National Aeronautics and Space Administration

NASA

Science Mission Directorate

Report from the Bridge Program Workshop Organizing Committee

Editors

Marianne Smith, Ph.D.
Oak Crest Institute of Science

Ron Gamble, Ph.D.
NASA Goddard Space Flight Center

Regina Jorgenson, Ph.D.
Maria Mitchell Observatory

Carl Moore Jr., Ph.D.
Florida A & M University

Jesus Pando, Ph.D.
DePaul University

Padi Boyd, Ph.D.
Director, SMD Bridge Program/NASA Goddard Space Flight Center

Nicolle Zellner, Ph.D.
Deputy Director, SMD Bridge Program/ NASA HQ/Albion College

www.nasa.gov

Contents

Executive Summary **1**

Introduction **6**

Bridge Program Workshop Organizing Committee **10**

NASA Opportunities and Gaps **14**

Introduction 14

Key Thematic Areas 14

Hispanic-Serving Institutions (HSI) **17**

Introduction 17

Key Thematic Areas 17

Historically Black Colleges and Universities (HBCU) and Primarily Black Institutions (PBI) **20**

Introduction 20

Key Thematic Areas 20

Asian American and Native American Pacific Islander-Serving Institutions/Native Hawaiian-Serving Institutions/Tribal Colleges and Universities, and Native American-Serving Nontribal Institutions **22**

Introduction 22

Key Thematic Areas 22

Community Colleges **24**

Introduction 24

Key Thematic Areas 24

Primarily Undergraduate Institutions **27**

Introduction 27

Key Thematic Areas....27

California Programs and Institutions 29

Introduction 29

Key Thematic Areas....29

Accessibility....31

Introduction 31

Key Thematic Areas....31

Assessment, Capacity Building, Evaluation, and Social Impacts (ACES)....33

Introduction 33

Key Thematic Areas....33

STEM Mentoring 36

Introduction 36

Key Thematic Areas....36

Early Career Perspectives....38

Introduction 38

Key Thematic Areas....38

Themes and Observations 40

Findings 41

Conclusions 44

Acronyms and Abbreviations 45

References 47

Acknowledgements 51

Appendices....54

Appendix 1: Relevant Executive Orders and Presidential Memoranda 54
Appendix 2: SMD Bridge Program Workshop Sessions 55
Appendix 3: STEM Mentoring Resources 57
Appendix 4: Evidence-based Program Design 61

Figures and Tables

List of Figures

Figure 1. Percentage of Bachelor's Degrees in STEM Fields Earned by Black/African Americans 7

Figure 2. Percentage of Bachelor's Degrees in STEM Fields Earned by Hispanic Americans 7

Figure 3: Percentage of Physics Degrees Earned by Individuals Marginalized by Race/Ethnicity 8

Figure 4: Comparative Chart of SMD Bridge Program Workshop Findings Correlated to Four Major State of the Profession Reports on Culture, Leadership, and Constraints 8

Figure A4.1: Evidence-Based Program Design Process 61

Figure A4.2: Evidence-Based Decision Making 63

Figure A4.3: Input from Workshop Participants 63

Figure A4.4: Draft Logic Model 64

List of Tables

Table 1. SMD Bridge Program Workshop Organizing Committee Members (BPWOC) 10

Table 2: SMD Bridge Program Working Groups and Working Group Leads 12

Table 3: Additional Breakout Session Topics and Leads 12

Table 4: Common Themes Across Institution Types 43

Table A2.1: Schedule of the SMD Bridge Program Workshop Sessions 55

Executive Summary

This informational report is the product of multiple meetings of a diverse set of working groups, many representing communities that have traditionally not engaged with NASA. These groups came together during the week-long NASA SMD Bridge Program Workshop, held in October 2022, and provided multiple opportunities for community input with the purpose of co-creating NASA's Science Mission Directorate Bridge Program, a new initiative aimed at increasing participation in NASA SMD activities. This report is informed by those discussions and intended to guide NASA in shaping a Notice of Funding Opportunity (NOFO) that broadens the participation of students, faculty, and institutions in Science Technology Engineering and Math (STEM) experiences available within NASA. The purpose of this report is not to address the many issues faced by under-resourced communities but to lay a foundation for NASA to develop a program in which underserved students, faculty, and institutions can receive funding, work with NASA, and use their local expertise to address these issues.

The two guiding principles or tenets that surfaced from the workshop discussions are:

- The ideal NASA Bridge Program would center the needs of students, faculty, and institutions that have been historically and systematically marginalized.
- The ideal NASA Bridge Program would have NASA lead a paradigm shift by assuming primary responsibility for building impactful relationships/partnerships with marginalized and underserved communities to diversify its workforce and the STEM community.

The workshop sessions produced reports that captured the key thematic areas that surfaced during the workshop in such a way as to have findings in alignment with the two guiding principles. The working group sections of this report are organized in the same manner—Introduction, Key Thematic Areas, and Findings. While each working group reported different thematic areas and findings, some commonalities surfaced. These commonalities are highlighted in Table 4 on page 45. Here, we report the thematic areas followed by the findings.

Key Thematic Issues

The most prevalent themes focused on concentrating resources within underserved communities and making under-resourced institutions[1] the lead in collaborations with other institutions and NASA Centers. In these collaborations, the discussants agreed that two-year institutions could serve as the lead institutions. Other popular themes concerned funding, mentoring, ease of access across institutions regardless of their available resources, process modification and streamlining, and program marketing.

The reports stressed that regarding funding, programs should support participants' total costs, including grant management infrastructure, childcare, student travel, technical training, funding for faculty teaching buy-out and/or summer support, etc. There were two significant thrusts for mentoring: all programs should have structured and funded mentoring programs, and all programs need culturally appropriate mentor training for Principal Investigators (PIs) and mentors at the local institution and administrators and mentors at the NASA Centers.

1 Under-resourced is defined as a lack of access to specialized, professional, financial, or institutional expertise and communal knowledge, and/or working with neglected or dated infrastructures and limited or absent assets and resources resulting in lack of recognition, competitiveness, and cyclical absent or diminished funding. Under-resourced institutions of higher education are typically characterized as having both insufficient resources and large numbers of disadvantaged and/or low-income students.

The groups advocated designing program entry points that allow and encourage under-resourced institutions to apply as a means of providing better access for target institutions. For example, institutions without prior NASA involvement could use smaller, capacity-building grants to build the infrastructure and knowledge base to apply for larger grants. These grants provide funding so that under-resourced institutions will support adaptation, planning, and skill development needed to fully support a full Bridge Program. Furthermore, modifications to existing NASA programs could make it easier for under-resourced institutions to leverage the resources of these programs to amplify their proposals. Some groups advocated for a relaxed GPA/course completion requirement to increase the number of applicants to the program from historically excluded minorities. And, several groups mentioned streamlining the application process so that institutions with small or no sponsored projects office could apply. Engaging applicants throughout the academic year was posited to improve persistence. Finally, it was suggested that there might be a need for internal NASA discussions so that NASA personnel fully understand the value of these programs.

Findings

The working groups were asked to submit findings aligned with the above guiding principles. These findings addressed two distinct areas: 1) the desired programmatic elements of the NOFO and 2) the resulting proposal process. The key findings in each area are listed below.

Programmatic Findings

- **General Principles:**
  - While engaging underserved communities, NASA and external partners should be mindful of power dynamics and ensure that parties are not enacting power imbalances that have historically not served these communities. One necessary way that this is accomplished is by ensuring that the majority of the funding and leadership of the program is controlled by the underserved institutions. Another strategy is to financially support easy access to state-of-the-art laboratories, computational resources, and training for faculty and staff from under-resourced institutions.
  - NASA SMD should directly target community colleges to intentionally signal NASA's understanding of community college students and faculty's critical role in diversifying the science and engineering workforce. Persons with extensive community college experience should be involved in outreach to community colleges and provide input on specific marketing, announcements, support activities, and proposal reviews related to community colleges.
  - Program announcements, marketing, and outreach should directly target all types of under-resourced institutions and intentionally signal NASA SMD's intent to work with these institutions as a critical approach to diversifying the science and engineering workforce. Clear and accessible language that avoids jargon that might be confusing to under-resourced institutions should be utilized. Hosting webinars or virtual workshops specifically tailored to under-resourced institutions can provide a platform for questions and discussion. Establishing direct communication channels, such as dedicated email addresses and helplines, can facilitate personalized assistance for potential applicants.
  - Resource-heavy administrative elements should be handled centrally, either through NASA or through regional collaborations between Program institutions to ensure that access is not dependent on an individual institution's potentially limited resources. The development of common evaluation tools, accounting procedures, compliance forms, reporting structures, etc., will relieve stress from institutions that cannot afford to build and sustain these administrative program components. Creating centralized support services for data

management, compliance, and reporting requirements allows under-resourced institutions to allocate more time and resources to their core program.
  - Commit to long-term (5+ years) relationships. Short-term funding keeps the focus on immediate needs, but may interfere with addressing root causes and infrastructure development that are needed to sustain workforce development. Start and stop funding forces faculty and institutions to re-develop needed support systems. For example, support staff need to be re-hired and re-trained, which needlessly imposes replacement costs for resources directed at services that were once in place. Long-term support helps institutions to build capacity, which allows them to build expertise, attract talent, and engage in long-term strategic planning.
  - Build program elements slowly to ensure that each new component or approach adequately addresses the concern it is intended to solve and that target institutions also have adequate time to prepare for participation in the program.
  - Refrain from general metric counting (i.e., number of under-resourced institutions that apply for a grant, number of diverse students who engage in funded SMD Bridge opportunities) as a means of measuring success. Ensure instead that meaningful outcome measures of success are in place (i.e., number of under-resourced institutions that receive and successfully implement an award; number of diverse students who are engaged in funded projects and retained in STEM academic programs and careers) and that Bridge Program leadership has sufficient authority to ensure continuous program improvement based on outcome data.

- **Enable/Support Collaboration Building:**

  - Provide a means of engagement for collaborations among different organizations, institutions, societies, evaluators, etc. The Workshop Organizing Committee interprets this as meaning, for example, that target institutions and applicable organizations and societies and others should have an opportunity for face-to-face engagement organized and supported by NASA.
  - Ensure SMD scientists and engineers are aware of the NOFO and the emphasis on under-resourced institutions and MSIs. An organized list of SMD scientists and engineers who are open to partnering with these institutions should be readily available to interested institutions.

- **Enable/Support Cohort Formation:**

  - Prioritize support to cohort-building experiences, student empowerment workshops, and counterspaces [1] for participating students. These may be in-person and/or online with the full cohort, as well as center-specific experiences for students in similar geographic locations.
  - Identify opportunities to connect Principal Investigators (PI) to build a supportive community among new and experienced PIs.

- **Appoint and Support NASA Facilitator(s)/'Point People' to be Responsible for Making and Sustaining Connections with Under-served Institutions:**

  - Establish a Program "point person" -- someone assigned to a set of areas, and from the community, who can be an emissary and facilitator. These point persons, whether NASA staff or consultants, should have extensive experience in and knowledge of institution type as well as have the capacity to support infrastructure issues that arise. They should be tasked with developing a means of engaging respectively across cultures, for example, by providing training on interacting with indigenous cultures, providing a Bridge person as an emissary and facilitator, etc.

- Cultivate long-term relationships with underserved institutions. The point person should connect institutions and individual faculty to others within NASA to ensure relationships are durable.

- **Redesign the Proposal Process to Meet Target Institutions' Needs:**
  - Simplify the NOFO to ensure accessibility by novice institutions.
  - Reimagine the proposal process as a co-development, two-phased opportunity in which phase one consists of the submission of an initial idea and phase two involves NASA personnel or consultants working with and providing resources to the interested communities to develop the plan, budget, pathway, etc.
  - Recognize that under-resourced institutions may not have the benefit of a grants office or a proposal writer. As such, the institution may require additional support to produce a proposal with all required components. Providing a preliminary application round with constructive feedback for these institutions may be necessary.

- **Redesign the Proposal Review Procedures:**
  - Ensure that members of review panels fully understand the focus of the SMD Bridge Program, the funding call details, and the expectations of the review process.
  - Perform a critical analysis of the meritocratic system of review and current 'one size fits all' standards of review. Reviews should be structured such that the focus is put on the content of the proposal and such that institutions are not penalized due to their lack of resources, experience submitting NASA grants, gender of the PI, etc. [2-5].
  - Ensure that members of review panels are trained to set aside judgment and be aware of their personal assumptions. This includes panel members receiving training on the full range of unconscious biases[2] and how they can impinge on equitable proposal reviews.

- **Provide Realistic Financial Support and Keep the Majority of Funding at/in Underserved Institutions:**
  - Ensure that in proposals for partnerships between under-resourced and better-resourced institutions, the under-resourced partner retains a majority of the funding. Financial support must be concentrated on historically excluded minorities, underserved institutions, and faculty.
  - Proposers should be allowed to ask for the real costs of administering the program (e.g., buying out faculty teaching responsibilities may include not just the faculty salary, but costs for finding replacements).
  - Participants need to be compensated for all of their time working in this NASA SMD Bridge Program.

- **Create Support and Structures for Developing, Maintaining, and Evaluating Effective Mentoring at Participating Sites:**
  - Funding for academic year programming that includes culturally-informed mentoring and mentor training should be necessary for most programs. Faculty need to be intentionally prepared to mentor. In the absence of local STEM mentor training, NASA should support mentor training for faculty.

2 Unconscious biases are learned assumptions, beliefs, or attitudes that humans may not be aware of. While bias is a normal part of human brain function, it can often reinforce both negative and positive assumptions. In part, unconscious biases may include gender, ageism, name, affinity, confirmation, contrast, beauty, and idiosyncratic biases as well as the halo or horn effect.

  - Programs should set the expectations for participating mentors and make clear distinctions between the various roles of mentors (supervisors, advisors, mentors, etc.). The program should also establish a safe mechanism for mentees to report poor mentorship.

- **Provide Support and Training for Early Career Professionals at Underserved Institutions, as well as Opportunities for Research Growth[3]:**
  - Encourage and support early career professionals to leverage NASA's wealth of resources to enhance their research and career development. For example, summer sabbaticals at NASA centers could be awarded to early career faculty allowing both research advancement and collaborations to be formed. Short-term boot camps in basic skills such as coding, data access, etc., could build the foundational skill sets needed to engage in cutting-edge research. Grant writing workshops for early career faculty would overcome the training gap in this critical skill and enable these researchers to better compete for funding.

Findings Specific to the Grant Proposal Process

- Provide a dedicated pathway for each MSI/institutional category to propose through. Clarify the call for proposals and ensure that program requirements are readily accessible and provide institution-specific pre-proposal office hours that include time for brain-storming and problem-solving.
- Enable an extended application window (i.e., a minimum of 90 days between NOFO and deadline) and provide the opportunity to apply for longer grants (5+ years). For example, the longer period may include reduced funding for a planning/organizing period (i.e., 2 years) followed by full project implementation funding (i.e., 5 years).
- Provide the opportunity for capacity/relationship building in the grant proposal process. For example, the first year of the grant period could be solely focused on relationship building between the applicant and NASA (or between the institution and NASA) with reporting requirements in alignment with that goal and knowledge building to support a full grant proposal.
- Reduce the bureaucratic/paperwork requirements to a minimum. Provide 'hands-on' proposal support, including grant management training via NASA staff or consultant. In addition to helplines and training, NASA should provide individualized support to proposers, focusing on those from institutions that have not previously received NASA funding. Ideally, the NASA support professional(s) will have experience working in and with different types of under-resourced institutions and have experience with the nuanced policies, priorities, and processes at that institution-type.
- Allow budgetary requests to support critical infrastructure needs like internet hotspots, computers, lab equipment, transportation, student housing, child- or elder-care support, etc. Budget request procedures should be flexible to allow for other funding as needed and to address other financial issues that might arise during a program.
- Design the proposal review process to fairly evaluate proposals from novice writers and institutions, support/reward a flexible approach to program design, and allow for the inclusion of a broad range of students without imposing rigid performance criteria (i.e., GPA). Ensure review panels are prepared to equitably score proposals and evaluate submissions that address the Bridge Program priorities.

The body of the report more fully describes these critical thematic areas and findings.

3 This recommendation comes directly from the Early Career Work Group and Early Career sessions at the workshop. The Bridge Program Workshop Organizing Committee recognizes that there are mid- and late-career faculty at under-resourced institutions who will also benefit from additional encouragement, resources and support enabling them to apply for and lead a Bridge Program proposal.

Introduction

In recent years, there has been growing recognition that the practice of Science, Technology, Engineering, and Mathematics (STEM) exists within a larger social, cultural, economic, and political environment. Over the past decade, the increasing incidence of hate crimes targeting minoritized communities, including Black, Asian American and LGBTQ+ communities, has brought to the forefront the negative impacts of wide-ranging social disparities, systematic structural issues with racism, and police brutality. Moreover, the enduring consequences of the COVID-19 pandemic highlight disparate adverse effects along gender, class, race, and generational lines.

