERG leaders. Fast Company. https://www.fastcompany.com/90959733/why-more-companies-are-starting-to-pay-erg-leaders.

[126] Sherman, C. (2023, Jan 03). Research shows workforce experience drives loyalty and retention. Deloitte Digital. https://www.deloittedigital.com/us/en/blog-list/2023/workforce-experience-by-design.html.

[127] Cullen, Z. (2023). Is Pay Transparency Good? *National Bureau of Economic Research*. https://doi.org/10.3386/w31060.

[128] Bersin, J, & Enderes, K. (2021). *Elevating Equity: The Real Story of Diversity and Inclusion* (pp. 1–52). Josh Bersin Academy. https://bersinacademy.com/courses/elevating-equity.

[129] Global Industry Analysts. (2023). (rep.). *Diversity and Inclusion — Global Strategic Business Report*. Research and Markets. https://www.researchandmarkets.com/reports/5519706/diversity-and-inclusion-dandi-global-strategic#product--toc.

[130] Oakes, K. (2022, April 12). How Building a Culture of Career Mobility Can Help Retain Talent. Harvard Business Review. https://hbr.org/webinar/2022/03/how-building-a-culture-of-career-mobility-can-help-retain-talent.

[131] This story is based on information shared at https://www.instagram.com/p/CGa0aG1gsNN/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA%3D%3D.

[132] Kane, J. (2022). *Seizing the U.S. infrastructure opportunity: Investing in current and future workers*. The Brookings Institution. https://www.brookings.edu/articles/infrastructure-workforce/.

[133] Bureau of Labor Statistics, U.S, Department of Labor. (March 2022). National Compensation Survey–Benefits. https://www.bls.gov/ebs/.

[134] Gallup. (2021). *The American Upskilling Study: Empowering Workers for the Jobs of Tomorrow*. https://www.gallup.com/analytics/354374/the-american-upskilling-study.aspx.

[135] DeVry University (2023). Closing the Activation Gap: Converting Potential to Performance by Upskilling the Workforce. https://www.devry.edu/content/dam/devry_edu/newsroom/closing-the-activation-gap.pdf.

[136] Chamberlain, A. (201, March 6). Why Do Employees Stay? A Clear Career Path and Good Pay, for Starters. Harvard Business Review. https://hbr.org/2017/03/why-do-employees-stay-a-clear-career-path-and-good-pay-for-starters.

[137] Coffman, J., Rosenblum, E., D'Arcy, A., & Thompson Love, L. (2021, August 11). How Clear Career Paths Strengthen Retention—and Diversity. https://www.bain.com/insights/how-clear-career-paths-strengthen-retention-and-diversity/.

[138] Geena Davis Institute (2018, September 24). Portray Her: Representations of Women STEM Characters in Media. https://seejane.org/research-informs-empowers/portray-her/.

[139] Ibid.

[140] Funk, C., & Parker, K. (2018, January 9). Women and Men in STEM Often at Odds Over Workplace Equity. Pew Research Center. https://www.pewresearch.org/social-trends/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/.

[141] National Center for Science and Engineering Statistics (NCSES). 2023. *Diversity and STEM: Women, Minorities, and Persons with Disabilities 2023*. Special Report NSF 23-315. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/wmpd.

[142] Louie, P., & Wilkes, R. (2018). Representations of race and skin tone in medical textbook imagery. *Social science & medicine (1982), 202*, 38–42. https://doi.org/10.1016/j.socscimed.2018.02.023.

[143] Witzig R. (1996). The medicalization of race: scientific legitimization of a flawed social construct. *Annals of internal medicine, 125* (8), 675–679. https://doi.org/10.7326/0003-4819-125-8-199610150-00008.

Appendix

Key Terminology

- **Diversity:** The presence of individuals from a wide range of social, ethnic and other backgrounds. Diversity includes members from various races, abilities, incomes, geographies, sexual orientations, genders and other backgrounds.
- **Community of Practice:** A community of practice (CoP) is a group of people who share a common interest in a specific domain. They regularly collaborate to share information, improve their skills, and actively work on advancing their knowledge of the domain.
- **Equity:** Eliminating barriers and facilitating the advancement of historically excluded and marginalized groups to achieve success on par with that of historically prioritized groups.
- **Historically Excluded and Marginalized Communities:** Individuals or groups of individuals belonging to backgrounds that have experienced disproportionate discrimination or unfair treatment resulting in unbalanced outcomes in education, opportunity, employment, representation and more.
- **Learning Spaces:** Locations where learning takes place, including schools, museums, community organizations, libraries, parks and nature centers.
- **Local Officials:** Individuals working in the decision-making and political spheres within their specific communities (can refer to city, county, etc.).
- **Nontraditional Students:** Students entering or returning to higher education one or more years after high school. Nontraditional students often spend time in the workforce before pursuing higher education.
- **Parity:** The status of equality, whether in pay, status, access to opportunities, representation or other factors. In this context, parity is defined as access to and thriving within STEMM learning opportunities, fostering a sense of inclusion and belonging in the workplace, pay equity, and much more.
- **Scientific Enterprise:** All economic activities are based on the scientific process, including both academic and commercial processes.
- **STEMM Ecosystem:** The broad collection of networks, organizations and individuals committed to the advancement of science, technology, engineering, mathematics and medicine.
- **STEMM R&D:** Research and development in the science, technology, engineering, mathematics and medical fields.