Against this extensive cultural background, the National Academies Decadal Survey on Astronomy and Astrophysics 2020 (Astro2020) [1] found that students at Minority-Serving Institutions (MSIs) are a large and diverse talent pool for the field. MSIs identified in the Higher Education Act (20 U.S.C. § 1067k(3) include Historically Black Colleges and Universities (HBCUs), Hispanic-Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), Alaska Native-Serving and Native Hawaiian-Serving Institutions, Predominantly Black Institutions (PBI), Asian American and Native American Pacific Islander-Serving Institutions (AANAPISI) and Native American-Serving Nontribal Institutions (NASNTI) and, though not defined by statute, American Indian and Alaska Native-Serving Institutions (AIANSI). For example, all the top 10 producers of African American baccalaureates in physics are HBCUs [2]. In addition, institutions such as Primarily Undergraduate Institutions (PUIs) and community colleges[4] play a crucial role in providing 'on-ramp' opportunities for traditionally under-represented folks into the STEM fields. For example, approximately 50% of all underrepresented minority students begin their post-secondary education at two-year community colleges [2].

It is well-established that the STEM fields suffer from a long-standing shortage of racial and gender diversity. For example, Figures 1 and 2 show the percentages of bachelor's degrees earned by Black/African-Americans and Hispanic Americans in various STEM fields, compared with the same demographic U.S. college-age population and Figure 3 shows the percentage of physics degrees earned by individuals marginalized by race/ethnicity as compared to their overall representation in the population. The figures demonstrate that these racial/ethnic groups are under-represented in all fields relative to the U.S college-age populations.

Furthermore, under-representation generally increases in lockstep with degree/seniority level, an effect sometimes referred to as the 'leaky pipeline,' resulting in a persistent scarcity of diverse folks at the highest levels of the STEM workforce. The rate of URMs earning Ph.D. degrees in physics has remained low (~5%) and essentially without an increase over the past 20 years. Crucially, the current systems and interventions fail to adequately address issues of under-representation.

4 In the United States, community colleges, sometimes called junior colleges, technical colleges, two-year colleges, or city colleges, are primarily public institutions providing tertiary education. Community colleges provide coursework leading to certificates, diplomas, and associate degrees. Many students planning on earning a baccalaureate degree begin at a community college and then transfer to a four-year college or university to complete a bachelor's degree

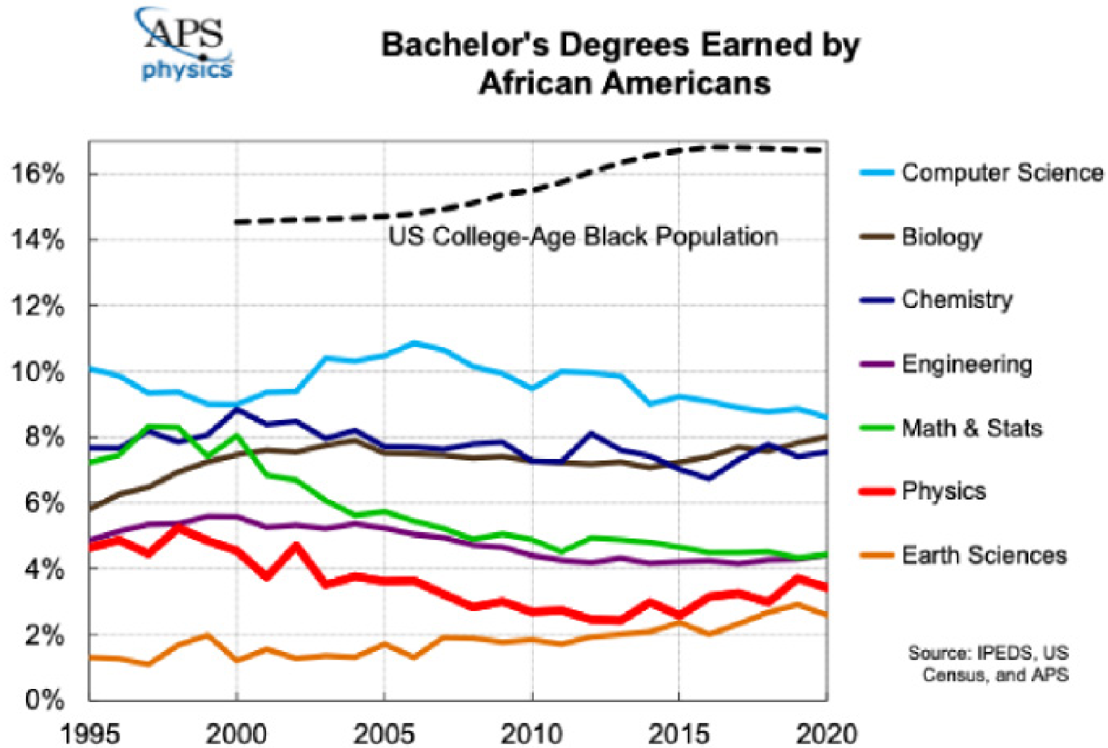


Figure 1. Percentage of Bachelor's Degrees in STEM Fields Earned by Black/African Americans
Source: https://www.aps.org/programs/education/statistics/

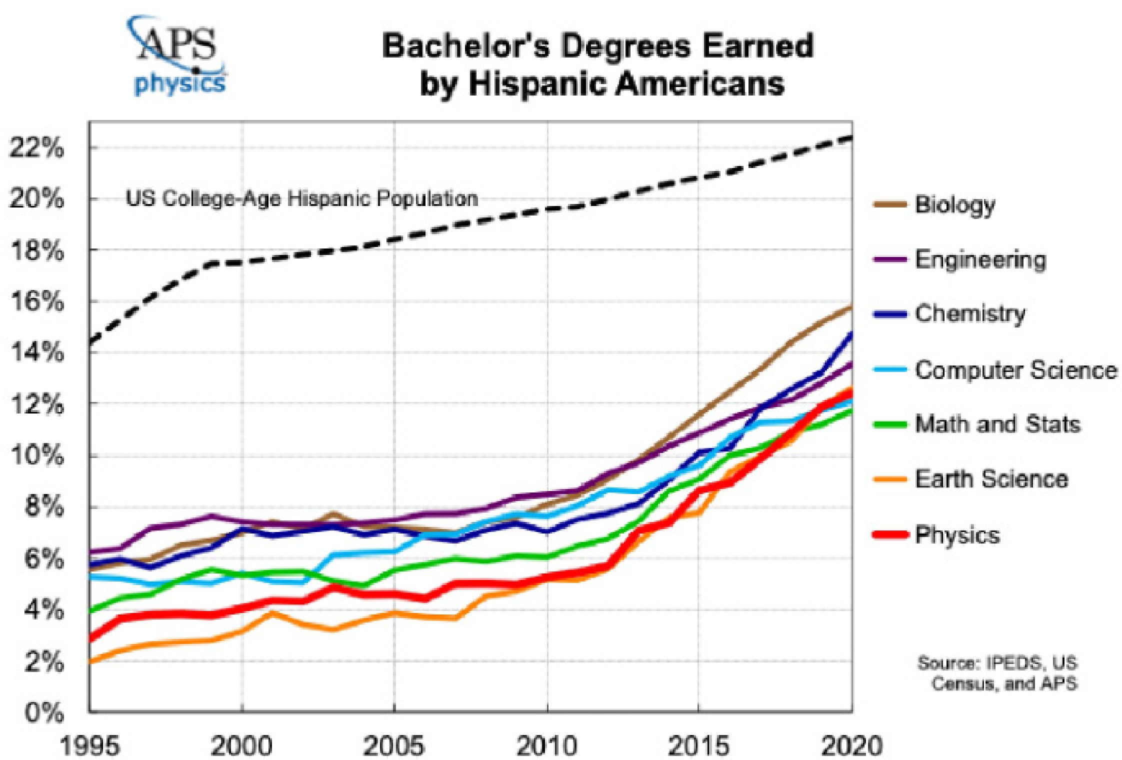


Figure 2. Percentage of Bachelor's Degrees in STEM Fields Earned by Hispanic Americans
Source: https://www.aps.org/programs/education/statistics/

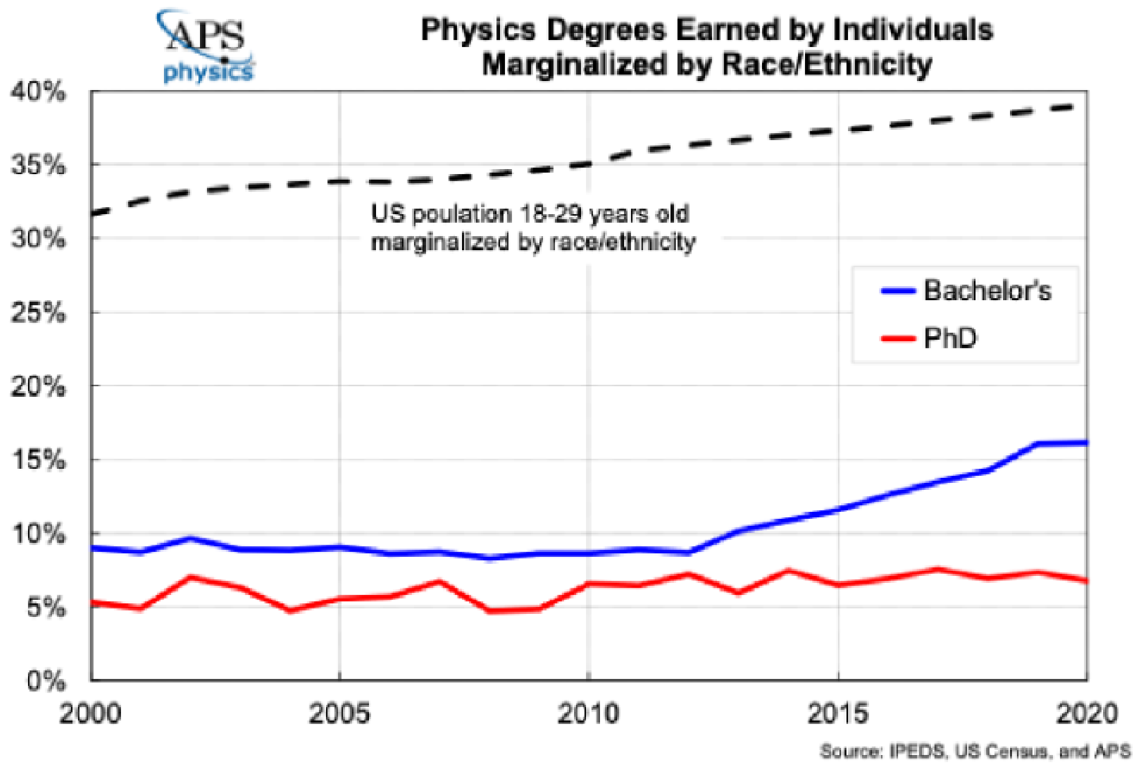


Figure 3: Percentage of Physics Degrees Earned by Individuals Marginalized by Race/Ethnicity
Source: https://www.aps.org/programs/education/statistics/

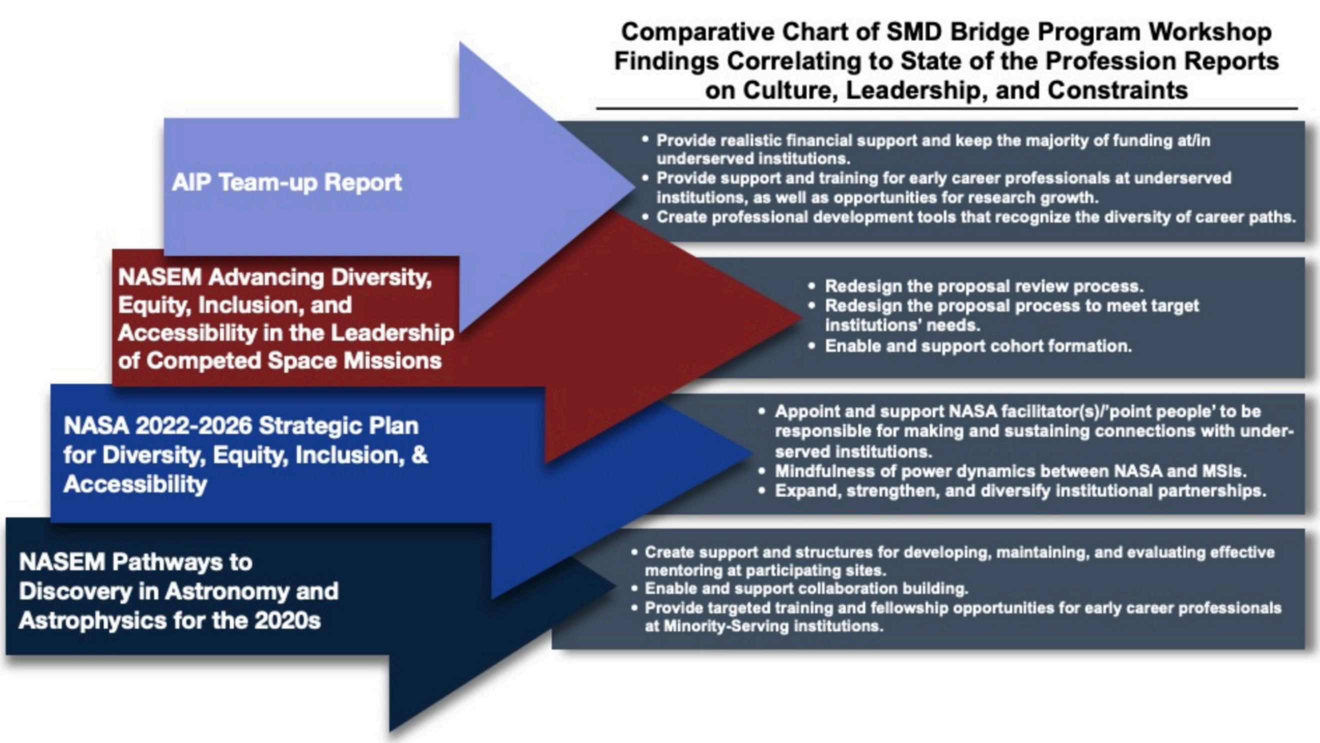


Figure 4: Comparative Chart of SMD Bridge Program Workshop Findings Correlated to Four Major State of the Profession Reports on Culture, Leadership, and Constraints ('rules of the game')

Multiple meetings, surveys, and reports including, but not limited to, the National Academies of Science, Engineering, and Medicine (NASEM) Decadal Surveys, the American Institute of Physics TEAM-UP Report, and the Inclusive Astronomy meetings and Nashville findings[5] have made clear an urgent call to action and change in several major areas affecting STEM: 1) culture, 2) leadership, and 3) constraints or the 'rules of the game'.

Shown in Figure 4 are topics identified as SMD Bridge Workshop findings that critically overlap topics in four of the most impactful surveys and reports on the current state of the physics & astronomy professions. The workshop findings (right side of Figure 4) are organized in terms of how these conclusions correlate to the named surveys and reports (left side of Figure 4). These areas (culture, leadership, constraints) are intertwined and should be targeted together. There is increasing recognition that there is an onus on the system, not just the individual, to enact change.

Furthermore, several recent Executive Orders (EO) and Presidential Memoranda (PM) have attempted to address some of these issues (see EO/PM list, Appendix 1), and NASA, as a federal agency, implements and supports these orders and memoranda. In 2022 NASA released an Equity Action plan to "...recognize and overcome the visible and invisible systemic barriers that hinder equitable, inclusive access – by individuals or communities – to the government programs, resources, and opportunities that make all of NASA's work possible" [4].

5 See reports at the following sites: https://sparck.nationalacademies.org/vivisimo/cgi-bin/query-meta?query=Decadal+Survey&v%3Aproject=uweb_proj_ex; https://www.aip.org/diversity-initiatives/team-up-task-force; and, https://tiki.aas.org/tiki-index.php?page=Inclusive_Astronomy_The_Nashville_Recommendations

Bridge Program Workshop Organizing Committee

NASA's Science Mission Directorate (SMD) is committed to a culture of inclusion, diversity, equity, and accessibility where all employees feel welcome, valued, respected, and engaged. The SMD Bridge Program is a new initiative to improve diversity, equity, inclusion, and accessibility within the NASA workforce and within the U.S. science and engineering community. It aims to increase engagement and partnering between Minority-Serving Institutions (MSIs) (i.e., Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs)) and other under-resourced institutions (i.e., Community Colleges and Primarily Undergraduate-Serving Institutions (PUIs)) with NASA Centers. A successful new Bridge Program will include paid research and engineering studentships with the goal of enabling and supporting the transition of science and engineering students from undergraduate studies into graduate programs and into the NASA workforce and the broader U.S. science and engineering communities.

Prior to designing the Notice of Funding Opportunity (NOFO), the SMD wanted to gather ideas and suggestions on what the NOFO might include from a broad range of community stakeholders. In May 2022, the SMD solicited applications for participation in the Bridge Program Workshop Organizing Committee (BPWOC) from individuals at U.S.-based research and academic institutions, industry, and professional organizations (e.g., Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS), National Society of Black Physicists (NSBP)) as well as from private individuals. Applicants in any NASA SMD science or mission area, STEM discipline in higher education, anthropology or sociology, or any relevant discipline were considered. Applicants at any career stage with expertise and drive to build long-lasting partnerships between students, mentors, HBCUs/MSIs and other under-resourced institutions and NASA Centers to increase diversity within the U.S. science and engineering communities, including the NASA workforce, were encouraged to apply. Applicants with backgrounds, training and/or certification in creating inclusive STEM work and learning environments were particularly encouraged.

Over 80 applications from community members engaged in a broad array of science and engineering, at every career stage and from various institutions across the country, were received. After careful consideration, the following individuals became members of the BPWOC (Table 1).