STEMM OPPORTUNITY ALLIANCE

SOA Network

American Association for the Advancement of Science Staff

- **Travis T. York,** Director, Inclusive STEMM Ecosystems for Equity and Diversity
- **Shirley M. Malcom,** Senior Advisor to the CEO and Director of SEA Change
- **Michael Feder,** Program Director, Inclusive STEMM Ecosystems for Equity and Diversity

Advisory Council

- **April Arnzen,** Micron Technology
- **Gilda Barbarino,** Olin College of Engineering
- **Carrie Billy,** American Indian Higher Education Consortium
- **George Boggs,** American Association of Community Colleges
- **France Córdova,** Science Philanthropy Alliance
- **Tshaka Cunningham,** Polaris Genomics
- **Adam Falk,** Alfred P. Sloan Foundation
- **Maria Flynn,** Jobs for the Future
- **Helene Gayle,** Spelman College
- **Bernard A. Harris Jr.,** Vesalius Ventures
- **Chevy Humphrey,** Museum of Science and Industry, Chicago
- **Paula A. Johnson,** Wellesley College
- **Oona King,** Uber
- **Allyson Knox,** Microsoft
- **Talia Milgrom-Elcott,** Beyond100K
- **Christofer Nelson,** Association of Science and Technology Centers
- **Ron Ottinger,** STEM Next Opportunity Fund
- **Marla Pérez-Davis,** Kent State University
- **Stephen L. Pruitt,** Southern Regional Education Board
- **David J. Skorton,** Association of American Medical Colleges
- **David Spergel,** Simons Foundation
- **Michael Stroik,** 3M Community Relations
- **Bonnielin Swenor,** Johns Hopkins Disability Health Research Center
- **Blanton S. Tolbert,** Howard Hughes Medical Institute
- **David Wilson,** Morgan State University

Founding Partners

- American Association for the Advancement of Science
- Doris Duke Foundation

Funding Partners *as of March 20, 2024*

- Alfred P. Sloan Foundation
- Burroughs Wellcome Fund
- Chan Zuckerberg Initiative
- Gordon and Betty Moore Foundation
- Heising-Simons Foundation
- Henry Luce Foundation
- Josiah Macy Jr. Foundation
- Lasker Foundation
- Lyda Hill Philanthropies
- Rita Allen Foundation
- Simons Foundation
- Spencer Foundation

Alliance Partners *as of March 20, 2024*

Please see our website for an up-to-date list of our growing alliance.

- 2030STEM
- 3M
- Afterschool Alliance
- Albert Einstein Distinguished Educator Fellowship Program
- American Association of Colleges and Universities
- American Association of Community Colleges
- American Association of Physics Teachers
- American Association of State Colleges and Universities
- American Chemical Society
- American Council on Education
- American Educational Research Association
- American Geophysical Union
- American Heart Association
- American Indian Higher Education Consortium
- American Indian Science and Engineering Society
- American Institute of Biological Sciences
- American Institute of Physics
- American Institutes for Research
- American Museum of Natural History
- American Physical Society
- American Physiological Society
- American Psychological Association
- Amgen Foundation
- AnitaB.org
- Arizona Science Center
- Arizona State University
- Association for Women in Science
- Association of American Medical Colleges
- Association of American Universities
- Association of Public and Land-grant Universities
- Association of Science and Technology Centers
- Beyond100K
- Biogen
- Black in Cardio
- Black Innovation Leaders of Florida
- Black Sisters in STEM
- BoSTEM
- Boston Scientific
- Boston University Chobanian & Avedisian School of Medicine
- Brown Girls Code
- Brown University
- Building Engineering and Science Talent
- Carnegie Corporation of New York
- Center of Science and Math in Context, UMass
- Chicago Council on Science and Technology
- Chicago Pre-College Science and Engineering Program
- Code Savvy
- Community College Presidents Initiative in STEM
- CommunityShare
- createMPLS
- Creating Pathways and Access for Student Success Foundation
- Desert Research Institute
- Design Connect Create
- Discover Engineering
- DuPont
- Education Development Center
- Excelencia in Education
- For Inspiration and Recognition of Science and Technology
- Franklin Institute
- Frontiers of Flight Museum
- G{Code}
- Geena Davis Institute on Gender in Media
- GirlStart
- Great Minds in STEM
- Hampton University
- Harvey Mudd College
- Health Research Alliance
- High Tech Kids

- Howard Hughes Medical Institute
- Hypothesis Fund
- IBM
- Icahn School of Medicine at Mount Sinai
- Illumina
- Institute for the Advancement of Food and Nutrition Sciences
- Inventionland Education
- Jason Learning
- Jobs for the Future
- Johns Hopkins University
- Johnson & Johnson
- Journal of Science Policy and Governance
- Kansas State University College of Education
- Kapor Center
- KUAMP
- Last Mile Education Fund
- L'Oréal USA
- Manufacturers Association of Central NY
- Merck
- Mexican American Opportunity Foundation
- Micron
- Microsoft
- Morgan State University
- Museum of Science and Industry, Chicago
- National Alliance for Partnerships in Equity
- National Center for Women and Information Technology
- National Council of Teachers of Mathematics
- National Girls Collaborative Project
- National Informal STEM Education Network
- National Math and Science Initiative
- National Postdoctoral Association
- National Q-12 Education Partnership
- National Science and Technology Medals Foundation
- National Science Policy Network
- National Science Teaching Association
- National University
- New America
- New York Hall of Science
- Northeast Florida Regional STEM2 Hub, Inc.
- Novartis
- Oak Ridge Associated Universities
- Olin College of Engineering
- Oregon STEM
- Pennsylvania Alliance for STEM Education
- Pivotal Ventures
- Polaris Genomics
- Project Exploration
- Project Lead The Way
- Quality Education for Minorities Network
- Raising Overachieving STEM Academics
- Regeneron
- Research America!
- Rockhurst University
- Sankofatech
- Science Club for Girls
- Science Friday Initiative
- Science Philanthropy Alliance
- SciTech Institute
- Scratch Foundation
- Smithsonian Science Education Center
- Snap Inc.
- Societies Consortium on Sexual Harassment in STEMM
- Society for Science
- Society for the Advancement of Chicanos/ Hispanics and Native Americans in Science
- Society of Hispanic Professional Engineers
- Society of Women Engineers
- Southern Regional Education Board
- Spelman College
- St. Jude Children's Research Hospital
- STEM Center of Excellence
- STEM Connector
- STEM Education Coalition
- STEM Funders Network
- STEM Next Opportunity Fund
- Students for the Exploration and Development of Space
- Teaching Institute for Excellence in STEM
- Tech Accountability Coalition
- Techbridge Girls
- Telos Learning
- Tennessee State University
- Texas Girls Collaborative Project
- Texas Woman's University
- The Henry Ford
- Thermo Fisher Scientific
- Tiger Global Impact Ventures
- Universal Technical Institute
- Universities Research Association
- University Innovation Alliance
- University of Maine
- University of Texas Rio Grande Valley
- USA BMX Foundation
- UTeach Institute
- Vanderbilt University
- Verizon
- Vertex
- Watertown City School District
- Wellesley College
- WestEd
- WeTeach_CS
- Whiz Girls Academy
- Women in Engineering Pro-Active Network
- Women in Revenue