Table 1. SMD Bridge Program Workshop Organizing Committee Members (BPWOC)

Dr. Vemitra Alexander	NASA Marshall Space Flight Center
Dr. Clayton J. Clark II	North Carolina A&T University
Dr. Ronald S. Gamble, Jr.	NASA Goddard Space Flight Center
Dr. Noel Gardner	Jackson State University
Edward Gonzales (co-chair)	NASA Goddard Space Flight Center
Bri Hart (co-chair)	American Physical Society
Dr. Carol Hood	California State University, San Bernardino
Dr. Regina Jorgenson	Maria Mitchell Observatory
Dr. Carl A. Moore, Jr.	Florida A&M University
Dr. Jesus Pando	DePaul University

Dr. Alvin L. Smith	Jet Propulsion Laboratory
Dr. Marianne Smith	Oak Crest Institute of Science
Dr. Nicolle Zellner (Deputy Director, SMD Bridge Program)	Albion College/NASA Headquarters
Dr. Patricia Boyd (Director, SMD Bridge Program)	NASA Goddard Space Flight Center/NASA Headquarters

Led by Dr. Padi Boyd of NASA Goddard Space Flight Center and Director of the SMD Bridge Program along with SMD Bridge Program Deputy Director and co-convener Dr. Nicolle Zellner of Albion College/NASA Headquarters, the BPWOC Executive Committee first met in late July 2022. The full BPWOC committee held its initial virtual meeting the first week of August 2022. The focus of the Committee was to help set the Workshop agenda(s), reach out to invited speakers, and provide guidance on the effective recruitment and engagement of potential stakeholders at all career levels, from students to institutional administrators. The entire BPWOC met weekly through October 11, 2022, and smaller subgroups of the BPWOC met prior to the workshop, as needed.

The BPWOC established the following goals for the Workshop:

- Assess the state of current Bridge Programs and similar programs that impact the NASA STEM workforce. Learn from Bridge Program participants about their processes,
- impacts, lessons learned, gaps, limitations, and suggested goals and objectives for the NASA SMD Bridge Program.
- Assess the state of current student and early-career programs within NASA, including learning about their processes, impacts, lessons learned, gaps or limitations of existing programs, and suggested goals and objectives for the NASA SMD Bridge Program.
- Hear from experts in STEM higher education, mentoring, and organizational change.
- Establish measurable goals and objectives common to stakeholders at educational institutions, especially HBCUs, HSIs, TCUs, Community Colleges, and PUIs.
- Establish measurable goals and objectives common to stakeholders at NASA Centers, including science and engineering organizations, higher education programs, and employee resource groups.
- Discuss models for potential Bridge partnerships.
- Discuss potential elements for a draft SMD Bridge Notice of Funding Opportunity (NOFO), including its scope, priorities, schedule, and processes to apply.
- Introduce the NASA SMD Bridge Program to all stakeholders and explain its importance to NASA.

To facilitate stakeholder discussions during the Workshop breakout sessions, the BPWOC established five working groups and identified working group leads (Table 2). Working groups held meetings in the weeks leading up to the Workshop to solicit additional working group members, perform topic research, collect support materials, and determine questions for the breakout sessions.

Table 2: SMD Bridge Program Working Groups and Working Group Leads

Working Groups	Working Group Leads
Community Colleges	Teresa Ciardi (College of the Canyons)
California Programs and Institutions	Carol Hood (CSUSB) Alvin Smith (JPL)
Assessment, Capacity Building, Evaluation, and Societal Impacts (ACES)	Ronald Gamble (NASA/GSFC) Vemitra White-Alexander (NASA/MSFC) Carol Hood (CSUSB)
STEM Mentoring	Rodolfo Montez (Smithsonian Astrophysical Observatory Chandra X-ray Center) Lynn Cominsky (Sonoma State University)
Early Career Perspectives	Jenna Cann (NASA/GSFC) Arturo O. Martinez (BAERI/NASA Ames)

The BPWOC, through their weekly discussions, also identified seven additional areas to address during workshop breakout sessions. Committee members and other stakeholders led the breakout session discussions and contributed to the topic summaries included in this report. The additional areas and the leads are outlined in Table 3.

Table 3: Additional Breakout Session Topics and Leads

Additional Breakout Topic Area	Additional Breakout Topic Area Leads
NASA Opportunities and Gaps	Shawn Domagal-Goldman (NASA/GSFC) Antonino Cucchiara (NASA/HQ) Patricia Boyd (NASA/HQ)
Hispanic-Serving Institutions	Jesus Pando (DePaul University) Sara Callori (CSU San Bernardino)
Historically Black Colleges and Universities and Primarily Black Institutions	Clayton Clark (North Carolina A&T University) Alvin Smith (JPL) Willie Rockward (Morgan State University) Kim Barnett (LMI) Tiffany Kelly (NASA)
Asian American and Native American Pacific Islander Serving Institutions, Native Hawaiian-Serving Institutions, Tribal Colleges, and Universities, and Native American- Serving Nontribal Institutions	Regina Jorgenson (Maria Mitchell Observatory) Daniella Scalise (NASA) Becks Prescott (University of Hawai'i)
Primarily Undergraduate Institutions (PUI)	Nicolle Zellner (Albion College) Breanna Binder (Cal Poly Pomona) Amy Steele (McGill University)

Additional Breakout Topic Area	Additional Breakout Topic Area Leads
Accessibility	Alyssa Whitcraft (University of Maryland) Marianne Smith (Oak Crest Institute of Science) Carl Moore Jr (FAMU-FSU)
Evidence-Based Program Design	Rick Gilmore (NASA) Tara Strang (NASA)

The virtual Workshop was held the week of October 17 daily from 11:00 am to 4:00 pm ET. The full agenda for the Workshop is available in Appendix 1. Among those who registered for the Workshop were 26 students and 221 professionals representing 33 U.S. states, Puerto Rico, and Guam, and 12 foreign countries.

Over 200 participants attended one or more of the 37 breakout sessions throughout the weeklong workshop. On the final day of the Workshop, each group provided a summary of the discussions and findings during the Workshop breakout sessions.

Based on the findings from the Workshop, meetings held in September and October, the workshop breakout sessions discussions, and BPWOC deliberations, the BPWOC outlined core tenets for the NASA Science Mission Directorate (SMD) Bridge Program:

- The ideal NASA Bridge Program would center the needs of students, faculty, and institutions that have been historically and systematically marginalized.
- The ideal NASA Bridge Program will have NASA lead a paradigm shift by assuming primary responsibility for building impactful relationships/partnerships with marginalized and underserved communities to diversify its workforce and the STEM community.

Following the workshop, working group and breakout session leads submitted an executive summary on their topic with findings aligned with the core tenets for consideration by NASA as they constructed the SMD Bridge Notice of Funding Opportunity (NOFO).

NASA Opportunities and Gaps

Introduction

The Partnership for Public Service has ranked NASA the best place to work among large agencies in the federal government for a decade. While women and people of color are consistently under-represented in the NASA workforce [1], the Agency recognizes that developing and retaining a top-quality diverse workforce is paramount to its mission, quoted below:

> Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and bring new knowledge and opportunities back to Earth. Support growth of the Nation's economy in space and aeronautics, increase understanding of the universe and our place in it, work with industry to improve America's aerospace technologies, and advance American leadership [2].

During the SMD Bridge workshop, breakout groups discussed NASA Centers: Opportunities and Gaps. The goal was to examine existing opportunities for career advancement at NASA, and the gaps between those opportunities focused on early career scientists from backgrounds that have been historically and systematically marginalized. These opportunities represent unique possibilities to expand access to NASA research and agency-centered careers. They also provide a potential foundation for layered mentoring between various career stages: supervisor to employee, civil servant to postdoc, postdoc to student, and peer-to-peer. However, many issues exist regarding these programs that NASA must address to successfully implement a Bridge Program.

Key Thematic Areas

Several interrelated themes emerged from the workshop session.

Communication with External Stakeholders

A standard set of questions from participants arose at the outset of these discussions:

- What opportunities currently exist?
- How can people find those opportunities?
- Is there a centralized list of these opportunities?

Most participants had questions similar to the above, regardless of whether they were from an institution historically disconnected from or marginalized by NASA as well as those historically connected to NASA. The questions' commonality indicates a broad problem affecting all applicants to NASA funding opportunities and could also impact NASA Bridge Program applicants. That problem is the perception that NASA opportunities at all levels, from internships to postdoctoral fellowships to Pathways employment opportunities, are poorly communicated to external stakeholders. Furthermore, these negative impacts will be felt most by early career scientists or faculty partners from under-resourced and historically marginalized communities/institutions. This communication barrier creates additional filters and biases that favor historically overrepresented groups and well-connected institutions.

External Collaboration/Partnership

A related theme was the need for strong collaborations and partnerships, broadly across NASA's existing opportunities, especially in the context of a Bridge Program. Strong alliances and partnerships will be critical to a successful Bridge Program for many reasons, beginning with ensuring that NASA appropriately advertises the program to the students and faculty members it aims to serve. Therefore, a program that focuses on under-resourced institutions must place the students at its center throughout its initiatives/activities. Student-centeredness means sustained, multi-year engagement with the students, their advisors, mentors, and support network at their home institution. If done correctly, this connection can create a virtuous cycle that builds a closer relationship between NASA and the students' home institution and decreases application barriers for others at that institution so that they can be more involved with NASA programs and activities. The virtuous cycle will be most effective if the collaborations are intentional, based on newly established trust, and expected by the program's participants.

Internal Collaboration/Partnership

Another place collaboration is essential is internal to the agency itself. Agency complexity often results in offices implementing programs they did not initiate. This method of program management has led to a disconnect between a program's original intended beneficiaries (e.g., under-represented students/scientists) and the actual impact. In many of these cases, the programs run the risk of failing to reach the goals as intended and disenfranchising individuals and institutions that could have benefited the most. One commonly cited example is a center or program instituting a rigid grade point average (GPA) cutoff for various opportunities placing an unnecessary and biased filter on applicants instead of reviewing applicants holistically and understanding what may have impinged on their GPA (e.g., food insecurity, temporary or long-term homelessness, illness, etc.). Other obstacles to receiving diverse applicants include an application process that often caters to traditional-path students (e.g., four-year undergraduate institutions), application format, application questions/prompts, etc.

The disconnects between intended and actual impact can serve to reinforce entrenched inequalities, and Agency advocates become discouraged from further participation in specific programs, broader Agency initiatives, or further attempts to diversify and improve the STEM workforce. The status of the statistical demographic spread in STEM fields, as shown in previous sections describing the state of the profession (Figures 1, 2, and 3), exhibits the outcomes of unfocused efforts and highlights the barriers faced by diverse candidates. The Agency must ensure clear communication and buy-in from all the offices involved in the Bridge Program to move efforts at diversifying this program, other programs, and the NASA workforce forward.

Student-centered, Individual Needs

One of the other keys to a successful program will be to ensure that the Bridge Program NOFO considers a student's needs in the context of NASA-specific restrictions and bureaucracy. For example, some projects may require on-site access, but that may not fit the professional and personal requirements of a student who must stay connected to their home community. Other opportunities may require access to information restricted to U.S. citizens, creating significant work barriers and a non-inclusive environment for students and postdocs who may have work or education visas in the U.S. Similarly, the historical displacement of Indigenous peoples from federal land and the rising threat of environmental damage to the land means there should be a level of sensitive and historically informative consideration of our programs to the land they sit on, as well as the cultural relationships students/participants may have to that land. Finally, some students may require logistical support and resources such as housing and transportation that the agency has struggled to provide. The NOFO must address these specific needs through a holistic consideration of the student and the opportunity.

Findings in Line with Guiding Principles

The above considerations led to the following findings:

- There is a need to address barriers to participation across all stages of the program: improve outreach and advertising to target institutions, students, and faculty; provide support for under-resourced applicants; revise criteria for accepting and reviewing applications and proposals; and ensure internal buy-in, commitment, and collaboration.
- Comprehensive support should be provided to all participants: provide adequate funding, mental health support, mentoring, access, tailored logistical support, internet connectivity, work documentation, and post-program follow-up; and serve students at crucial stages (e.g., transfer, post-baccalaureate). NASA should ensure that services in proposals are sufficiently comprehensive and provide additional support where needed.
- Professional development should be approached holistically: connect participants to multiple opportunities; collaborate with them, their mentors, and home institutions on a continued, throughout-the-year basis; tailor work and professional development to success as defined by the students.
- Build and propagate a strong culture: earn trust in the ways defined by the students, surrounding participants with a strong DEIA culture (require DEIA training for everyone, partner with DEIA practitioners' groups, and collaborate with DEIA practitioners); serve as an example/model for strengthening other agency programs.
- Design programs consistent with an understanding of the "braided river" [3]: remove assumptions about where participants might come from or where they may go; create professional development tools that recognize the diversity of career paths.
- Expand and strengthen institutional partnerships: partner with the wide variety of institution types, existing Bridge Programs, and other STEM programs focused on supporting under-represented STEM students (e.g., U.S. Department of Education TRiO STEM and Title III Part F, and NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) programs); partner with STEM professional societies that have a robust focus on minority scientists and communities, Employee Resource Groups (ERG), and faculty at target institutions (e.g. minority-serving institutions and community colleges).

Hispanic-Serving Institutions

Introduction

According to the Bureau of Labor Statistics, employment in STEM occupations between 2021–2031 is expected to grow by about 11% [1]. However, not enough students are entering STEM fields to fill the available jobs and currently, there are two STEM jobs for every qualified job seeker. The lack of STEM representation is more pronounced in the Hispanic community. A recent Pew Research Center study found that even though Hispanics make up ~19% of the U.S. population, only 8% of the STEM workforce identifies as Hispanic [2]. Additionally, Hispanics are the largest minority group in the public school system but score lower than national averages on math and science achievement tests and are subsequently under-represented at both the undergraduate and graduate levels, exacerbating the representation of Hispanics in STEM.

According to the most recent data from the U.S. Department of Education there are 572 HSIs in 28 states, the District of Columbia, and Puerto Rico with the highest concentrations in California and Texas. Hispanic-Serving Institutions (HSIs) comprise less than 20% of all institutions of higher education but enroll two-thirds of all Hispanic undergraduates. Thus, these institutions must play a critical role in addressing the under-representation of Hispanics in STEM fields. Members of the BPWOC had the goal of securing information needed to help shape an SMD Bridge Program announcement in a way that will enable HSIs to participate fully and make gains towards full representation.

Key Thematic Areas

First and foremost, it is essential to understand that there are Hispanic-serving institutions and there are Hispanic-enrolling institutions [3]. The SMD Bridge Program's focus concerning the Hispanic community must be on those institutions that serve the Hispanic community. Almost 70% of HSIs are public, and about 60% are four-year institutions. This clarification means that many Hispanic students are attending two-year HSIs. Thus, this program should be designed with the flexibility to allow both two- and four-year institutions to participate and to lead projects.

Three thematic areas emerged from the workshop: 1) direct student challenges, including financial support, 2) issues faced at the institutional level, including administrative support; and 3) faculty issues, such as summer support. We explore each of these areas in detail below.

Student Focus

Three major themes revolved around the student experience. The first was financial support for students, which we envisioned in different forms. The classic example of supporting student summer research is evident and vital. However, participants stressed that the support needs to be at a proper wage level to support travel, housing, and other expenses traditionally incurred by students participating in a summer research experience away from home. Notably, many Hispanic students have a strong community of support that they rely on to help address family and school financial needs as they occur. Financial circumstances and safety are more challenging when these students are away from their community. Lastly, DACA and other undocumented students have circumstances that can limit their access to federal support services[6].

6 DACA status gives undocumented immigrants protection from deportation and provides them with an Employment Authorization Card and a Social Security number. Here, undocumented immigrant refers to immigrants without DACA or other legal status.

The second theme that emerged was the need for mentoring in which mentors recognize their own culturally shaped beliefs and are cognizant of differences of their mentees. Specifically, an understanding of Hispanic cultures is needed by the mentors. The idea is that a program aimed at Hispanic students should address the science and educational needs of the student while also addressing cultural aspects. For example, this might mean incorporating family and community aspects into the program (i.e., ensuring family members are invited to program orientations and poster presentations) or creating cohorts with students from similar backgrounds.

The last central theme that emerged around student issues concerned DACA students. Concerns included financial matters such as how to get scholarships/stipends to DACA students and how to widely disseminate information on how institutions successfully support DACA students.

For all HSI students, it may be beneficial to produce materials in both English and Spanish.

Institutional Focus

The issues faced by HSIs at the institutional level fall into two groups. The first concerns establishing partnerships to effectively pool resources. Examples include retreats in which faculty from well-resourced institutions (HSIs or not) meet with faculty from under-resourced institutions for an extended time to establish intentional research/educational partnerships that will result in a long-lasting collaboration. Formal partnerships between two- and four-year institutions could also foster curriculum alignment and course articulation facilitating student transfers. These partnerships may also have the ability to effectively support two-year colleges' entry into the Bridge Program and other NASA efforts.

The second group of issues concerns the need to create administrative support within the institution. Many HSIs are under-resourced and do not have the support structures, personnel, or institutional knowledge base to successfully administer and manage large STEM grants. Many two-year and some four-year colleges have small (or no) sponsored projects offices. In these environments, getting awarded funds to students and faculty becomes problematic. Additionally, some institutions have minimal experience writing STEM proposals or being the lead institution for an extensive program.

Faculty Focus

There are also two general areas of issues related to faculty. The first issue is related to compensation that could come traditionally in the form of summer support, but there were other suggestions. For example, faculty fellowships or visiting scientist opportunities from institutions whose faculty have not traditionally participated in these activities are desirable. Financial support for two-year college faculty in summer research and fellowship experiences would be highly beneficial. Compensation for faculty/student mentoring activities during the academic year is also needed.

The second group of issues included training of HSI faculty and collaboration between HSI faculty and research active scientists. Training should consist of technical training, training on data sets, software, etc., and practical, culturally appropriate mentoring. Collaboration with highly active research scientists would allow faculty from two-year and four-year institutions, those with heavy teaching loads, and those from under-resourced institutions to leverage their limited time and fully participate in scientific research.

Findings in Line with Guiding Principles

The common trends in each thematic area were respect for the Hispanic culture, mentoring and mentor training, and financial support that addressed the total participation costs. These themes are in line with the guiding principles of the SMD Bridge Program and lead to the following set of findings:

- Concentrate financial support on under-resourced institutions, their faculty, and their historically excluded students.
- Fund Hispanic-serving as opposed to Hispanic-enrolling institutions. Proposers should be allowed to ask for the actual costs of administering a Bridge Program. For example, buying out faculty teaching responsibilities may include the faculty salary, costs for finding replacements, etc.
- Student support must include travel and housing, but also must have the flexibility to address other financial issues that might arise during a summer program.
- Most programs should provide funding throughout the academic year and include culturally informed mentoring and mentor training. Cohort building should be strongly encouraged.
- There should be capacity-building set-asides where underserved institutions, two-year and tribal colleges, and NASA centers can establish the needed relationships to apply for a full proposal. The capacity-building programs might also allow those institutions without the grant-supporting infrastructure to gain the knowledge necessary to support a full grant.
- The same kind of capacity-building funding should be established for individual faculty from underserved institutions, two-year, and tribal colleges to build the needed relationships with NASA centers and research-intensive universities to apply for a full proposal.

Historically Black Colleges and Universities (HBCU) and Primarily Black Institutions (PBI)

These findings come from the feedback from breakout sessions at the SMD workshop. Not all workshop attendees were members of the HSI community. The future focus of the BPWOC is to gather further input from the HSI community. Based on the workshop discussions and BPWOC meetings, the findings above are aligned with the guiding principles of the SMD Bridge Program.

Introduction

Historically Black colleges and universities (HBCUs) began in an environment of legal segregation. Currently, 101 two- and four-year HBCUs located in 19 states, the District of Columbia, and the U.S. Virgin Islands serve nearly 300,000 students. In 2020, 76% of students enrolled at HBCUs were Black/African American [1].

Primarily Black Institutions (PBI) are not HBCUs but institutions with student populations of at least 40% Black/African American. To receive the PBI designation, institutions must (a) enroll at least 1,000 undergraduate students, (b) have a minimum 50% low-income or first-generation degree-seeking undergraduate enrollment, (c) have a low per-full-time undergraduate student expenditure in comparison with other institutions offering similar instruction, and (d) enroll at least 40% Black/African American students.

There are currently 67 PBIs, a mix of four-year universities and two-year colleges, urban and rural, to educate the underserved. While PBIs are located throughout the country, they are concentrated in the South, Midwest, and East. PBIs, as with Minority-Serving Institutions in general, serve high percentages of Pell Grant recipients in addition to their large populations of students of color [2].

The HBCUs and PBIs Workshop breakout sessions and subsequent work addressed how the SMD Bridge Program can better support HBCU and PBI institutions, students, and faculty. They considered current support for Research Intensive (R1) institutions as opposed to non-R1 institutions and how the SMD Bridge Program can ensure a culture of inclusion at NASA for program participants and help NASA build lasting relationships with these colleges and universities.

Herein we describe key thematic areas from discussions and findings on these topics for consideration by the SMD Bridge Program leadership.

Key Thematic Areas

The most common themes in the SMD Bridge Workshop discussions on NASA collaborations with HBCUs and PBIs focused on long-term support for collaboration and equitable opportunities. The breakout began by establishing the need for these collaborations and the great experiences they can provide for students and faculty.

Long-term Collaboration

Long-term sustainable collaborative partnerships can grow, develop, and mature to meet the needs of the institutions and NASA itself if provided the necessary support. One significant support noted was the need for effective and honest communication on what each institution desires and can provide to the relationship. Concerning NASA, the apparent benefit its association provides HBCUs and PBIs is cutting-edge research, continuous growth in various technological fields, and numerous opportunities in varied disciplines which provide a life-enhancing career. HBCUs and PBIs can provide a wealth of untapped talent. This valuable pool can diversify and strengthen the country's workforce, particularly in science, technology, engineering, and mathematics (STEM).

The further discussion yielded other beneficial supports that facilitate long-term collaborations between HBCUs and PBIs, pathways for reciprocal partnerships, and mutual trust.

Equitable Opportunities

The other major topic in the breakout session was the availability of equitable opportunities. Many who had experience at both HBCUs and PBIs felt the lack of fair opportunities was a significant reason that more [NASA-related] research has not occurred at these institutions. Potential solutions to counteract unbalanced options included building specific HBCU/PBI consortiums and increasing the opportunities to network. A significant takeaway from this overall discussion was that the NASA SMD Bridge Program should continue to search for better processes that meet the institutions where they are with the resources and personnel that are presently available.

Meeting the Needs of HBCUs and PBIs

After expounding on the previous points, the discourse migrated to how NASA could meet the specific needs of HBCUs/PBIs. Often, these institutions have conditions ranging from limited supporting infrastructure to few personnel with NASA-related experience. Communication of these needs requires discussion between NASA and the institution, understanding that higher-level cooperation can flourish after establishing baseline requirements. Resources that NASA controls can satisfy significant research partnership needs and less obvious but necessary institutional needs as well.

Findings in Line with Guiding Principles

The workshop facilitated conversations on the potential supports that would facilitate collaborations between HBCUs and PBIs with the NASA SMD Bridge Program. Along with the need for long-term support and equitable opportunities to aid in building and maintaining these relationships, we found the following:

- Develop categories of targeted NOFOs specific to institution type.
- Cultivate inclusive, long-term relationships with HBCUs and PBIs, each having a point of contact at NASA with whom to build relationships.
- Identify the institutions' unique needs that could be met by NASA's wealth of resources to strengthen the institution's ability to grow its research viability.
- Streamline the proposal process and provide grant management training and grant implementation support for all involved.
- Provide targeted training and fellowship opportunities for early career professionals at these institutions.
- Commit to the possibility of longer-term (10+ years) relationships.
- Identify strategies to help faculty feel valued within the research process.

These findings offer potential solutions the SMD Bridge Program can implement in developing practical and sustainable partnerships with HBCUs, PBIs, and other minority-serving institutions.

Asian American and Native American Pacific Islander-Serving Institutions/Native Hawaiian-Serving Institutions/Tribal Colleges and Universities, and Native American-Serving Nontribal Institutions

Introduction

This chapter focuses on students, faculty, and institutions of the following categories: Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs), Native Hawaiian-Serving Institutions (NHSIs), Tribal Colleges and Universities (TCUs), and Native American-Serving Nontribal Institutions (NASNTIs), with the aim of identifying and addressing the gaps and needs of the institutions and the individuals they represent in order to support and eventually expand institutional resources and involvement with NASA programs.

We begin by acknowledging that these four institutional types are distinct, each having their own characteristics, communities, and cultures. As heard in one of the sessions: "These institutions are so different from each other, and I worry about thinking of them as one group when they have unique characteristics and communities and cultures that make them up."

While there was no working group for this category, this chapter aims to summarize the discussions and community feedback obtained during the break-out discussions held as part of the SMD Bridge Workshop.

Key Thematic Areas

Despite the vast differences in these institution types, the robust discussions during the workshop led to several overlapping thematic areas.

Relationship Building

Several key themes surfaced during the Bridge Workshop break-out discussions. Most prominent was the importance of relationship building, particularly at smaller institutions. For programs to be successful, NASA and other external partners need to go slow, listen, and focus on relationship-building.

The BPWOC expressed concern that a program assembled hastily may not have fully addressed the critical needs of stakeholders at Asian American and Native American Pacific Islander-Serving Institutions, Native Hawaiian-Serving Institutions, Tribal Colleges and Universities, and Native American-Serving Nontribal Institutions. The BPWOC emphasized that NASA must remain cognizant of the history of partnerships that privilege mainstream institutions while devaluing the contributions of non-mainstream institutions/groups.

To foster the relationship building process, it will be imperative that representatives of NASA and other external partners know how to engage across cultures and that they spend adequate time building durable relationships with the MSI/non-mainstream partners. Gathering sufficient input from the historically excluded communities and co-constructing the meaning of ideas, needs, and plans will allow NASA to build a program that does not inadvertently further disenfranchise these institutions, their faculty, and students.

Barriers for Potential Proposers

The discussions identified several barriers that potential proposers face. As the institutions in these categories tend to be small and/or without the institutional support for the federal grant submission process present at larger institutions, including at larger minority-serving institutions (MSIs), faculty and other potential proposers are left without support for the lengthy and complicated proposal submission process. Furthermore, many may not even bother applying, even for opportunities designated specifically for MSIs, as they recognize they will be competing with well-resourced MSIs that already have the institutional capacity for supporting federal grant submissions. Excessive paperwork, both in submission of proposals and in administration of awards, was identified multiple times as a barrier.

To overcome these barriers (lack of institutional resources, knowledge, and support), workshop participants indicated the need for NASA to be more flexible in the way they select and fund programs avoiding, for example, complex proposal submission requirements.

In light of these key themes, there were several open questions that the group discussed including how NASA might best go about establishing initial connections in a respectful way and how they can ensure that any collaborations that are created are truly reciprocal. Additionally, workshop participants asked if reciprocity and community service and engagement would be built into the proposal requirements and if NASA would identify internal strategies to address bureaucratic barriers.

Findings in Line with Guiding Principles

In conclusion, the Asian American and Native American Pacific Islander-Serving Institutions, Native Hawaiian-Serving Institutions, Tribal Colleges and Universities, and Native American-Serving Nontribal Institutions discussion groups provide the following findings:

- NASA should perform a critical analysis of the meritocratic system of review and current ‘one size fits all’ standards of review.
- Throughout the entire process of engaging these communities, NASA and external partners should be mindful of power dynamics and ensure that parties are not enacting power imbalances that have historically not served tribes or indigenous communities.
- NASA should provide a means of engagement for collaborations between different organizations, institutions, societies, etc.
- NASA should establish a Bridge Program “point person” -- someone assigned to a set of areas, and hopefully from the community for which that person will be the resource – who can be an emissary and facilitator.
- The Bridge Program should develop a means of engaging respectfully across cultures, for example, by providing training on interacting with indigenous cultures, providing a Bridge person as an emissary and facilitator, etc.
- The Bridge Program should ensure that in proposals for partnerships between under-resourced and better-resourced institutions, the under-resourced partner retains the majority of the funding
- NASA should reimagine the proposal process as a co-development, two-phased opportunity in which phase one consists of the submission of an initial idea, and phase two involves NASA working with and providing resources to the interested communities to develop the plan, budget, pathway, etc.

Community Colleges

Introduction

Community colleges[7] play a critical role in workforce development across the nation. They have a broad mission to provide academic programming and skills training to prepare students for jobs or to transfer to four-year colleges and universities [1]. Nationwide, over 1,000 public, tribal, and independent community and two-year colleges enrolled over 10.3 million undergraduate students during the 2020-2021 academic year. Overall, two-year colleges' student population is 27% Hispanic, 12% Black, 7% Asian-Pacific Islander, 1% Native American, and 4% two or more races. Also, two-year college students are more likely to be first-generation (29%), single parents (15%), veterans (4%), students with disabilities (20%), or students who have earned a prior baccalaureate degree but are changing careers (8%) [2]. Black and Hispanic students are consistently over-represented at large and underfunded community/two-year colleges [2, 3]. Moreover, community colleges enroll a more significant percentage of economically disadvantaged students but are unable to fully meet students' needs with financial aid [4].

Students at community and two-year colleges enroll in STEM majors at rates consistent with their peers who begin at four-year institutions [5], yet retention and completion rates trail those of students at four-year schools [5,6]. Among recent science and engineering baccalaureate degree recipients, 62% reported having attended community college at some point during their studies, and about 36% reported earning an associate's degree [7].

These data make it clear that sincere efforts to diversify NASA's and the nation's science and engineering workforce must include provisions to include community college students and faculty. During the SMD Bridge Program workshop, the community college working group and the community college breakout sessions identified several critical themes.

Key Thematic Areas

Community and two-year colleges enroll many students who are traditionally under-represented in science and engineering degrees and employment. While community college student retention and completion rates are lower than those of students at four-year institutions, experiential learning opportunities related to students' STEM degree interests have shown to dramatically improve student outcomes [8,9].

The Community College Working Group's goal was to ascertain which factors impede community colleges, their students, and their faculty from participating in programs such as the proposed SMD Bridge Program and make findings that can lead to broader inclusion of community colleges.

Student Focus

Community college students typically have complex lives outside of school, which often includes working, caring for family, and attending to additional community responsibilities. They have often attended under-resourced K-12 schools or schools with lower expectations for economically disadvantaged students and students of color and, as such, may be under-prepared for STEM-related math and science coursework. They often attend school part-time to balance the other sectors of their lives, prolonging the completion of transfer coursework. Their community college GPA may reflect the complicated lives they live and are not necessarily a fair reflection of the academic and intellectual capital of students at two-year institutions [11, 12].

7 In the United States, community colleges, sometimes called junior colleges, technical colleges, two-year colleges, or city colleges, are primarily public institutions providing tertiary education, also known as continuing education, that focuses on certificates, diplomas, and associate degrees.

Community college students face difficult choices when presented with unpaid experiential learning opportunities (see, for example, NASA Community College Aerospace Scholars (NCAS))[8]. While they may have a keen interest in these projects and understand that they will provide long-term academic and career benefits, they often cannot forgo paid employment or ignore their other responsibilities [4].

Community college students struggle with developing their STEM identity and moving through feelings of imposter syndrome. For students of color, their belongingness in STEM is further challenged as they frequently attend classes taught by instructors with little DEIA training and have limited access to other mentors. When combined with their experiences with structural and systematic racism, the likelihood of their retention is reduced.

In addition to students of color, community colleges enroll large numbers of active-duty military, veterans, students with disabilities, undocumented students, parents, and other non-traditional students who have tremendous potential to contribute to the science and engineering workforce. These students have unique needs that must be addressed for them to have equal opportunities to participate in a NASA SMD Bridge project.

Institutional Focus

Public community and two-year colleges, with the lowest level of per-student funding in most state systems, often do not have sufficient infrastructure to consider federal grants. While some of these schools have well-developed grants offices, many have minimal grants offices or no grant personnel, making it nearly impossible for them to compete for NASA, state, federal, or foundation funding.

Additionally, the diverse needs of students, faculty, and the institution may limit the upper administration's understanding of the value to the campus of participating in a NASA-related grant, resulting in their not approving the submission of a SMD Bridge proposal from their campus.

Faculty Focus

Community colleges are known for their open-access policies (e.g., open to anyone with no admission criteria) and focus on teaching and learning. Faculty at these institutions teach full loads–often four or more courses per term–and rewards in the tenure and promotion process are generally attributed to teaching and contractual institutional service. With the emphasis on teaching, most faculty do not have access to release time to run a grant, so there will likely be few incentives for writing a proposal.

Faculty in the Community College Working Group and faculty participants in the SMD Bridge workshop community college sessions frequently articulated their lack of familiarity with the proposal-writing process and with grants administration in addition to the limited time they have outside of teaching and office hours. Many expressed that writing and administrative support from a grants office would be limited if one existed at their institution. Faculty indicated that they find little time to develop cross-sector partnerships and interact with peers at other institutions, which may limit their ability to participate in a collaborative proposal. Finally, faculty indicated that while they mentor STEM students formally and informally, they have had little or no preparation and training for this role.

The working group also discussed current NASA offerings intended for community colleges. During the discussion, faculty indicated they are rarely aware of NASA grant NOFOs and find only limited alignment between current NASA professional development and curriculum offerings and their immediate needs. During discussion, faculty

8 https://www.nasa.gov/stem/murep/projects/ncas.html

indicated that their college or system-approved course outlines[9] might not sufficiently parallel NASA professional development topics for the information to be helpful.

Findings in Line with Guiding Principles

The Community College Working Group highlights the following findings consistent with the key thematic areas and with the SMD Guiding Principles.

- **Intentionality**: Provide announcements, marketing, and outreach directly and specifically to community colleges in order to intentionally signal NASA SMD's understanding of the critical role community college students and faculty have in diversifying the science and engineering workforce.
- **Access**: Ensure that NOFOs, application instructions, and grant templates are simplified with the non-grant-writing professional in mind and provide ongoing support for the faculty as they design, prepare, and submit proposals and implement projects. Adding a NASA support professional with robust experience working in and with community colleges will be critical in supporting these under-resourced two-year institutions.
- **Financial Support**: Community college faculty and students must be compensated for their time participating in a NASA SMD Bridge Program. Ensuring that the NOFO provides clear information that institutions may cover the full cost for faculty release and/or extra duty time and student stipends in their budget will be important.
- **Flexibility**: The NOFO should ensure that community college proposers have flexibility with program design and that reviewers are prepared to be flexible with scoring proposals from novice writers.
- **GPA**: Notably, the Community College Working Group hopes that NASA recognizes that GPA is not an accurate picture of student ability and therefore eliminates GPA thresholds for participation in its internships, research experiences, and funded grant activities.
- **Mentor Training and Preparation**: Faculty must be "intentionally prepared to mentor." In the absence of STEM mentor training at the community college, we recommended that NASA support other avenues of mentor training for participating faculty [13] which may include training provided through NASA and open to all grantees.
- **Support and Recognition**: Through the work of the SMD Bridge Program, NASA has the opportunity to begin to change negative opinion of community colleges and help the broader community recognize that community colleges play an essential role in supporting the nation's STEM development needs.