Table 3: Strategy Summary

Strategy Area	Goals	Key Actors	Key Actors	Approaches	Steps		
Accountability and Partnership **Groundwork for Collaborative Action**	**1. Develop strong systems and processes for measuring equity in STEMM to hold ourselves accountable for progress.**	• Annual reporting on the latest state for each of the progress metrics included in the national strategy is released each year, starting in 2025. • 100% of SOA partners have made public commitments aligned with at least one pillar of the national strategy by 2025. • SOA partners have launched a working group for each pillar with detailed metrics for public accountability for the working group's outcomes.	• Public and private employers • Local, state and federal policymakers • Community and/or nongovernmental organizations • Media organizations • Philanthropies • Educational institutions	• Establish data-driven accountability structures that allow partners to report and easily understand progress and hold the community responsible for action.	• **Working Groups:** Establish cross-sector working groups of partners responsible for cocreating accountability structures and processes. • **Shared Indicators:** Develop shared indicators of progress toward STEMM equity that include all key sectors and use benchmarks to measure the success of efforts.	• **Accessible Data Collection:** Increase accessibility of public and private data collection and analysis of progress toward shared goals. Provide increased attention to sharing information with the public in a disaggregated format, potentially in a national database, to determine the effectiveness of actions on all communities, especially those who have been historically excluded and marginalized in STEMM.	• **Accessible Data Analysis:** Publish and widely distribute annual reports assessing the progress made by various sectors in the STEMM ecosystem with callouts to high-impact opportunities. Increase attention to sharing information in a disaggregated format, potentially in a nationwide database.
				• Improve and coordinate data collection across the STEMM ecosystem to broaden, deepen, and strengthen key metrics.	• **Descriptive, Relevant Data:** Working with public and private stakeholders and data providers, collect qualitative and quantitative data in transparent, effective, and efficient methods that enable disaggregation by historically excluded and marginalized populations. Ensure that metrics are reviewed for relevance, efficacy, and efficiency to actively inform program implementation. Identify opportunities to automate data collection to ensure accurate and complete data are regularly collected without placing a high degree of additional burden on institutions and organizations.	• **Community Involvement:** Collaborate with targeted groups to formulate metrics and analyze data, integrating their perspectives into data collection, evaluation, sensemaking, and reporting. • **Impact on Historically Excluded and Marginalized Communities:** Report on the short- and long-term impact of STEMM equity implementation strategies on targeted communities.	
	2. Establish key infrastructure for enabling coordination and collaboration across institutions and sectors, with a focus on building, strengthening and empowering partnerships.	• 50% of SOA partners have engaged in new collaborations to advance the goals of the national strategy by 2035. • SOA has grown to a total of 600 partners by 2042 to advance its goals.	• Public and private employers • Local, state and federal policymakers • Community and/or nongovernmental organizations • Media organizations • Philanthropies • Educational institutions	• Facilitate knowledge sharing within and among communities of practice across all STEMM sectors.	• **Collaborative Infrastructure:** Engage SOA partners in a collective impact network that facilitates their ability to collaborate on achieving the goals of the pillars.	• **Communities of Practice:** Anchor partners regularly convene communities of practice from a variety of STEMM sectors (e.g., industry, education, research) to discuss and promote effective steps taken to improve equity.	• **Centralized Platforms:** Establish centralized platforms, such as a shared database of programs implemented by SOA partners and improved national STEMM data systems, to facilitate knowledge sharing and cultivation across the STEMM ecosystem.
				• Create and amplify opportunities for organizations to work together on concrete equity initiatives that are shared across institutions, regions and sectors.	• **Working Groups:** Establish cross-sector working groups that meet on a regular basis to establish, utilize and iterate on equity action plans in different areas.	• **Multi-Partner Collaborations:** Launch and create dedicated support, funding and infrastructure for new equity initiatives that are led by two or more partners, especially those that bring together institutions from different sectors.	