9 Typically, curriculum at the community college level is approved by both a campus curriculum committee and then by the state system or Chancellor's office. While faculty have the freedom to identify how they will teach topics in the official course outline, they generally do not have the ability to change the scope of the course without a course redesign.

Primarily Undergraduate Institutions

Introduction

There are more than 2800 Primarily Undergraduate Institutions (PUIs) in the United States and they grant ~12% of bachelor's degrees in science and engineering [1]. With student-teacher ratios on the order of 12:1, the small class sizes and a more caring climate at some PUIs may be safer spaces for women pursuing science, technology, engineering, and mathematics (STEM) majors and career paths [2]. Indeed, more personalized teaching and mentoring allow for experiences that can help to retain women and members of under-represented groups in the STEM disciplines. PUIs are unique in that their faculty have high teaching expectations, mentor numerous students in and outside the classroom, and typically contribute more service to their departments and their college as a whole compared to faculty at very highly research-intensive institutions (R1s). They are also distinct because undergraduates at PUIs are more likely to remain in academic-year research than their peers at R1 institutions [3].

Faculty at PUIs teach anywhere from 5-8 classes per year, with laboratory sections usually counting as one-half a class. As a result of the pressure on the time needed to perform expected teaching and service duties, there is little time remaining for faculty to focus on research or travel to conferences for exposure to research and networking. Missing these opportunities is problematic because at most PUIs, research activity (including paper publishing and invited talks) is essential to promotion, tenure, merit, and bonus (PMB) reviews and decisions. During the academic year, teaching requirements leave little time to write competitive research proposals, and the PUI often lacks sufficient departmental and campus resources to manage the financial aspects of those proposals (e.g., to shepherd those proposals through to the funding agencies). As a result, many research-active PUI faculty conduct research on a budgetary pittance, confine it to the summer and have trouble getting their work acknowledged by the community. Sadly, even though PUI faculty are more likely than faculty at R1 institutions to publish journal articles with undergraduate students [4], these conditions limit undergraduate students' access to research.

The NASA SMD Bridge Program provides a valuable funding line for faculty and students at PUIs to participate in extensive and collaborative activities, including space missions. Key to these collaborations is information sharing and knowledge transfer among the institutions and their personnel; infrastructure to support the grants processes at the PUI; and long timelines (>3 years) to allow for consistent funding for PUI faculty time, faculty-student mentoring, and student research.

Key Thematic Areas

Emerging from the discussions related to PUIs was the need for sustained synergistic research and training programs that address the needs of larger partners (e.g., NASA Center, R1) and create specific opportunities for the smaller partners (i.e., PUI) to fill this role. For example, a Bridge Program between a PUI and a NASA Center or an R1 would include the following:

- a meaningful partnership with research personnel that provides:
  - direct access to comprehensive research programs at NASA centers and R1s for students and faculty;
  - mentoring and networking support for faculty;
  - accountability for all partners;

- sustained long-term funding that is transferable from:
  - student to student as they progress through and graduate from their college;
  - PUI to graduate school if the funded student so chooses;
  - institution to institution if a faculty member chooses to move institutions;
- supporting infrastructure required for the grants processes.

Findings in Line with Guiding Principles

A successful PUI-R1-NASA Bridge Program would require:

- quality career and research mentoring for PUI faculty;
- long-term (>3 years) funding that is focused on the career development of the faculty member who mentors student research partners; and
- meaningful research opportunities for PUI undergraduate students that results in a pathway to graduate school or employment in a STEM field.

California Programs and Institutions

Introduction

California is the most populous state in the union, with a highly structured public higher education system that serves an ethnically and racially diverse student population. It is also home to three NASA Centers, a significant aerospace industry, and robust existing STEM student development programs, including the Mathematics, Engineering Science Achievement Program (MESA)[10] and Cal-Bridge[11] . Because they share similar goals, the SMD Bridge Program may wish to engage these programs and others (i.e., U.S. Department of Education TRiO STEM and Title III Part F programs, and NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) programs) to address equity gaps at traditional four-year colleges, universities, community colleges, and other community stakeholders across California.

Higher education in California includes three systems. The California Community College system comprises 116 community colleges which serve nearly 2 million students annually. The California State University (CSU) system has 23 campuses serving approximately 500,000 students. The CSU primarily serves undergraduate students but also awards Master's degrees and, in limited cases, professional doctorate degrees. The University of California (UC) system consists of 9 four-year institutions, with an additional campus providing only graduate degrees in health-related fields. Additionally, a MESA program works in select California community colleges to prepare a diverse population of transfer-ready STEM students. MESA directors are embedded in a community college and work on advising students and providing research and professional development opportunities.

Herein, we describe the key thematic areas of discussion identified during the SMD Bridge Workshop as they relate to many California institutions and NASA Centers and, we present the outcomes and findings for consideration by the SMD Bridge Program leadership.

Key Thematic Areas

The most common themes in the SMD Bridge Workshop discussions on NASA collaborations with California institutions focused on understanding the current Bridge Program models that already exist in California and how NASA SMD Bridge might leverage these relationships for program success. The conversation began with discussing existing California Beridge programs and how they interact with in-state NASA Centers. One such program for traditional four-year institutions is Cal-Bridge which provides intensive mentoring, scholarship, and summer research opportunities to undergraduates in their last two years at a CSU. Cal-Bridge has a proven track record. Of the 128 scholars served since 2014, more than 75% of seniors have been admitted directly into a Ph.D. program and an additional 10% to a master's degree (MS) program. Cal-Bridge students represent the diversity of California; 69% are students of color, with 17% identifying as Black or Latina women; 62% are first generation; 19% identify as members of the LBGTQ+ community, and 19% identify as having a disability; 43% of scholars identify as women or nonbinary [1]. Initially starting as an astronomy summer research program in 2009, additional National Science Foundation funding in 2014 created the Cal-Bridge mentorship program. The Cal-Bridge Program is a partnership between the nine University of California and 23 California State University campuses. Although the program began in astronomy, it has now branched out to include physics, computer science, computer engineering, mathematics, and statistics. Cal-Bridge scholars are recruited with the help of local faculty and staff liaisons at each campus. Scholars currently receive up to $10,000/year in financial aid based on demonstrated need, intensive, joint mentoring by CSU and UC faculty,

10 MESA https://mesausa.org/

11 Cal-Bridge https://www.cpp.edu/calbridge/index.shtml

professional development workshops designed to help scholars prepare to apply to graduate school, and access to a wide variety of summer research opportunities. With new state funding from the California legislature, Cal-Bridge will expand its mentoring and professional development programs to include Ph.D. students in the University of California system.

The working group discussed the Mathematics, Engineering, and Science Achievement (MESA) program. Established over 40 years ago, MESA is for educationally disadvantaged middle and high school and community college students who seek to transfer to a four-year institution. MESA has a college preparation program that bridges classroom concepts to real-world practice. The college preparation program assists with academic planning, facilitates college campus tours, hands-on STEM competitions, internship opportunities, professional development, and a host of other programs related to mentoring, personal, and social skills enhancement. Over many decades, the program has supported over 24,000 students across 350 middle and high schools, 40 community colleges, and 13 universities in California. Participants are 80% more likely to be admitted to a UC campus than their non-participating peers.

The discussion also yielded several concerns for students participating in programs across California that the SMD Bridge Program might consider addressing. The top three areas of discussion were: 1) addressing California housing and transportation solutions for students working/interning at NASA Centers as the basis of evaluation for Bridge proposals received; 2) establishing longer-term funding for programs of 5-10 years as relationships take time to establish and require consistent attention, and 3) recognizing the existing relationships built through Cal-Bridge in California.

Findings in Line with Guiding Principles

The workshop discussion sessions provided thorough conversations on the potential supports that would better facilitate collaborations between California Institutions with the NASA SMD Bridge Program. Along with denoting the need for long-term support and affordable housing for students, the working group added the following findings:

- The SMD Bridge might consider leveraging the existing Cal-Bridge and MESA networks, as well as networks in similarly focused programs for NASA programs/opportunities.
- There should be more community involvement and wide dissemination of SMD partnering with CA MSIs.
- Given that there are multiple NASA Centers in California, the SMD Bridge Program should encourage direct participation by local students at NASA Centers.
- SMD partnerships should consider including funds for providing childcare or elder care, depending on the needs of the students.
- The SMD Bridge Program should create a safe space for individuals to discuss topics related to their community concerns/needs.
- Research opportunities at NASA Centers or CA-based industry partners should offer more flexibility (e.g., part-time and remote options) and locations (e.g., CA NASA centers tend to be in areas where the cost of rent, childcare, etc. limits who can participate).

These findings provide potential solutions the SMD Bridge Program can implement in developing practical and sustainable partnerships with California institutions and other existing minority-serving programs across the state.

Accessibility

Introduction

In NASA's Strategic Plan for Diversity, Equity, Inclusion, and Accessibility (DEIA), accessibility is defined as providing accommodations and modifications to ensure equal access to employment and participation in activities, eliminating and reducing physical barriers to promote equitable opportunities, and ensuring every outward-facing and internal activity or electronic space can be accessed by every person independently [2].

The BPWOC shares the goal of ensuring equal access to NASA opportunities by persons with a disability; however, for the Workshop, the BPWOC framed the accessibility breakout sessions to focus broadly on understanding factors that limit institutions, faculty, and, to some extent students' participation in NASA-sponsored programs and applying for NASA-funded grants. We understand that this focus deviated from that of many accessibility stakeholders because it was not centered primarily on access based on persons with physical, intellectual, or emotional disabilities. Accessibility, in this context, concerns making information, activities, and environments sensible, meaningful, and usable for as many people as possible.

Key Thematic Areas

The key theme from the Accessibility breakout session was that flexibility is required to provide access to persons at unique, diverse, and underserved institutions. Flexibility is demonstrated when NASA alters the traditional methods by which it works with institutions and people to ensure that those who have been previously excluded are included with the result that they are awarded opportunities.

Barriers

The lack of infrastructure, staff, and grant-knowledgeable administrators at small and under-resourced institutions results in a barrier to access. For example, at many Tribal Colleges and Universities, not only is there an absence of a dedicated grants department but there may also be an Internet and digital infrastructure gap. These issues can affect the ability of faculty to build and submit grants of typical complexity.

Faculty at non-research-intensive universities, such as those at PUIs, community colleges, and other MSIs, must conduct research while having heavier teaching and service responsibilities. Time constraints and lack of institutional support make it challenging for them to apply for grant funding. Consequently, it is difficult for these faculty members to develop a research agenda and commit time to supporting students in performing NASA-relevant research.

NASA could address accessibility in these and similar situations using strategies like those below.

- Host in-person and remote workshops on the proposal submission and grant administration processes for staff. When possible, these workshops could take place at a centrally located institution so that travel is easier for many of the participants. Recording the workshops would permit those who cannot attend to view later.
- Fund previously awarded MSI and other under-resourced faculty members with challenging circumstances (i.e., high teaching loads and little institutional support) to present at NASA facilitated workshops focused on faculty proposal preparation and research grant production.
- Institute collaborative opportunities where a proposer is encouraged to collaborate with other MSIs and under-resourced institutions, faculty, and students who have not previously had a NASA grant.

Institutions in a particular category may differ significantly from each other. For example, the U.S. Department of Education recognizes more than 100 HBCUs, but only 11 are classified as Carnegie R2 “high research activity” [3]. The faculty at many of these schools have high teaching loads and the lack of substitute faculty may render traditional teaching time buyouts impossible.

Findings in Line with Guiding Principles

After the breakout sessions on Accessibility, participants were asked for their three top findings to improve SMD Bridge Program accessibility. The following items are a synopsis of the findings.

- Increase simplicity of the application process. Examples include a rolling submission schedule, easy-to-understand language, and availability of program officers during grant writing perhaps through posted online, synchronous office hours.
- Increase the flexibility of awards spending. Examples include the buyout of faculty teaching time, the ability to move funding between categories with explanation, childcare support funding, increased time for award spending, and eliminating student intern GPA requirements.
- Increase NASA’s understanding and support of diverse institutions by:
    - assigning dedicated program officers to specific institutional categories. It would be helpful if these program officers matriculated from an institution of the same category to which they are assigned.
    - creating protections for smaller institutions from larger R1 institutions such that the majority of a grant’s funding is budgeted to the non-R1 institution
    - eliminating proposal review bias associated with younger/less established proposers and proposers from smaller institutions by creating review panels with majority non-R1 faculty members and facilitating workshops where faculty of non-winning proposals can work with NASA personnel to improve their proposals.

Assessment, Capacity Building, Evaluation, and Social Impacts (ACES)

Introduction

The assessment, capacity building, evaluation, and social impacts (ACES) working group sought to discover how the capacities of MSIs to participate in STEM research activities is affected by their limited resources. These capacities include basic research and grant administration infrastructures and time stressors that faculty, students, and staff are often under at these institutions. These factors greatly affect the ability of many under-resourced institutions to compete for grant funding, to properly design evidence-based programs, and to monitor and evaluate the effectiveness of their programs. The ACES group also investigated the appropriate accountability metrics that measure success and the wider impacts of establishing a thriving research relationship with NASA.

The critical factor for the SMD Bridge Program to be successful is that NASA be cognizant of the myriad constraints which under-resourced institutions, their faculty, and their students face. For example, faculty workload including teaching and scholarship, along with student mentoring responsibilities, are directly correlated with their institutional capacity. When the institution is under-resourced, the overall research capacity of MSI/HBCU faculty is reduced in comparison to faculty at research-intensive institutions due to the faculty's increased teaching and mentoring duties. In addition, students at MSIs often have responsibilities that require substantial support in order for them to engage in research opportunities. Awareness of these issues will help the SMD Bridge Program to begin to shift the status quo in the overall production of students pursuing STEM career paths.

Key Thematic Areas

The most common themes that emerged in the discussions on program capacity building and impacts from professional societies centered around the importance of having appropriate mentoring and providing a student-focused approach to achieving program outcomes.

An unexpected pivot in these discussions that appeared was to involve individuals from the business/financial side of NASA and include them in the conversation early. The working group stressed the importance of involving administrative support for institutions that might not have those structures in place locally.

Capacity of Faculty-Student Relationships

The working group determined that it is necessary for the SMD Bridge Program to be clear on what the program is offering to MSI partners and what these institutions need to give/provide as a minimal baseline for program success. Every institution will need something different from the partnership. The ACES working group found that there should be baseline metrics for each type of institution's (Ph.D.-granting, MSI, PUI, or community college) capacity for research. The result would be a sliding scale correlated to the program's institutional research capacity (IRC) evaluation. The following question was presented in these discussions of IRC:

What can the SMD program provide to improve IRC, and what metrics or components would you expect to be assessed? And why?

Discussions focused on the overall structure of the future solicitation and ways to encourage SMD Bridge Program investigators to synergize their proposals to NASA missions and mission concepts, instrumentation, archival data products, and/or engineering facilities. The appropriate metrics for success for faculty-student outcomes should include both qualitative (i.e., interviews) and quantitative (i.e., surveys, productivity, student retention and completion) data.

It was also determined that it is necessary to understand the current state of the relationships between students and faculty at under-resourced institutions. This baseline is needed to gauge real success and to design appropriate programs that meet the local need. It was stressed that a student-centered program along with a genuine collaboration between faculty and NASA was critical in making a significant impact.

Leveraging Program Accountability from Professional Societies

It will be important to identify and evaluate the Bridge Program's effectiveness in retaining students in their respective fields. The ACES working group suggests creating an external advisory board to the program that would provide insight on closing the achievement gap between majority and under-represented groups in STEM and identifying ways societal groups/organizations can become partners or collaborators with the SMD program. Group members discussed the potential of student internships, joint graduate or early-career fellowships, and conference travel grants as some viable approaches. The most critical questions that arose in these discussions were the following:

How can [the SMD Bridge Program] leverage program accountability from professional societies?

What impact do professional societies have on the retention and persistence of students and early career professionals?

Understanding how to bring professional societies into the Bridge Program early to help participating Minority-Serving Institutions build their capacity and program success could be a critical aspect of the program. Eliminating the feeling of isolation and being an imposter or "Earth-born alien" in their field of study is pivotal for student matriculation through the program. In addition to these responses, implementing needs-based travel or mini-grants for student-faculty pairs to travel was discussed.

Evidence-based Program Design and Evaluation

The Evidence-based Program Design Process (see Appendix 4) will help strategically facilitate the program's overall design and activities in an effective manner that advances existing strategies aligned to federal and NASA goals, objectives, and directives. The design process, further described in Appendix 4, was reviewed during the SMD Bridge Program Workshop with SMD Bridge Program leadership, Working Groups, and stakeholders. The ACES working group facilitated two concurrent breakout sessions to discuss elements of the development of program goals and objectives and develop a program logic model. The working group captured participant input and highlighted the findings on these critical elements in synergy with the guiding principles.

Findings in Line with Guiding Principles

Co-developing the metrics in collaboration with the program team members to measure the efficiency and efficacy of these activities is essential from the beginning. Providing student funding for non-research efforts (DEIA activities, programmatic support, outreach, etc.) became an important component when compiling findings for the Bridge Program. Supporting faculty to invite students to attend and participate in conferences became a standard recommendation. ACES compiled the following findings in line with the core tenets of the NASA SMD Bridge Program.