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps		
Engagement **Nurturing Curiosity in Every Child**	**1. Ensure all schools provide rigorous, high-quality mathematics and science coursework with access to necessary learning supports.**	• All students have access to, and 75% of middle school students enroll in algebra courses by 2030. • All high school students have the opportunity to take calculus, physics and other advanced math and science courses by 2040.	• Federal, state and local policymakers • Pre-K-12 institutions and educators • Community-based organizations • Museums, science centers and zoos • Local and regional businesses • Parents, guardians and caregivers • Out-of-school, after-school and summer learning programs • Leaders in the media and entertainment industry (e.g., screenwriters, producers, actors)	• Increase the average amount of time that students spend learning STEMM subjects and the number of accessible, high-quality classes.	• **Universal Design:** Invest in the universal design of STEMM curricula and learning spaces so that the greatest number of people can benefit.	• **Professional Support:** Create the support needed for school districts to develop and implement inclusive curricula for STEMM subjects, including but not limited to identifying and addressing funding, teacher quality and culturally responsive pedagogy.	• **Resource Sharing:** Create resources for open-source learning plans on STEMM materials and support more inclusive and learner-focused curricular development in pre-K-12 schools.
				• Ensure that all secondary school students have access to and are supported in registering for dual and concurrent enrollment classes, taking STEMM AP courses, or engaging in other rigorous academic program opportunities regardless of school district.	• **Access to Advanced Courses:** Remove barriers and increase encouragement for students of color, students with disabilities and students facing other structural obstacles to access and success in advanced STEMM courses (e.g., AP, dual enrollment and concurrent enrollment courses), including access to early learning experiences that prepare students for success.		
				• Provide access to modern technologies and resources within all pre-K-12 schools and other learning spaces to address the digital divide.	• **Broadband Infrastructure:** Invest in high-speed internet infrastructure to build the capacity of schools, communities and families, especially in rural areas, districts, and national and regional non-profit programs to support STEMM learning.	• **Tech Equipment:** Provide students with access to high-quality facilities and equipment, such as science and computer labs, and in-classroom tools, such as tablets and other learning technologies, and teach fundamental skills courses exploring how to best leverage these tools.	
	2. Provide children and their families with equitable access to high-quality STEMM learning experiences, including in informal and technology-enabled settings.	• 3.5 million more youth, with at least 50% from marginalized communities, participate in out of school STEMM learning experiences by 2025. • 6.5 million more youth, with 70% from marginalized communities, participate in after-school STEMM learning experiences by 2030. • All Title I schools have access to after-school STEMM experiences by 2025.	• Federal, state and local policymakers • Pre-K-12 institutions and educators • Community-based organizations • Museums, science centers and zoos • Local and regional businesses • Parents, guardians and caregivers • Out-of-school, after-school and summer learning programs • Leaders in the media and entertainment industry (e.g., screenwriters, producers, actors)	• Increase access to and participation in high-quality informal and community-led STEMM learning opportunities—which have been proven to improve students' comfort with and desire to pursue STEMM education and careers—including equitable partnerships with schools and access to online learning platforms.	• **Informal Learning Opportunities:** Identify ways to incorporate rigorous, research-based STEMM learning during childhood play and outside formalized learning settings and support parents and guardians in affirming, creating and participating in informal STEMM learning opportunities for children.	• **Early STEMM Introduction:** Greatly expand the focus of federal investment in the Head Start Program and 21st Century Community Learning Centers (21CCLC) programs to incorporate early childhood engagement and learning, inclusive of STEMM, that encourages discovery and social-emotional development. • **Data Systems:** Leverage and strengthen national surveys of out-of-school STEMM participation, such as the Afterschool Alliance's America After 3PM survey, to better track program quality, access and reach.	• **Capacity Building:** Build the capacity and financial support for community-led organizations, both grassroots and national, to provide high-quality STEMM learning experiences. • **Asset-Based Approaches:** Invest in efforts to collaborate with individuals to elevate human experiences and prioritize the cultural identities of various communities and identities within corporations, small businesses and government in an effort to deploy a wide array of youth-led, joyful STEMM learning experiences that nurture curiosity in children.
				• Provide ample opportunities for experiential learning so that theoretical and abstract concepts within curricula are better understood, retained and applied.	• **Innovative Pedagogy:** Study, support and implement innovative pedagogical approaches, including work-based, project-based and other experiential learning.	• **Experiential Learning:** Develop partnerships between local industry and educational institutions to increase access to relevant experiential learning opportunities.	• **Authentic STEMM Learning:** Empower students to engage in fruitful learning opportunities outside school hours at zoos, science centers, museums, state and national parks, national and federal laboratories, entertainment and media, and other such places that foster authentic STEMM learning experiences.
				• Introduce children and their parents to STEMM careers and augment the diversity of people in those careers across the range of preparation, from certificate to doctoral education.	• **Career Exposure:** Expand and strengthen career fairs, in-class presentations, informative webinars and work-based learning opportunities to build applied knowledge and professional networks. • **Uplift Historically Excluded and Marginalized Professionals:** Support specific efforts to highlight professionals from historically excluded and marginalized groups in order to redefine norms around who belongs in STEMM.	• **Connect to Regional Economies:** Support specific efforts to highlight professionals from local areas, tying culturally relevant relationships from a community's educational institutions to local economies and leveraging science and technology infrastructure to boost impact.	• **Expand STEMM Narratives:** Support efforts to expand STEMM narratives, ensuring trade, agriculture and other critical occupations are seen and highlighted as valued and viable STEMM career pathways open to all. Ensure that these work environments are inclusive, depicted as such in popular media and portrayed as being integral to the STEMM field.

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps		
Inspiration **Developing Skilled and Diverse Educators**	**1. End the persistent shortage of STEMM pre-K-12 educators.**	• Reduce the STEMM teacher shortage in the hardest to staff schools by one-third by 2035. • End the teacher shortage by 2045 with an increase in average teacher retention across all demographics.	• Federal, state and local policymakers • Local school districts • After-school, out-of-school and informal educators • Postsecondary teacher preparation programs • Parent-teacher associations and organizations • Teaching professionals; teaching licensors	• Expand on-ramps to the teaching profession, including mid- and late-career professionals with STEMM experience in other sectors.	• **Preservice Teacher Preparation:** Significantly expand the types and number of opportunities for affordable, comprehensive and evidence-based on-ramps to teaching to increase access and excellence, especially including apprenticeships. • **Expand Teacher Licensing:** Advocate for and implement policies that increase the flexibility of teacher licensing while maintaining quality standards.	• **Teaching Apprenticeships:** Scale effective teaching apprenticeships programs. • **Reform Hiring:** Increase ability for school administrators to hire excellent and well-qualified teaching professionals for open positions, especially those from nontraditional educational pathways.	
				• Create regional systems to assess and track teacher workforce gaps, retention and representation.	• **Measure Teacher Shortages:** Project and forecast teacher shortages and representation at the national, regional, state and local levels to proactively manage and inform workforce policy.	• **Clear Teaching Trajectories:** Create pathways for teacher career advancement and salary increases throughout the STEMM teacher career trajectory, including opportunities for externships to enable educators to gain STEMM industry experience. In addition, reward strategic educator career advancement, including for those who are teacher leaders, those who are mentors and those who serve in high-need settings.	
	2. Diversify the STEMM educator workforce so that it reflects local and regional demographics.	• Double historically excluded and marginalized communities' participation in teacher preparation programs by 2035. • Double the retention of historically excluded and marginalized STEMM educators by 2040. • Provide at least three-quarters of out-of-school STEMM educators with a regular form of professional development, coaching and/or mentorship by 2030.	• Federal, state and local policymakers • Local school districts • After-school, out-of-school and informal educators • Postsecondary teacher preparation programs • Parent-teacher associations and organizations • Teaching professionals; teaching licensors	• Strengthen incentives and support structures to attract and retain educators from a wide range of diverse and intersecting backgrounds.	• **Debt and Tuition Relief:** Support educator-focused student loan forgiveness initiatives and expand the number and amount of STEMM educator scholarships.	• **Fair Public Finance:** Stabilize and increase funding for public schools, especially allocating funds for evidence-based STEMM programs and competitive teacher compensation.	• **Public Support for Teaching:** Increase positive public support for the teaching profession, including recognition through improved salaries and enhanced valuing of the roles of these professionals in society.
				• Align educational norms with evidence that defines excellent education as inclusive, culturally relevant, assessment-informed and delivered utilizing the most current evidence-based teaching and learning strategies.	• **Healthy Teaching Environments:** Provide students and educators with the services needed to promote and protect their total well-being, including mental health, and to support safe, inclusive and equitable learning and teaching environments. Implement widely accepted credentials for social-emotional learning and anti-bias teaching. • **Collaborative Professional Development:** Create opportunities for professional learning and leadership along with the opportunity to work collaboratively within and across schools and community-led organizations through local communities of practice. Create opportunities to understand emerging and engaging teaching techniques and other education research trends.	• **STEMM Specialization:** Support advanced STEMM certifications and advanced credentials for educators who serve students across the elementary through postsecondary spectrum. Also, ensure that more STEMM students receive teaching skills and that students pursuing a degree in education have access to and can pursue STEMM concentrations. • **Educator-Employer Dialogues:** Create local, regional and national forums and channels that connect employers and educators to create shared curricula and employee expectations.	• **Forward-Thinking Leadership:** Develop and retain strong leadership at the school and district level, while providing professional development opportunities to existing and new leaders. • **State of the Art Pedagogy:** Utilize professional societies for scientists, engineers, health professionals, educators and more to provide professional development opportunities, especially for new and emerging topics in STEMM pedagogy.

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps		
Discovery **Creating Opportunity for All in Higher Education**	**1. Ensure higher education institutions and their STEMM programs are accessible, inclusive and designed to support the talent development of all people.**	• Cut the enrollment gap for historically excluded and marginalized groups in half by 2030. • Cut the degree-granting gap for historically excluded and marginalized groups in half by 2035.	• Postsecondary institutions • Local officials • Community organizations • Professional societies • Public and private funders	• Ensure all STEMM programs of study are evaluated on the basis of learning effectiveness across all students and departments and that colleges establish and make progress toward eradicating achievement and opportunity gaps for their students.	• **Systemic Improvement Plans:** Ensure all higher education institutions implement evidence-based systemic improvement plans to improve outcomes for all, especially focusing on addressing the systemic barriers that have blocked access and success for persons from historically excluded and marginalized communities.		
				• Update and improve student admissions, transfer and financial aid processes to use legally sustainable and effective strategies to improve access and enrollment for students from historically excluded and marginalized or nontraditional backgrounds.	• **Audit Recruitment Practices:** Audit student recruitment practices for separate enrollment processes into STEMM degree programs. • **Holistic Review Enrollment:** Emphasize holistic reviews, including reconsidering the use of historical merit measurements like standardized test scores (e.g., school exams, ACT/SAT, GRE, MCAT) in the application process.	• **Partnerships for Student Support:** Build the capacity of community-led organizations to authentically partner in equitable relationships with institutions of higher education to support increased access to STEMM degrees for students from historically excluded and marginalized communities while engaging in research that mutually benefits students, community organizations and institutions of higher education.	• **Cost and Affordability Improvement:** Advocate for increased federal investments in financial aid and state-level systemic reforms aimed at increasing the affordability of higher education. Additionally, connect prospective and current higher education students to financial aid and scholarship resources.
				• Enhance opportunities for students to pursue a broad range of STEMM pathways, including by taking advantage of CCs and RPUs and easing transfers for students with some postsecondary training.	• **Seamless Student Transfer:** Create a nationwide system of articulation agreements that allow students to easily transfer in order to find effective STEMM degree pathways. • **Two-year to Four-year Transfers:** Strengthen and simplify transitions from two-year and associate programs to four-year college degree programs.	• **Community Colleges:** Position CCs not only as a steppingstone for students aiming for four-year degrees but also as a viable educational mid- and endpoint for students. Support and scale programs that better connect STEMM talent at CCs with employers.	• **RPUs:** Increase funding for and awareness of RPUs and support efforts to encourage nontraditional students and students from historically excluded and marginalized backgrounds to enroll in RPUs.
				• Increase opportunities and support development and awareness of diverse STEMM pathways for nontraditional students and adult learners.	• **Military Credit Programs:** Bolster and scale programs that translate military service and training into academic credits at four-year institutions to create opportunities for veterans that will open the door to STEMM careers.	• **Nontraditional Postsecondary Learning:** Support and scale nontraditional postsecondary STEMM learning programs such as coding bootcamps, STEMM apprenticeship programs, badging and work-to-learn programs.	• **Increase Support for Nontraditional Students:** Provide access to learning opportunities, funding support, wraparound services and mentorship for older learners and other nontraditional students in their educational endeavors.
				• Establish proactive and inclusive educational cultures and environments that include transparency, accountability, ongoing measurement and assessment, and support for all students to ensure the success of students from historically excluded and marginalized populations.	• **School and Career Navigation:** Support students with robust one-on-one counseling to decide majors, identify academic supports and consider career pathways. • **Suspend Exclusionary Courses:** Improve teaching in introductory courses with successful research-based approaches that foster STEMM learning for all at multiple learning levels. • **Expand Academic Engagement:** Broaden the availability of curricular and cocurricular engagements, including corequisite remediation, bridge programs, internships, mentorships and sponsorships, peer support groups, undergraduate research opportunities and more. • **Effective Reporting Structures:** Create safe and reliable reporting structures and institute appropriate consequences for incidents of bias, discrimination and harassment.	• **Equity-Centered Professional Development:** Provide faculty with opportunities to learn skills that contribute to creating more inclusive learning environments and value and reward culturally responsive and effective mentorship. • **Expand Undergraduate Research:** Create opportunities for all undergraduate students at two- and four-year institutions to substantially engage in research, both as credit toward degree-granting programs and to cultivate personal interests. • **Strengthen Supports for Graduate Students:** Increase targeted support and mentorship for graduate students in STEMM disciplines to facilitate students' short- and long-term success in STEMM pathways, including developing interventions aimed at ensuring graduate students are retained in STEMM careers after completing their education.	Additionally, encourage adding communications, pedagogy and curricular components to skills incorporated into STEMM graduate degree preparations. • **Partnerships Between Institutions:** Foster authentic, sustainable and mutually beneficial partnerships between highly resourced PWIs and HBCUs and other MSIs that benefit both students and faculty. Partnerships may include teaching, research collaborations, co-operatives and internships, networking, mentoring, bridge programs to graduate education and more. Funding for these efforts should be invested directly in, or appropriately shared, by MSIs to enable authentic collaborations.
	2. Create equitable and inclusive systems and policies for educating, developing, hiring, retaining and advancing STEMM faculty from historically excluded and marginalized populations across fields of study.	• 100% of R1 and R2 universities adopt evidence-based equity and inclusion strategies and practices for STEMM graduate programs and faculty hiring and advancement. • Historically excluded and marginalized communities comprise one-third of STEMM faculty by 2045.	• Postsecondary institutions • Local officials • Community organizations • Professional societies • Public and private funders	• Increase equity in efforts to hire, retain and support diverse STEMM faculty across scientific disciplines.	• **Pathways to Advanced Education:** Develop tailored and legally sustainable programs to increase diversity among graduate students, postdoctoral fellows and medical residents by preparing students and scholars for success, offering culturally relevant mentoring, introducing them to networks and providing early opportunities for residency programs and grants.	• **Increase Tenure Pathways:** Provide increased pathways to tenure for faculty from diverse backgrounds, including addressing inequities and barriers in graduate training and postdoctoral programs, especially regarding finances and debt accumulation. Additionally, increase emphasis on teaching, mentoring, field building and community engagement in tenure decisions to ensure service efforts are recognized.	• **Early-Career Supports:** Expand opportunities for early-career funding and holistic support for junior faculty and support them in establishing their research agendas, teaching practice and university service while advancing their careers in academic science. • **Vibrant and Inclusive Professional Organizations:** Strengthen professional and affinity organizations to enhance support for tenured and nontenured faculty across all ranks.