- Create tracks and connections with professional societies to help with the grant administration so that the MSIs and faculty can focus on connecting students with the research.
- Provide more flexibility for participating students addressing the cost-of-living issues that prevent participation.

- Ensure clarity of calls for proposals, consider eligibility deadlines, and ensure that program requirements are readily accessible.
- Build cohorts between bridge students from all two- and four-year institutions.
- Recognize that the inequities in access to opportunities are systemic–not individual– and address changes in processes that perpetuate these problems.
- Develop performance and evaluation requirements for the SMD Bridge Program Notice of Funding Opportunity (NOFO).

These findings provide important input that the SMD Bridge Program may consider as they develop a NOFO that leads to an impactful shift in the current state of STEM programs aimed at increasing the numbers of under-represented minority students and faculty who participate in NASA-funded activities.

STEM Mentoring

Introduction

Strong positive mentorship helps develop students into scientists, and negative or absent mentorship can drive students out of STEM. The quality of mentorship varies widely across the academy. Most students, scientists, researchers, and faculty have not participated in structured mentoring programs. Effective mentoring is the subject of a major report released by the National Academies [1]. The goal of this Working Group was to consider the best practices that lead to effective mentorship and consider how to highlight mentorship in the SMD Bridge Program NOFO and subsequently implement mentorship in Bridge projects.

Key Thematic Areas

Discussions during the STEM Mentoring Working Group meetings leading up to the workshop and breakout sessions during the workshop illuminated several significant themes related to the needs of students and mentors, as well as mentoring models and preparation.

Students

Participants in the Working Group and at the workshop recognized that students have various needs to address—academic, financial, and social-emotional—in order to ensure their success. A critical step to ensuring successful mentoring relationships includes training, so that mentors and mentees can adequately align their expectations, develop appropriate communication strategies, and recognize each other's needs within and outside the mentoring relationship.

Poor mentorship was a consistent theme throughout the discussions. STEM students, postdocs, and early career participants provided recent examples of poor mentorship and the need to provide students with a safe and secure reporting process where they can discuss their concerns without negative repercussions from the mentors or the department.

Mentors

Discussions consistently highlighted several areas critical to effective STEM mentoring: relearning how to listen, fostering a growth mindset in self and mentees [2], self-awareness of personal limits, and empathy. Faculty indicated that not all their peers are currently equipped to be mentors, and there needs to be evaluation processes to help mentors learn new skills or remove them from the mentor pool. In part, participants highlighted the need for mentor training.

The second area of discussion related to STEM mentors was the need for financial and structural support (e.g., training and mentoring resources) and recognition for their mentoring. Most participants indicated that their mentoring activities are not part of their tenure and promotion files, yet robust mentoring requires a significant time commitment.

Mentoring Models and Preparation

Participants in the Working Group discussions and workshop breakout sessions consistently highlighted the constellation mentoring model. In this approach, students should have mentors at all levels, including peers, near-peers, advisors, other professionals, etc., and the differences between mentor levels should be emphasized.

Constellation mentoring assists mentees and mentors in establishing multiple avenues for communication. However, the onus for facilitating the mentoring should NOT be on the student.

Within the context of mentoring models, the scope of mentoring should go beyond academic mentoring and include financial, career, etc. Participants in the Working Group compiled a list of mentor training programs and resources (see, Appendix 3) and, while they believe mentor training is a must for all projects, they cautioned against mandating any particular mentoring framework since institution-specific mentoring may already exist.

Findings in Line with Guiding Principles

- Require a robust mentor training plan as a part of the awarded program's end-of-year evaluation and reporting.
- Establish a NASA-based mentorship training program that is available to sites.
- Ensure mentor accountability by collecting and assessing regular feedback on mentoring relationships and establishing and using evidence-based evaluation metrics.
- Include the need for multiple mentors in the mentoring plan, clearly define mentor/mentee roles and expectations, provide a safe reporting mechanism for poor mentorship, and establish a response protocol for quickly investigating and resolving poor mentorship.

Early Career Perspectives

Introduction

The goal of the Early Career Perspectives Working Group was to determine the primary challenges, goals, and concerns of the early career population and relate them to the ideals and best practices for the NASA SMD Bridge Program. Working Group members were recruited from across scientific disciplines and career paths to ensure a robust exploration of these topics.

Key Thematic Areas

Below we briefly describe the key themes that arose throughout the Working Group and workshop breakout discussions, as well as from two surveys of 31 students and early career scientists across scientific disciplines and career paths [1]. The surveys asked seven questions including those listed below:

1) How did your education and early career/student academic experiences prepare you for your current career?

2) Did you receive ample support and encouragement in your education and early career environment to contribute and participate in tasks to help enhance your career?

3) What are the places (if any) where you feel like your education and experiences did not prepare you for your current career or career goals? Do you have any thoughts about how you could have been better served?

Mentorship

Students should have access to various trained mentors (peer, near-peer, and professional) to provide support, including professional guidance, advocacy, award recommendations, and career preparation. Furthermore, growth mindset [2] mentorship must be integral to the mentoring program. A growth mindset relates to how people view challenges and setbacks. Those with a growth mindset believe that their skills and performance can improve with work. The program should thoughtfully match students with more than a single mentor at the onset of the program to ensure that they can receive diverse advice from various professionals.

Career Development

The program must support students from diverse backgrounds throughout their education so that they may gain the skills necessary to thrive in a wide range of careers. There are multiple fulfilling career paths that STEM graduates can take, and there has been a substantial shift towards non-academic pathways. To fully support students, it is vital to ensure that their degree programs are helping prepare them for their ideal career pathways, including non-academic careers. This support can take many forms, including skills-based workshops, networking with alumni in various jobs, and internship opportunities. It is also essential to consider the career development of students who take “non-traditional” career paths. Not all scientists proceed from high school through graduate school without breaks. It is vitally important to ensure that these students can take full advantage of the opportunities provided through the Bridge Program to the extent they wish.

Formal Support Systems

A program should supply students with holistic support to complete their degrees. Holistic support includes the following: financial aid (e.g., livable stipends, money to apply for grants/funding, reimbursements for Graduate Record Examination or similar exams, travel funds to conferences or other career-advancing activities), counseling (e.g., career and personal), and both academic/career-related (e.g., coding, presentations, teaching) and individual skill building (e.g., time management, stress management). Furthermore, a person's diverse circumstances (e.g., disabilities, parenthood, finances) may affect their consistent participation in the program. An ideal program should adapt to a student's needs and provide support and resources if they need to enter, exit, and re-enter the program.

Inclusive Community

It is of the utmost importance that all students and early career members can work in a safe, inclusive environment where they can succeed and help others thrive. Sadly, many work environments promote an unhealthy and highly competitive environment. The same can be true of Bridge Programs, where students must compete for limited spaces and they encounter biases within their department and field. Therefore, the program should support students by forming a community and a bonding cohort and provide financial support for counterspaces [3] where marginalized students challenge each other to push beyond stereotypical narratives, develop counterstories, and learn adapting strategies from others navigating similar struggles. An inclusive community will mitigate systemic issues, and we recommend that the NASA SMD Bridge Program messaging states its desire to combat systemic issues.

Findings in Line with Guiding Principles

In line with the core tenants of the NASA SMD Bridge Program, the Early Career Perspectives Working Group highlights the following findings to ensure that participants in the Bridge Program are well-supported and able to thrive. We understand that there are inherent inequities in the scientific community and higher education system. We attempt to mitigate these inequities through these findings, even if we cannot solve them through this program alone.

- The program should offer structured and effective mentorship to all participants, including mentor training for all mentors and leaders. Practical mentor training includes workshops and regular check-ins.
- The program should prioritize support for cohort-building experiences, student empowerment workshops, and counterspaces to counteract the negativity and toxicity inherent in too many academic environments.
- The program should provide professional support (e.g., career counseling and skill development) for diverse career pathways, especially those outside academia since there are STEM graduates pursuing non-academic careers. Many academic mentors may not have career experiences outside of academia; therefore, non-academic mentors should be included.

In general, the Early Career Perspectives Working Group suggests that the implementation of findings that require significant resources (i.e., grants development and management, reporting, financial management, etc.) be handled centrally either through NASA or through regional collaborations between Bridge Program institutions, so that access is independent of an institution's potentially limited resources.

Themes and Observations

The BPWOC organized the workshop around key stakeholders and Working Groups that were identified in advance of the workshop. Each produced a set of findings targeted to that specific group of stakeholders. Nevertheless, there were overarching themes that spanned all the working group and workshop breakout sessions. A summary of those themes follows.

One key theme was the need to center the program teams on underserved students, institutions, and faculty. Centering means concentrating resources within underserved communities and that partnerships and collaborations between institutions and NASA Centers should have under-resourced institutions as the lead institution. These lead institutions should span the range of two-and four-year institutions. The funding should include full support, considering childcare, the actual costs of students traveling for a summer opportunity, technical training, MSI faculty funding, and infrastructure support for institutions that do not have the administrative resources to manage grants.

Another key theme that appeared was the need to tailor programs across the resource hierarchy of institutions. Entry points to the program that allow and encourage under-resourced institutions to apply must be an integral part of the design. Perhaps NASA could make smaller capacity-building grants available, giving institutions that have not traditionally been involved with NASA the opportunity to build the needed infrastructure and knowledge base to apply for grants successfully. Moreover, NASA should ensure that information about the resources and best practices in existing programs are easily accessible to under-resourced institutions in a manner that allows them to incorporate them into their proposals and strengthen their chance at being funded.

Mentoring was a key theme that emerged. The mentoring theme had two major components. First, there was strong support for mentor training for both PIs at the local institution and at NASA centers. Several times the need for culturally appropriate mentoring was put forth, and this kind of mentoring cannot occur unless there is mentor training that brings into focus the need to understand student backgrounds and lived experiences. The second component was assuring that students are mentored and not made to feel isolated. It was advocated that cohorts be used to address the need to build community among students from under-represented communities. Also mentioned in several places was the need for true collaboration between faculty at under-resourced institutions and NASA centers. A more substantial partnership helps involve faculty that have not traditionally been connected with NASA and eases the transition for students.

Several other themes related to faculty appeared. Primarily, these themes focused on streamlining the application process so that early career faculty might find an easier entrée into the proposal writing, submission, and review processes at NASA. Streamlining would also benefit faculty at smaller institutions with limited or no office of sponsored projects support to better compete for Program funding. Additionally, better communication between NASA and under-resourced institutions may encourage more of these institutions and their faculty to apply.

Findings

Groups were asked to submit findings aligned with the above guiding principles. These findings addressed two distinct areas: 1) the desired programmatic elements of the NOFO and 2) the resulting proposal process.

Key findings, separated between those related to the program and those related to the grant processes, are outlined in the executive summary and are provided in each topic area. The findings are briefly restated, below.

Programmatic Findings

- **General Principles**
  - Throughout the entire process of engaging underserved communities, NASA and external partners should be mindful of power dynamics and ensure that parties are not enacting power imbalances that have historically not served these communities. Recognize that inequities in access are systemic, not individual, and changes are needed to processes that perpetuate these problems.
  - Announcements, marketing, and outreach efforts should be directed specifically to community colleges and intentionally signal NASA SMD's understanding of the critical role community college students and faculty have in diversifying the science and engineering workforce.
  - Resource-heavy processes, such as reporting and financial management, should be handled centrally, either through NASA, or through regional collaborations between Bridge Program institutions, to ensure that access is not dependent on an individual institution's potentially limited resources.
  - Commit to funding long-term (5+ years) relationships.

- **Enable/Support Collaboration Building and Cohort Formation**
  - Encourage collaborations between a range of organizations, institutions, and professional societies with different resource levels.
  - Prioritize support for student cohort-building experiences, student empowerment, and networking.

- **Appoint and Support NASA Facilitator(s)/'Point People' to be Responsible for Making and Sustaining Connections with Under-served Institutions**
  - Establish a cadre of program officers that will serve as the first point of contact and continuing support for underserved institutions.
  - Develop a means of engaging respectfully across cultures, for example, by providing training for program officers on interacting with indigenous cultures.
  - Cultivate long-term relationships with underserved institutions.

- **Redesign the Proposal and Proposal Review Procedures**
  - Reimagine the proposal process as a two-phased, co-development opportunity in which phase one consists of the submission of an initial idea, and phase two involves NASA working with and providing resources to the interested communities to develop the plan, budget, pathway, etc.

  - Perform a critical analysis of the meritocratic system of review and current 'one size fits all' standards of review. Reviews should be structured such that the focus is put on the content of the proposal and such that institutions are not penalized due their lack of resources and experience submitting NASA proposals.

- **Provide Realistic Financial Support and Keep the Majority of Funding at/in Underserved and Under-resourced Institutions**

  - Ensure that in proposals for partnerships between under-resourced and better-resourced institutions, the under-resourced partner retains the majority of the funding. Financial support must be concentrated on underserved students, institutions, and faculty.
  - Proposers should be allowed to ask for the real costs of administering a Bridge Program (e.g., buying out faculty teaching responsibilities may include not just the faculty salary, but costs for finding replacements, etc.).
  - Participants need to be compensated for all of their time working in a NASA SMD Bridge funded program.

- **Create Support and Structures for Developing, Maintaining, and Evaluating Effective Mentoring at Participating Sites**

  - Funding for academic year programming that includes culturally informed mentoring and mentor training should be necessary for most programs. Faculty need to be intentionally prepared to mentor. In the absence of local STEM mentor training, NASA should support mentor training for faculty.
  - Programs should set the expectations for participating mentors and make clear distinctions between the various roles of mentors (supervisors, advisors, mentors, etc.). The program should also establish a safe mechanism for students to report poor mentorship.

- **Provide Support and Training for Early Career Professionals at Underserved Institutions, as well as Opportunities for Research Growth**

  - Encourage and support early career professionals to leverage NASA's wealth of resources to enhance their research and career development.

- **Additional Areas**

  - Elevate the status of under-resourced public institutions. Amplify the assets that under-resourced institutions already have.
  - Leverage existing programs that have the potential to further diversify the STEM workforce and encourage flexibility in forming partnerships across institutions and industry.

Findings Specific to the Grant Proposal Process

- Provide a dedicated channel for each MSI/institutional category to propose through.
- Clarify the call for proposals and ensure that program requirements are readily accessible.
- Enable a longer application window (i.e., minimum of 90 days between NOFO and submission deadline).
- Provide the opportunity to apply for long-term funding (5+ years).

- Provide the opportunity for capacity/relationship-building in the grant proposal process for both underserved institutions and individual faculty to apply for grants in which the first year is solely focused on relationship building (with reporting requirements in alignment with that focus/goal) and/or gaining knowledge needed to support a full grant proposal.
- Reduce the bureaucratic/paperwork requirements to a minimum.
- Provide 'hands-on' proposal support. In addition to helplines and training sessions, NASA should provide individualized support to proposers, with a focus on those from institutions who have not previously received NASA funding. This should include grants management training as well. Ideally the NASA support professional(s) will have experience working in and with multiple types of under-resourced institutions.
- Allow for budgetary requests to support critical infrastructure needs like Internet hotspots, computers, lab equipment, transportation, student housing, child- or elder-care support, etc. Budget request procedures should have flexibility to allow for other funding as needed and/or to address other financial issues that might arise during a program.
- The proposal review process should be designed to fairly evaluate proposals from novice writers and institutions, support/reward a flexible approach to program design, and allow for the inclusion of a broad range of students without imposing rigid performance criteria (i.e., GPA and other metrics of merit).

Table 4: Common Themes Across Institution Types

	Concentrate funding at under-resourced institutions	Culturally-informed mentoring, mentor training and accountability	Full financial support	Administra-tive support and simplified proposals	Facilitate the development of institutional partnerships	CCs as lead institutions and equal partners	Align proposal review process with the goal of diversifying funded institutions	Remove barriers to application and participation	Longer project period	Targeted outreach and support to each institutional category
NASA		X	X	X	X			X		X
HSIs	X	X	X	X	X	X				
HBCU/PBIs	X	X	X	X	X	X	X	X	X	X
AANAPISI/ NHSI/Tribal Colleges	X	X		X	X		X	X		X
Community Colleges	X	X	X	X	X	X	X	X		X
PUIs	X	X		X	X				X	X
CA Institutions			X							X
Accessibility	X						X	X		
ACES			X		X			X		
STEM Mentoring		X								
Early Career		X								

Conclusions

Some targeted Bridge Programs such as the NSF-supported APS Bridge to the Ph.D. program are successfully diversifying the Ph.D. student ranks [1]. Other Bridge Programs have had varying degrees of success [2]. These less successful programs aim to get students to complete their STEM degrees but typically do not address wider issues affecting student success.

The NASA SMD Bridge Program should have degree completion as one of its key goals. However, as was made clear both in the working group discussions and discussions during the workshop, a systems approach is needed to sustain a program that increases the number of STEM graduates from under-represented groups. If a systems approach is adopted and built thoughtfully, the NASA SMD Bridge Program will have a distinctive character that encourages and supports historically excluded institutions to engage with NASA to achieve the goal of transforming the future STEM workforce.