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps
Innovation **Leveraging Diverse Minds in R&D**	**1. Ensure researchers from historically excluded and marginalized communities receive equitable opportunities for funding, career navigation and support.**	• Invest $15 billion in research infrastructure and capacity building at HBCUs, TCUs and other MSIs by 2040. • Double the amount of research funding received by HBCUs, TCUs and other MSIs by 2045. • Close the funding gap for PIs from historically excluded and marginalized backgrounds by 2035.	• Public and private research funders • Professional societies • Postsecondary and other educational institutions • Federal, state and local governments	• Remove barriers to both federal and private grant funding for researchers from diverse backgrounds, targeting opportunities to build research capacity in PIs from historically excluded and marginalized groups.	• **Diversify Agency and Private Funder Leadership:** Include diverse voices in agency leadership positions and redefine agency, philanthropy and industry agendas in ways that reflect needs and issues across diverse communities. Pursue diverse voices to drive innovation and provide opportunities for a wider array of scientists and medical researchers to do both basic and applied research. • **Incubate Nascent Programs:** Provide resources to emerging research institutions, minority-serving institutions and community-based organizations that offer models and pathways for success, including entrepreneurial success.
				• Build STEMM research capacity and infrastructure within HBCUs and other MSIs.	• **Allocate Government Funding:** Increase federal and state funding to HBCUs, TCUs, other MSIs and two-year institutions with the aim of increasing these institutions' innovation, knowledge contribution and degree production of STEMM student majors from historically excluded and marginalized populations. • **Increase HBCU and Other MSI Infrastructure:** Ensure that HBCUs and other MSIs have sufficient capacity and infrastructure, such as experienced grant writers, to make them more competitive for various public and private funding streams and more effective in providing students with research experiences directly and through partnerships. • **Provide Access to Read and Publish Peer-Reviewed Work:** Create opportunities for authors from low-resource institutions to have increased access to peer-reviewed work, such as tiered pricing models, while also providing access to publish in peer-reviewed journals without being limited by excessive and cost-prohibitive charges as well as more options to self-publish or self-archive. • **Sustainable Research Partnerships:** Foster mutually beneficial, sustainable and authentic research partnerships between highly resourced PWIs and HBCUs and other MSIs, including not only opportunities for internships and fellowships but also more substantial collaborations that build research capacity and infrastructure within HBCUs and other MSIs.
				• Expand the diversity of researchers and administrators working in scientific publishing and broader knowledge production.	• **Scale Supportive Infrastructure and Institutions:** Incentivize and scale successful institutional strategies for supporting students and practitioners from diverse populations to fully participate in STEMM research and development, such as through undergraduate research experiences and self-directed research support. • **Support Emerging Diverse Leadership:** Incentivize the inclusion of diverse perspectives among the leadership of academic research institutions, professional STEMM organizations and scientific journals. • **Leverage Professional Societies:** Coordinate programs within and across professional societies to develop and provide training for both historically excluded and marginalized communities and other members. • **Responsive and Inclusive Review:** Increase diversity among scientific review administrators while simultaneously providing cultural competence education to all scientific reviewers and program officers. • **Incentivize Board Diversity:** Address the need for diversity among scientific advisers, editorial boards of journals, and boards of university-funded startups. Incentivize such diversity through investment policies and other terms for partnership and support.
				• Expand the understanding and adoption of community-led research, education and service initiatives and community-based organizations that are crucial to engaging underserved populations in advancing STEMM.	• **Uplift Community Organizations:** Incentivize investment in diverse and inclusive community organizations and scale up successful community-led initiatives focused on supporting STEMM pathways and the overall research enterprise. • **Resource Community Scientists:** Create opportunities for community scientists to learn about and apply for funding solicitations and grants. • **Connect Researchers and Communities:** Increase funding for programs and initiatives that facilitate connections and engagement between researchers and communities through citizen science, crowdsourcing, prize competitions, challenges, clinical trials and university-community research partnerships. • **Embed Within Organizations:** Create and deepen opportunities for researchers to be placed into and support community and civil society organizations, including fellowships, workshops and joint-staffing positions, especially to deepen STEMM instruction and learning in both in- and out-of-school settings.
	2. Encourage entities in the STEMM R&D ecosystem to utilize robust plans for envisioning and implementing equity.	• Three-quarters of the top 100 U.S. patent-producing organizations commit to robust and actionable equity and inclusion plans by 2035. • The top 100 U.S. patent-producing organizations actively share their progress on equity and inclusion metrics by 2040.	• Public and private research funders • Professional societies • Postsecondary and other educational institutions • Federal, state and local governments	• Develop a process for and continue to improve equity reviews of government, philanthropic and private funding for STEMM research at all decision points.	• **Funding Sustainability:** Ensure the long-term durability of funding and program maintenance, investing in culture change over time with a focus on retention and continuous improvement and building on opportunities to confront and respond to emerging challenges and scale successful efforts. • **Evidence-Based Funding:** Analyze the distribution of current public and private grantmaking for efficacy and evidence, aligning funders with scientifically based approaches that support a representative pool of STEMM professionals from historically excluded and marginalized groups.
				• Implement processes in the public and private sectors that prioritize identifying and addressing disparities and impacts in STEMM R&D.	• **Working Groups for Equity:** Establish a working group to develop processes to advance equity in R&D, including agenda setting, needs assessments, resource allocation and the implementation of equity checks and reviews. • **Equity-Centered Research Oversight:** Support institutions that vet academic and industry research practices, especially adding capacity to educate organizations about equity-centered research practices and organizations holding themselves accountable when they fall short of their goals or fail to comply.
				• Expand the use of equitable and legally sustainable strategies for talent identification, recruitment, hiring, retention and promotion.	• **Adopt Race-Neutral Strategies That Promote Access:** The benefits associated with student and faculty diversity are a priority for many, if not all, institutions of higher education. In addition to defining clear educational aims and rationales associated with inclusion and diversity, leaders should hasten to adopt race-neutral strategies shown to broaden access and reduce barriers to all students. • **Legally Sustainable Hiring:** Connect legal experts to organizational leaders and recruiters for training and consultations on equitable talent identification, hiring and retention, and advancement strategies. • **Share Legal Guidance:** Provide opportunities to learn legally sustainable strategies that can support equitable talent pathways.