Acronyms and Abbreviations

AANAPISI	Asian American and Native American Pacific Islander-Serving Institutions
NOFO	Announcement of Opportunity
BPWOC	Bridge Program Workshop Organizing Committee
CC	Community Colleges
DACA	Deferred Action for Childhood Arrivals
DEIA	Diversity, Equity, Inclusion, and Accessibility
EEOC	Equal Employment Opportunity Commission
EO	Executive Order
ERG	Employee Resource Group
GPA	Grade Point Average
HBCU	Historically Black College or University
HSI	Hispanic-Serving Institution
LGBTQ	Lesbian, Gay, Bisexual, Transgender, and Queer
MESA	Mathematics, Engineering, Science Achievement
MSI	Minority-Serving Institution
NASA	National Aeronautics and Space Administration
NASNTI	Native American-Serving Nontribal Institution
NHSI	Native Hawaiian-Serving Institution
NSBP	National Society of Black Physicists
PBI	Primarily Black Institution
Ph.D.	Doctor of Philosophy
PM	Presidential Memoranda
PMB	Promotion, Merit, and Bonus
PUI	Primarily Undergraduate Institution
PWI	Primarily White Institution
R1	R1 universities are considered the most organizationally complex and prestigious, with very high research activity as measured by the Carnegie Classification of Institutions of Higher Education
SACNAS	Society for Advancement of Chicanos/Hispanics & Native Americans in Science
SMD	Science Mission Directorate
STEM	Science, Technology, Engineering and Mathematics
STEM TRiO	A reference to a federal student support services program designed to assist first-generation, low-income, and/or disabled students majoring in STEM.

S-STEM National Science Foundation (NSF) Scholarships in Science, Technology, Engineering and Mathematics program that supports low-income STEM students.

TCU Tribal Colleges and Universities

Title III, Part F The Hispanic-Serving Institutions (HSI) STEM and Articulation Programs fund projects to increase the number of Hispanic and other low-income students to attain degrees in the fields of science, technology, engineering and mathematics

URM Under-represented Minority

References

Executive Summary

1. Keels, M. (2019). *Campus counterspaces: Black and Latinx students' search for community at historically White universities*. Cornell University Press.

2. Bedi, G., Van Dam, N.T., & Munafo, M. (2012). Gender inequality in awarded research grants. *Lancet*, *380* (9840), 474. https://doi.org/10.1016/S0140-6736(12)61292-6

3. de Winde, C. M., Sarabipour, S., Carignano, H., Hainer, S., Ilangovan, V., Jadavji, N., ... & Ólafsdóttir, F. (2020). Towards inclusive funding practices for early career researchers. *Journal of Science Policy & Governance*, *18* (1), https://doi.org/10.38126/JSPG180105

4. Aloisi, A., & Reid, N. (2020). (Un) conscious bias in the astronomical profession: Universal recommendations to improve fairness, inclusiveness, and representation. *Astro 2020 Decadal Survey*, 13. *arXiv preprint arXiv:1907.05261*

5. Urquhart-Cronish, M., & Otto, S,P. (2019). Gender and language use in scientific grant writing. *FACETS 4*., 442–458. doi:10.1139/facets-2018-0039

Introduction

1. National Academies of Sciences, Engineering, and Medicine. (2021). *Pathways to Discovery in Astronomy and Astrophysics for the 2020s*. The National Academies Press. https://doi.org/10.17226/26141

2. American Physical Society, Education and Diversity. (n.d.). *Promoting People in Physics*. https://www.aps.org/programs/education/statistics/upload/140715-URM-Producers.pdf

3. Stassun, K.G. (2003, January). CSMA to host special session in Seattle on role of minority serving institutions. *Spectrum*, Jan-2003. https://aas.org/sites/default/files/2019-09/spectrum_Jan03.pdf

4. National Aeronautics and Space Administration, (n.d.). Mission equity: *2022 NASA equity action plan*. https://www.nasa.gov/sites/default/files/atoms/files/nasa_-_equity_report_-_v8.pdf

NASA Opportunities and Gaps

1. U.S. Equal Employment Opportunity Commission. (n.d.). *National Aeronautics and Space Administration (NASA)*. https://www.eeoc.gov/federal-sector/national-aeronautics-and-space-administration-nasa

2. National Aeronautics and Space Administration, Office of Diversity and Equal Opportunity. (n.d.). *Model equal employment opportunity program status report: FY 2021*. https://www.nasa.gov/sites/default/files/atoms/files/odeo-fy21_model_715_report_tagged.pdf

3. Batchelor, R. L., Ali, H., Gardner-Vandy, K.G., Gold, A.U., MacKinnon, J.A., & Asher, P.M. (2021, April 19). "Reimagining STEM workforce development as a braided river." *Eos*, *102*. https://doi.org/10.1029/2021EO157277

Hispanic-Serving Institutions

1. U.S. Bureau of Labor Statistics (n.d.). "Employment projections: Employment in STEM occupations." https://www.bls.gov/emp/tables/stem-employment.htm

2. Fry, R., Kennedy, B., & Funk, C. (2021, April 1). "STEM jobs see uneven progress in increasing gender, racial and ethnic diversity." Pew Research Center. https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity

3. Santiago, D. (2009, September 16). "Enrolling vs. serving Latino students." *Diverse Issues in Higher Education*. https://www.diverseeducation.com/demographics/latinx/article/15089007/enrolling-vs-serving-latino-students

Historically Black Colleges and Universities(HBCU) and Primarily Black Institutions (PBI)

1. Institute for Education Sciences, National Center for Education Statistics. (n.d.) "Fast facts: Historically black colleges and universities."

2. New America. (2015, January 21). "Predominantly black institutions: A background primer." https://www.newamerica.org/post-secondary-national-policy-institute/our-blog/predominantly-black-institutions-pbis/

Community/Two-Year Colleges

1. Aspen Institute. (n.d.). "Role of community college." https://www.aspeninstitute.org/programs/workforce-strategies-initiative/role-community-college

2. American Association of Community Colleges. (n.d.). "Fast facts 2023." https://www.aacc.nche.edu/wp-content/uploads/2023/03/AACC2023_FastFacts.pdf

3. Carnevale, A.P., Van Der Werf, M., Quinn, M. C., Strohl, J., & Repnikov, D., (2018) "Our separate & unequal public colleges: How public colleges reinforce white racial privilege and marginalize Black and Latino students." Georgetown University, Center on Education and the Workforce. https://cew.georgetown.edu/wp-content/uploads/SAUStates_FR.pdf

4. Sublett, C., & Taylor, J., (2021). "Net tuition, unmet financial need, and cooling out: A national study of degree aspirations among first-time community college students." *Community College Review*, *49* (4), 389–412.

5. Chen, X. (2013). "STEM attrition: College students' paths into and out of STEM fields: Statistical analysis report." National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. https://nces.ed.gov/pubs2014/2014001rev.pdf

6. Varty, A.K. (2022, June 1). "Promoting achievement for community college STEM students through equity-minded practices." *CBE—Life Sciences Education*, *21* (2). https://doi.org/10.1187/cbe.21-09-0237

7. Foley, D., Milan, L., & Hamrick, K. (2021, January 27). "The increasing role of community colleges among bachelor's degree recipients: Findings from the 2019 national survey of college graduates." *NSF 21-309*. *National Science Foundation, National Center for Science and Engineering Statistics*. https://ncses.nsf. gov/pubs/nsf21309

8. Snyder, J., & Cudney, E.A., (Eds.) (2018). "A retention model for community college STEM students." ASEE Annual Conference & Exposition. https://peer.asee.org/29719 doi:10.18260/1-2—29719

9. Chamely-Wiik, D., Frazier, E., Meeroff, D., Merritt, J., Johnson, J., Kwochka, W.R., Morrison-Shetlar, A.I., Aldarondo-Jeffries, M., & Schneider, K.R. (2021). "Undergraduate research communities for transfer students: A retention model based on factors that most influence student success." *Journal of the Scholarship of Teaching and Learning*, *21* (1), 193-224. doi:10.14434/josotl.v21i1.30273

10. Maroto, M.E., Snelling, A., & Linck, H. (2015). "Food insecurity among community college students: Prevalence and association with grade point average." *Community College Journal of Research and Practice*, *39* (6), 515–526. doi:10.1080/10668926.2013.850758

11. David, K.M., Lee, M.E., Bruce, J.D., Coppedge, B.R., Dickens, D., Friske, J., Hall, A.J., Singleton, M., Swicegood, J., & Thorman, J. (2013). "Barriers to success predict fall-to-fall persistence and overall GPA among community college students." *Journal of Applied Research in the Community College*, *21* (1), 5-13. https://www.questia.com/library/journal/1P3-3536800541/barriers-to-success-predict-fall-to-fall-persistence

12. Wickersham, K., & Wang, X. (2016). "What's life got to do with it? The role of life experiences in shaping female community college students' transfer intent in STEM fields of study." *Community College Journal of Research and Practice*, *40* (12), 1001-1012. doi:10.1080/10668926.2016.1211039

Primarily Undergraduate Institutions (PUI)

1. Slocum, R. D., & Scholl, J. D. (2013). "NSF support of research at primarily undergraduate institutions (PUIs)." *Council on Undergraduate Research Quarterly*, *34* (1), 31-40. https://link.gale.com/apps/doc/A341132822/AONE?u=vol_oweb&sid=googleScholar&xid=d9ef11ac

2. McGrath, C., Francovich, C., Smieja, J. A., Cronin, C., Lacueva, G., Sabin, R. E., ... & Zhong, X. (2019). "Building a framework to advance the careers of women in STEM at predominantly undergraduate institutions." *ADVANCE Journal*, *1* (2). DOI.org/10.5399/osu/ADVJRNL.1.2.1

3. National Science Foundation. (2023). "Diversity and STEM: Women, minorities, and persons with disabilities 2023." NSF 23-315. https://ncses.nsf.gov/pubs/nsf23315/

4. Giuliano, T. A., Kimbell, I. E., Olson, E. S., & Howell, J. L. (2022). "High impact: Examining predictors of faculty-undergraduate coauthored publication and presentation in psychology." *PLOS ONE*, *17* (3). https://doi.org/10.1371/journal.pone.0265074

California Programs and Institutions

1. Cal Poly Pomona. (n.d.). "About: Program success." https://www.cpp.edu/calbridge/about/ program-success.shtml

Accessibility

1. Congress.Gov. (n.d.). "S.933 - Americans with disabilities act of 1990." https://www.congress.gov/bill/101st-congress/senate-bill/933

2. National Aeronautics and Space Administration, (n.d.). "NASA strategic plan for diversity, equity, inclusion & accessibility." https://www.nasa.gov/sites/default/files/atoms/files/nasa_deia_strategic_plan-fy22-fy26-final_tagged.pdf

3. Fenley, N., (2022, January 4). "11 HBCUs awarded the coveted R2 status in the new Carnegie Classification update." *Blavity News & Politics*. https://blavity.com/10-hbcus-awarded-the-coveted-r2-status-in-the-new-carnegie-classification-update?category1=news

STEM Mentoring

1. Dahlberg, M. L., & Byars-Winston, A. (Eds.) (2019). "The science of effective mentorship in STEMM." The National Academies of Science, Engineering, Medicine. https://doi.org/10.17226/25568

2. Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Early Career Perspectives

1. Cann, J., & Martinez, A. (2022). Unpublished raw data on Early Career Perspectives. National Aeronautics and Space Administration, Science Mission Directorate, Bridge Program, Early Career Perspectives Working Group.

2. Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Conclusion

1. Vega, L. (2022, April 9-12). "The APS Bridge Program and my journey to the PhD." [Conference Presentation, Abstract L05.00001]. *APS April Meeting Abstracts*, *67* (6). https://meetings.aps.org/Meeting/APR22/Session/L05.1

2. Bradford, B. C., Beier, M. E., & Oswald, F. L. (2021, April 15). "A meta-analysis of university STEM summer bridge program effectiveness." *CBE—Life Sciences Education*, 20 (2), ar21. https://doi.org/10.1187/cbe.20-03-0046

Acknowledgements

This report was created with the collective collaboration of the following individuals and does not reflect the opinion of any specific individual.

Dr. Vemitra White-Alexander	NASA, Marshall Space Flight Center
Lalitha B. Balachandran	University of California, Santa Cruz/NASA Intern
Amethyst Barnes	Florida Institute of Technology
Dr. Kim Barnette	Logistics Management Institute
Dr. Jillian Bellovary	City University of New York
Dr. Breanna Binder	Cal Poly Pomona
Claudia Bolanos	NASA, Intern
Dr. Patricia Boyd	NASA, Goddard Space Flight Center
Tremaine Brittian	American Physical Society
Dr. Sara Callori	California State University, San Bernardino
Dr. Jenna Cann	NASA, Goddard Space Flight Center
Teresa Ciardi	College of the Canyons
Dr. Clayton J. Clark II	North Carolina A&T University
Dr. Lynn Cominsky	Sonoma State University
Lakiesha Cooper	Logistics Management Institute
Dr. Antonini Cucchiara	NASA, Headquarters
Dr. Michael Davis	National Science Foundation
Sara Doan	George Mason University
Dr. Ronald Gamble	NASA, Goddard Space Flight Center
Dr. Noel Gardner	Jackson State University
Shawn Domagal-Goldman	NASA, Goddard Space Flight Center
Rick Gilmore	NASA, STEM Engagement, Performance & Evaluation

Edward Gonzales	NASA, Goddard Space Flight Center
Dr. Andrew Grillo-Hill	WestEd
LaChel House	Logistics Management Institute
Bri Hart	American Physical Society
Dr. Carol Hood	California State University, San Bernardino
Dr. Feyi Ilesanmi	Missouri Department of Natural Resources
Dr. Regina Jorgenson	Maria Mitchell Observatory
Dr. Margaret Lazzarini	California Institute of Technology (CalTech)
Natasha Latouf	George Mason University
Tiffany Kelly	Logistics Management Institute
Dr. Arturo O. Martinez	Bay Area Environmental Research Institute/NASA Ames
Dr. Raquel Martinez	University of California, Irvine
Dr. Kavita Mittapalli	MN Associates
Dr. Teresa Monsue	NASA, Goddard Space Flight Center/CUA
Dr. Rodolfo Montez	Center for Astrophysics/ Harvard & Smithsonian
Dr. Carl Moore, Jr.	Florida A&M/Florida State University
Dr. Christopher Moore	Center for Astrophysics/Harvard & Smithsonian
Jeremias R. Nunez	George Washington University/NASA Intern
Dr. Jesus Pando	DePaul University
Lt. Col.Carlos Pinedo, Ph.D.	U.S. Air Force Test Pilot School
Dr. Maggie Potter	Jet Propulsion Laboratory
Dra. Nicole Cabrera Salazar	Movement Consulting
Dr. Alvin Smith, II	Jet Propulsion Laboratory
Dr. Marianne Smith	Oak Crest Institute of Science
Ruth Starr	Logistics Management Institute

Dr. Amy Steele	McGill University
Dr. Tara Strang	NASA, STEM Engagement, Performance & Evaluation
Joshua Valcarcel	WestEd
Michael Wangler	Chaffey College
Dr. Alyssa Whitcraf	University of Maryland
Dr. Katy Rodriguez Wimberly	University of California, Riverside
Dr. Nicolle Zellner	NASA, Headquarters/ Albion College

Appendices

Appendix 1: Relevant Executive Orders and Presidential Memoranda

- EO 13985: EO on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (Jan. 20, 2021)
- EO 13988: EO on Preventing and Combating Discrimination on the Basis of Gender Identity or Sexual Orientation (Jan. 20, 2021)
- EO 14020: EO on Establishment of the White House Gender Policy Council (March 8, 2021)
- EO 14031: EO on Advancing Equity, Justice, and Opportunity for Asian Americans, Native Hawaiians, and Pacific Islanders (May 28, 2021)
- EO 14035: EO on Diversity, Equity, Inclusion, and Accessibility In the Federal Workforce (June 25, 2021)
- PM Condemning and Combating Racism, Xenophobia, and Intolerance Against Asian Americans and Pacific Islanders in the United States (Jan. 26, 2021)
- PM on Tribal Consultation and Strengthening Nation-to-Nation Relationships (Jan. 26, 2021)

Appendix 2: SMD Bridge Program Workshop Sessions

Table A2.1: Schedule of the SMD Bridge Program Workshop Sessions

<table>
<tr><th>Monday
October 17, 2022</th><th>Tuesday
October 18, 2022</th><th>Wednesday
October 19, 2022</th><th>Thursday
October 20, 2022</th><th>Friday
October 21, 2022</th></tr>
<tr><td>Introduction to the SMD Bridge Program Workshop</td><td>Framing the Day: DEIA</td><td>Framing the Day: STEM Mentoring</td><td>Framing the Day: Academia and STEM Production</td><td>Opening Remarks</td></tr>
<tr><td>SMD Statement on the Bridge Program</td><td>Breakout Session I: Capacity Building and Professional Societies</td><td>Break-out Session I: Early Career Perspectives</td><td rowspan="6">Break-out Session I: (Parallel Sessions):
1) Historically Black Colleges and Universities & Primarily Black Institutions
2) Hispanic-serving Institutions
3) Asian American and Native American Pacific Islander-Serving Institutions, Native Hawaiian-serving Institutions, Tribal Colleges and Universities, and Native American Serving Nontribal Institutions</td><td>Reporting Out: Professional Societies and Capacity Building</td></tr>
<tr><td>Icebreaker</td><td rowspan="6">Break-out Session II: (Parallel Sessions):
1) Community Colleges
2) Accessibility
3) California Programs and Institutions
4) Primarily Undergraduate Institutions</td><td rowspan="2">Break-out Session II: STEM Mentoring</td><td>Reporting Out: Early Career Perspectives</td></tr>
<tr><td>Expectations and Goals for the Workshop/Q&A</td><td>Reporting Out: Evidence-based Program Design: Beyond the Metrics</td></tr>
<tr><td rowspan="3">Emerging NASA DEIA Programs and Efforts</td><td rowspan="4">Break-out Session III: (Parallel Sessions)
1) Community Colleges
2) Accessibility
3) California Programs and Institutions
4) Primarily Undergraduate Institutions</td><td>Reporting Out: STEM Mentoring</td></tr>
<tr><td>Reporting Out: Community Colleges</td></tr>
<tr><td>Reporting Out: Accessibility</td></tr>
<tr><td>Existing Bridge Programs</td><td>Breakout Session II: Capacity Building and Professional Societies</td><td>Reporting Out: California Programs and Institutions</td></tr>
</table>