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps		
Opportunity **Ensuring All Workers Thrive**	**1. Remove barriers to identifying, hiring, retaining, developing and promoting persons from historically excluded and marginalized communities in the workplace.**	• 20 million new STEMM workers from historically excluded and marginalized groups are added to the STEMM workforce by 2050. • 10 million new STEMM professionals from historically excluded and marginalized groups by 2035.	• Public and private employers • Federal, state and local policymakers • Regional workforce boards • Worker advocates and unions • Community organizations	• Create well-coordinated on-ramps that value a variety of educational backgrounds for an upwardly mobile STEMM career.	• **Commonsense Benchmarks:** Adopt and implement shared definitions for terms, data collection and data sharing across employers and industries. • **Companywide Equitable and Inclusive Hiring:** Implement equitable and inclusive hiring practices at all company levels so that company diversity is reflected at all levels of leadership.	• **Skills-Based Hiring:** Scale skills-based hiring practices and similar routines across the whole talent journey that demonstrate proficiency as part of the evaluation of candidates for employment. • **Support Nontraditional Backgrounds:** Encourage employers to hire candidates without traditional educational or previous work experience and provide on-the-job training to orient workers to new job skills and responsibilities. Additionally, honor previous job experiences, especially military service, that can be translated into on-the-job skills. • **Place-Based Workforce Coordination:** Create coordinated STEMM workforce hubs where education, industry and the civil social sector can strategically coordinate knowledge and allow organizations and individuals to access resources.
				• Support formal and informal workforce development strategies that can help workers more easily enter and advance in STEMM careers.	• **Expand Company Mentorship:** Introduce or scale up mentorship programs for all employees, particularly those from historically excluded and marginalized backgrounds, through programs sponsored by both employers and cross-sector organizations. • **Employer-Sponsored Upskilling:** Encourage employers to sponsor employees' continued education or upskilling.	• **Nontraditional Pathways and Credentialing:** Increase access to technology apprenticeships, badging and bootcamps that augment traditional learning environments and align with workforce needs.	• **Expand Access to Career and Technical Education:** Increase access to industry-informed STEMM two-year and certificate/technical programs to upskill America's workforce as well as provide support for graduate credentialing.
				• Remove barriers that keep historically excluded and marginalized communities from accessing capital, serving on boards and receiving career coaching.	• **Equity-Centered Accelerators:** Expand startup, incubator and accelerator programs, especially ones aimed at expanding and financially supporting entrepreneurship in service of historically excluded and marginalized communities.	• **Demystify Financial Supports:** Enhance education regarding pathways to accessing venture capital and establish programs to connect innovators from historically excluded and marginalized communities with startup incubators and accelerators. Additionally, monitor program participants to ensure those benefiting from such programs include those from the intended audience.	
				• Uplift and resource affinity programs for historically excluded and marginalized communities in the workplace.	• **Authentic Leadership Buy-In:** Garner and demonstrate organizational leadership buy-in and responsiveness to affinity programs.	• **Concretize Affinity Connections:** Compensate and recognize leaders and attendees for time spent building and participating in affinity and service programs.	
	2. Ensure workplaces feel supportive of historically excluded and marginalized communities.	• All STEMM employers commit to transparent job descriptions and career mobility plans by 2025. • All STEMM employers adopt robust equity and inclusion plans by 2025.	• Public and private employers • Federal, state and local policymakers • Regional workforce boards • Worker advocates and unions • Community organizations	• Root out bias, discrimination and harassment in all STEMM workplaces and support efforts to improve belonging.	• **Just Job Descriptions:** Include salary ranges and remove gendered, ableist and ageist language from job descriptions and advertisements to recruit a broader range of applicants.	• **Just Career Mobility:** Mitigate bias in performance evaluations, promotion decisions and award and recognition selection to promote equitable career advancement and access to leadership positions.	• **Proactive Anti-Harassment:** Establish proactive and inclusive anti-harassment structures that promote transparency, accountability, ongoing measurement and assessment, and support for individuals who have been targets of harassment. Implement consequences for perpetrators of harassment and discrimination while supporting those who've demonstrated allyship.
				• Ensure all STEMM companies have robust benefits packages, including parental leave and other family-friendly policies to support workers.	• **Total Employee Well-Being:** Provide support for critical life events that can occur throughout the course of a career, such as caregiving, chronic illness, disability and accessibility, mental health and pandemic recovery services. Offer comprehensive wraparound services to employees juggling multiple responsibilities and/or challenges.	• **Protections From Technological Advances:** Outline protections and plans for employees for job security and dignity that may be needed with the incorporation of new technologies such as AI and machine learning.	
				• Deploy rigorous and regular employer-sponsored upskilling programs with clear paths for upward mobility in the workplace.	• **Options for Career Advancement:** Implement regular training during work hours for employees interested in upskilling programs.	• **Clear Job Pathways:** Document and publicize pathways for career growth in the workplace. Moreover, assess the outcomes and impact of such pathway programs on employees of diverse and intersecting identities.	

Table 3: Strategy Summary *(continued)*

Strategy Area	Goals	Key Metrics	Key Actors	Approaches	Steps		
Capstone **Strategic Communications** 	**1. Ensure the demographics of STEMM professionals depicted in entertainment and media align with the demographics of the country.**	• Entertainment and media depictions of the STEMM field are inclusive and reflective of the population by 2030.	• STEMM leaders and communicators across sectors • Leaders in the media and entertainment industry (screenwriters, producers, actors, etc.) • Local and national news outlets • Communications professionals • Policymakers and other influential individuals • STEMM textbook and other informational resource distributors	• Equip STEMM communicators across sectors and venues with the tools and expertise needed to deliver inclusive messages about the critical role of diverse people in STEMM.	• **Informed Media Training:** Demonstrate effective ways to utilize narrative instruments (film, TV, literature, etc.) to accurately and impactfully depict the experiences of historically excluded and marginalized backgrounds as accepted and valued members of the STEMM ecosystem. • **Leadership and Communications Training:** Provide education on effective leadership and strategic communications to leaders from all parts of the STEMM ecosystem to help them identify and amplify compelling stories of individuals from marginalized backgrounds and their experiences in STEMM.	• **Public Awareness Campaigns:** Employ the use of traditional and nontraditional marketing tools (billboards, ads, podcasts, etc.) to effectively highlight the diversity of the STEMM workforce and showcase diverse individuals in varied roles. This can also include a focus on updating textbooks and other STEMM-related materials in schools to ensure diverse individuals and stories are included and uplifted.	• **Strategic Communications Callouts:** Utilize SOA's network and resources to highlight key areas where more progress can be made and disseminate information about effective communications strategies that can effectively build public awareness and spur pressure for change. • **Ongoing Assessment and Measurement:** Conduct assessments to measure the impact and effectiveness of collective efforts to systemically alter STEMM narratives and storytelling.
	2. Effectively illustrate the importance of diverse perspectives in STEMM and how they are critical to achieving excellence in STEMM.	• All Americans understand the necessity of an inclusive and diverse STEMM enterprise as critical to the U.S.'s scientific, social and economic advancement, health and national security by 2040. • SOA partners have measurably improved media and entertainment content that reflects SOA STEMM inclusivity guidelines by 2035.	• STEMM leaders and communicators across sectors • Leaders in the media and entertainment industry (screenwriters, producers, actors, etc.) • Local and national news outlets • Communications professionals • Policymakers and other influential individuals • STEMM textbook and other informational resource distributors	• Amplify the voices of individuals from historically excluded and marginalized groups and highlight how their contributions to STEMM positively impact the U.S.'s national security, economic well-being, global competitiveness and innovative capabilities.	• **Public Campaigns:** Encourage the dissemination of videos and other narrative pieces where individuals from historically excluded and marginalized backgrounds share their STEMM experiences with audiences.	• **Studies:** Produce studies that center around the importance of diversity and perspectives in STEMM. Such studies would highlight contributions to STEMM by individuals from historically excluded and marginalized communities and how they impact our everyday lives as well as national security and the U.S.'s economic well-being.	• **Remodel Textbooks:** Ensure that textbooks depict images of members from historically excluded and marginalized backgrounds at parity and that these books are stripped of the use of "race tax-ons" that have been shown to cause misdiagnoses and improper care. Overlooked historical figures who made impactful contributions to STEMM should also be highlighted in textbooks.
				• Support the translation of STEMM learning materials and other resources to be more inclusive to multilingual individuals and their families.	• **Translation Services:** Encourage distributors of STEMM textbooks and other educational resources to produce multilingual content to foster accessibility and equity of outcomes.	• **Develop Entertainment and Media Guides:** Work with SOA partners to develop resources and guidance for members of the entertainment and media industry that highlights the ways in which they can drive toward greater equity and access by promoting depictions of an inclusive STEMM ecosystem and workforce. These portrayals should underscore the roles and contributions of individuals from historically excluded and marginalized backgrounds.	