Monday October 17, 2022	Tuesday October 18, 2022	Wednesday October 19, 2022	Thursday October 20, 2022	Friday October 21, 2022
Introduction of the Working Groups	Break-out Session III: Early Career Perspectives			Reporting Out: Primarily Undergraduate Institutions
Break-out rooms: overview & expectations: discussion norms, zoom etiquette, etc.		Break-out Session IV: (Parallel Sessions) 1) Historically Black Colleges and Universities & Primarily Black Institutions 2) Hispanic-serving Institutions 3) Asian American and Native American Pacific Islander-serving Institutions, Native Hawaiian-serving Institutions, Tribal Colleges and Universities, and Native American-serving Nontribal Institutions	Break-out Session III: STEM Mentoring	Reporting Out: Historically Black Colleges and Universities and Primarily Black Institutions
	Breakout Session IV: NASA Centers' Existing Programs: Opportunities and Gaps			Reporting Out: Hispanic-serving Institutions
Break-out Session I: Setting the Stage: Evidence-based Program Design: Beyond the Metrics			Breakout Session IV: NASA Centers' Existing Programs: Opportunities and Gaps	Reporting Out: Asian American and Native American Pacific Islander--serving Institutions, Native Hawaiian-serving Institutions, Tribal Colleges and Universities, and Native American-serving Nontribal Institutions
				Reporting Out: NASA Centers Existing Programs
Closing Remarks	Closing Remarks	Closing Remarks	Closing Remarks	Closing Remarks

Appendix 3: STEM Mentoring Resources

The quality of mentorship varies widely across the academy. Strong positive mentorship helps develop students into scientists and negative or absent mentorship can drive students out of STEM. Mentor training is not common in the professional development of students, scientists, researchers, and faculty. The emphasis of the working group on STEM Mentoring has focused on identifying positive mentoring practices and mentor training resources. In this document are the results of the working group's activities.

National Academies Report on Mentoring

A major report released by the National Academies (The Science of Effective Mentorship in STEMM (2019); https://nap.nationalacademies.org/catalog/25568/the-science-of-effective-mentorship-in-stemm) lays out the importance of effective mentoring and provides a variety of information, resources, and tools to develop and implement strong positive mentoring relationships. The report also includes a list of recommendations and action items for various personnel at all administrative and departmental levels at institutions of higher learning. Many of these recommendations and activities are broadly applicable to any research environment. A complementary interactive guide online guide (The Science of Effective Mentorship in STEMM: Online Guide V1.0; https://nap.nationalacademies.org/resource/25568/interactive/index.html) is also available and provides references and access to the decade-long effort of the National Academies working group.

The NASA SMD Working Group on STEM Mentoring highly recommends that bridge sites consider mentoring recommendations and practices outlined in the National Academies report. The National Academies recommendations are listed below and more information can be found here:

1. Adopt an Operational Definition of Mentorship in STEMM
2. Use an Evidenced-based Approach to Support Mentorship
3. Establish and Use Structured Feedback Systems to Improve Mentorship at All Levels
4. Recognize and Respond to Identities in Mentorship
5. Support Multiple Mentorship Structures
6. Reward Effective Mentorship
7. Mitigate Negative Mentorship Experiences

There are additional recommendations for Funding Agencies that Support Mentorship and Scholars of Mentorship. Similar best-practices can be found throughout advising and mentoring initiatives at various institutions, e.g., Harvard's The Advising Project.

Mentoring Resources

The NASA SMD Bridge Program Working Group on STEM Mentoring compiled a list of popular mentor training resources developed and practiced by various institutions and centers. Brief overviews are provided to give the reader a starting point on the variety of resources along with an estimate on the investment of time for a given resource, the intended audience, and access. Although we include the intended audience (undergraduate/graduate, faculty, etc.), the knowledge in the resource can often be adapted (with careful thought) to many audiences.

Center for the Improvement of Mentored Experiences in Research (CIMER; https://cimerproject.org)

CIMER's Entering Mentoring

https://cimerproject.org/entering-mentoring

Time Investment: two hours to 8 weeks (full course)

Format: PDF guidebook for facilitating up to 8-week training courses. Courses are subject-specific (i.e. astronomy, physics, chemistry, engineering, etc.) and customizable. The guidebook includes instructions for facilitating activities for participants, which include writing exercises, pair/group discussions, and share-outs. CIMER is also available to lead these workshops.

Audience: Mentors of undergraduate students (but could be applicable for more senior students, the material is quite general)

Access: free download with sign-up.

Key Content: The main topics include Establishing Expectations, Maintaining Effective Communication, Assessing Understanding, Fostering Independence, Addressing Diversity, and Dealing with Ethics.

CIMER's Entering Research

https://cimerproject.org/entering-research/

Time Investment: Single day to semester (10-15 weeks) long experiences

Format: 96 activities targeting seven areas of trainee development and organized into 10-15 week long courses to be implemented as trainees engage in research. Organized into one 10-week course for summer undergraduates research students and three 15 week-long courses for novice undergrad, intermediate undergrad, and novice graduate students. Some components can be implemented as stand-alone workshops. CIMER also provides mentee training as well as facilitator training.

Audience: undergraduate and graduate research trainees

Access: free download with sign-up

Key Content: Research trainee development in seven areas: 1) Research Comprehension & Communication Skills; 2) Practical Research Skills; 3) Research Ethics; 4) Researcher Identity; 5) Researcher Confidence & Independence; 6) Equity & Inclusion Awareness & Skills; 7) Professional & Career Development Skills

CIMER's Mentoring Up (post-doc track)

https://cimerproject.org/mentoring-up/

Time Investment: 1-3 days (can be spread out over a longer period of time)

Format: workshop or series

Audience: mentee, postdoc

Access: free with sign-up

Key Content: Material focuses on building communication skills for graduate students to get the most out of their mentoring relationships. Encourages building self-advocacy and research independence. Included facilitation notes, exercises, and tools to develop the skills.

University of Michigan: Graduate Students Mentoring Guide: A Guide for Students

https://rackham.umich.edu/downloads/student-mentoring-handbook.pdf

Time Investment: About an hour without reading references/doing personal Q&A

Format: Student mentoring handbook provided by U of Michigan, has student resources and a student Q&A section

Audience: First-year graduate students learning the tenants of good mentorship and what to expect from a mentor

Access: public

Key Content: Outlines how a student should build their mentorship community, and the important tenants for fulfilling mentorship (task/instrumental, psychosocial, networking support). Also addresses pathways to navigate issues with department chair and/or mentors, and how to make a change if necessary.

How to Mentor Graduate Students: A Guide for Faculty

https://rackham.umich.edu/downloads/how-to-mentor-graduate-students.pdf

Time Investment: ~1.5 hour to read, suggests some introspection, working with mentee to develop shared expectations which would probably take an additional ~1 hr each

Format: Handbook, appendices with exercises, self-guided

Audience: Faculty taking on a new (graduate student) mentee, to a small extent program coordinators

Access: public

Key Content: Utilizes broader definition of mentor (vs. advisor); motivates and suggests key qualities mentors should have and/or develop; example practices and implementations from different departments (mentor matching, progress reports, professional development); Example templates for the mentor and mentee to develop shared expectations, catered to different disciplines and multiple mentors; bibliography; campus resources.

University of Minnesota's Mentoring Excellence Training Academy

https://ctsi.umn.edu/training/mentors/mentor-training

Time Investment: 3 sessions of 2 hours each or a self-paced 4 session format for non-UM personnel. Additional online courses available

Format: online virtual courses

Audience: Faculty in health or biological sciences or those in clinical and translational research

Access: open to both UM and non-UM participants with sign-up (may cost)

Key Content: aligning expectations; maintaining effective communication; addressing equity/inclusion; promoting professional development. Different workshops for those mentoring graduate students/undergraduate students. Additional workshop based on the national CARES Mentoring model with focus on addressing the effects of poverty in the Black community.

Fisk-Vanderbilt Masters-to-PhD Bridge Program Guidebook

(specifically, Chapter 4, "Mentoring and Community Building") https://www.fisk-vanderbilt-bridge.org/toolkit

Time Investment: 1-2 hours of self-study

Format: page 14-24 of the Guidebook, with a logic model, philosophy, tools, and resources

Audience: Practitioners of Bridge-like programs

Access: in addition to the Guidebook (above), the Toolkit for Practitioners can be obtained by completing an online request form

Key Content: Fisk-Vanderbilt Bridge Program employs a proactive and intentional approach to mentoring that utilizes established check-in points, broad confidential communication, and building a student's mentoring network. The Guidebook highlights their mentoring, academic, career, and community support.

CalBridge Mentoring Handbook

(specifically, "Best Practices for a Successful Mentor-Scholar Relationship" subsection): GoogleDrive Link

Time Investment: Less than one hour without following additional links

Format: pages 6 - 24 of the CalBridge handbook, webpages with links to additional resources

Audience: Faculty who are becoming mentors of URM and first-gen undergraduates and the undergraduate mentees

Access: public

Key Content: CalBridge uses a networked support mentoring model in which mentees can choose to join groups with specific emphasis on an as needed basis. Subjects include: Compassion, Power Imbalances & Harassment, Mental Health, Recommended Coursework and Degree of Difficulty, Study Habits and Exam Anxiety, Imposter Syndrome and Growth Mindset, Family and Relationship Pressures, Culture Shock

Mentoring Compacts

Mentoring compacts are a highly customizable approach for mentors and mentees to provide clear expectations and procedures. The National Academies' points to a few examples in their Tools and Resources section of the Online Guide: https://nap.nationalacademies.org/resource/25568/interactive/tools-and-resources.html#section

Appendix 4: Evidence-based Program Design

Rick Gilmore, M.Ed.

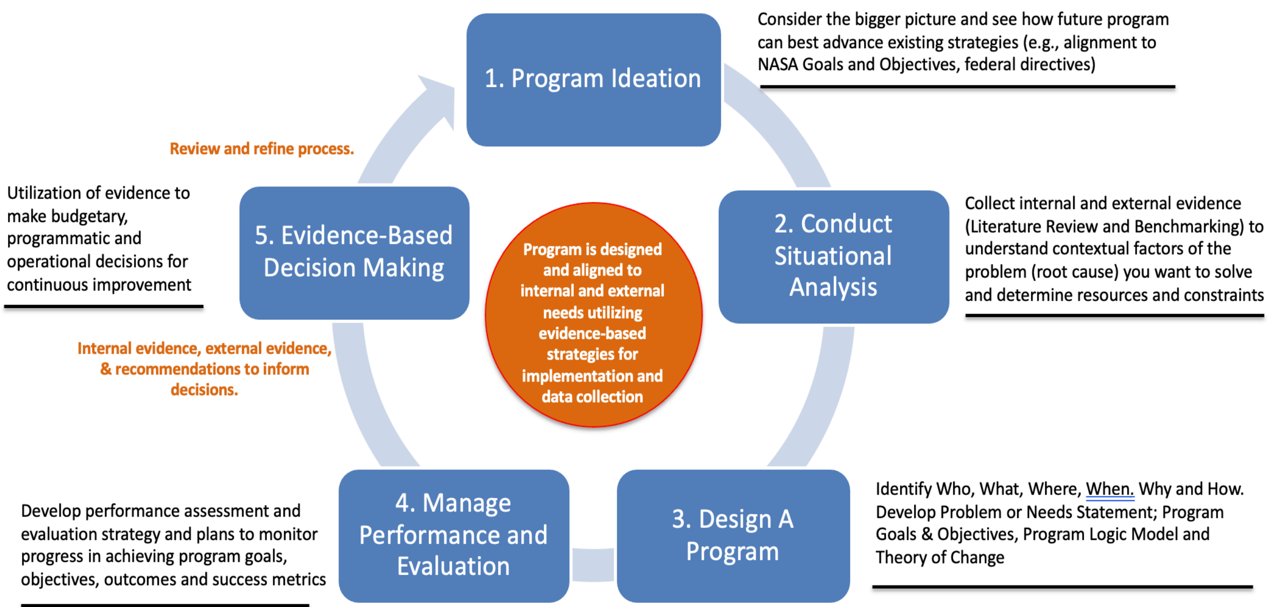
Performance Assessment and Evaluation Program Manager

Introduction

The overall success of the NASA Science Mission Directorate (SMD) Bridge Program is rooted in having a sound program design that is aligned to internal and external needs and utilizes evidence-based strategies for implementation, data collection, and management of performance and evaluation activities. Program design includes planning the environment and experience for a targeted audience to achieve strategic goals and objectives. Performance and evaluation management enables the ability to assess the extent to which 1) the program is working and why, 2) achievement of strategic goals and objectives, and 3) impact and outcomes of the program.

The Evidence-based Program Design Process (Figure A4.1) will help SMD Bridge Program Leadership and Working Groups strategically design the overall program and its activities in an effective manner that advances existing strategies aligned to federal and NASA goals, objectives, and directives

Figure A4.1: Evidence-based Program Design Process



.

STEP 1: Program Ideation

The SMD Bridge Program should take time to consider the bigger picture and to see how the future program can best advance existing strategies. In addition to Science Mission Directorate (SMD) strategies, goals and objectives, the following strategic documents highlight guidance, strategies, goals, and objectives that should as be considered:

- Executive Order on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (EO 13985)
- NASA Strategic Plan 2022

- 2022 NASA Equity Action Plan
- NASA Strategy for STEM Engagement
- CoSTEM 5-Year Strategic Plan
- Evidence-Based Policy Making Act of 2018

STEP 2: Conduct Situational Analysis

After assessing how best to advance existing strategies, the next step is to conduct a situational analysis. A situational analysis is a comprehensive review of the current state or conditions surrounding the program idea that could affect its design, implementation, or outcome. The SMD Bridge Program should collect internal and external evidence to understand the past and present contextual factors of the problem (root cause) you want to solve and determine resources and constraints. Strategies to collect this evidence include a literature review and benchmarking study which will inform your program problem statement, goals and objectives, and logic model. A literature review is a systematic review of scholarly sources (such as books, journal articles, and theses) related to a specific topic or research question to identify evidence-based practices that support proposed SMD Bridge Program. A benchmarking study is an evidence-based process seeking processes, best practices, strategies, and performance metrics from successful examples for comparison to SMD Bridge Program among organization peers and industry leaders to enhance good practices.

STEP 3: Design A Program

This next step in the process involves developing the problem or needs statement by identifying Who (audience, beneficiaries, and key stakeholders), What (scope and scale of issue), Where (geographic or specific location of the issue or problem), When (context, timing of issue or problem), Why (root causes of the issue, cultural impact, norms, and factors surrounding the issue), and How (issue affects beneficiary or stakeholder). It also involves developing program goals and objectives followed by the development of a program logic model and theory of change.

STEP 4: Manage Performance and Evaluation

In order to monitor progress in achieving program goals, objectives, outcomes, and success metrics, developing an overall performance assessment and evaluation strategy/plan is next. This strategy/plan defines the types of data/information (i.e., quantitative, qualitative, or mixed methods) needed to best meet program needs and federal program performance and evaluation guidance. The Office of Management and Budget (OMB) has established a federal website (www.evaluation.gov) that brings together the plans and activities that drive evaluation efforts across the federal government. This website also provides agency evidence plan information (e.g., learning agendas, capacity assessments, and annual evaluation plans) and resources.

STEP 5: Evidence-based Decision Making

The evidence-based decision-making process presented in Figure A4.2, below, should be employed to facilitate the use of the portfolio of evidence generated from executing the performance and evaluation strategy/plan to inform budgetary, policy, programmatic, and operational decisions. This process was created after reviewing government and agency policies and priorities and evidence-based decision-making documents of NASA and other federal agencies and private organizations.

The process steps include Stakeholder Engagement (Relevant stakeholders gather to identify the decisions to be made and how decisions align with overall strategic goals), Data Review (Critical analysis of internal evidence, external evidence, & recommendations), Communication Findings (In support of transparency and accountability, communicate findings-analysis of evidence), Facilitate Decision Discussions (Use evidence to help facilitate discussions

Figure A4.2: Evidence-Based Decision Making

with stakeholders to make decisions), and Review and Refine Process (Once decisions have been made, the process should be critically evaluated to identify opportunities for improvement).

Key Thematic Areas

The Evidence-Based Program Design Process described above was reviewed during the SMD Bridge Program Workshop with SMD Bridge Program Leadership, Working Groups and Stakeholders. Two concurrent breakout sessions (up to 41 participants in Breakout 1 and 36 in Breakout 2) were conducted to model elements of STEP 3: Design A Program (i.e., development of program goals and objectives and develop a program logic model) capturing participant input and findings on these elements as well as needs/concerns and key elements for the SMD Bridge Program using Google forms.

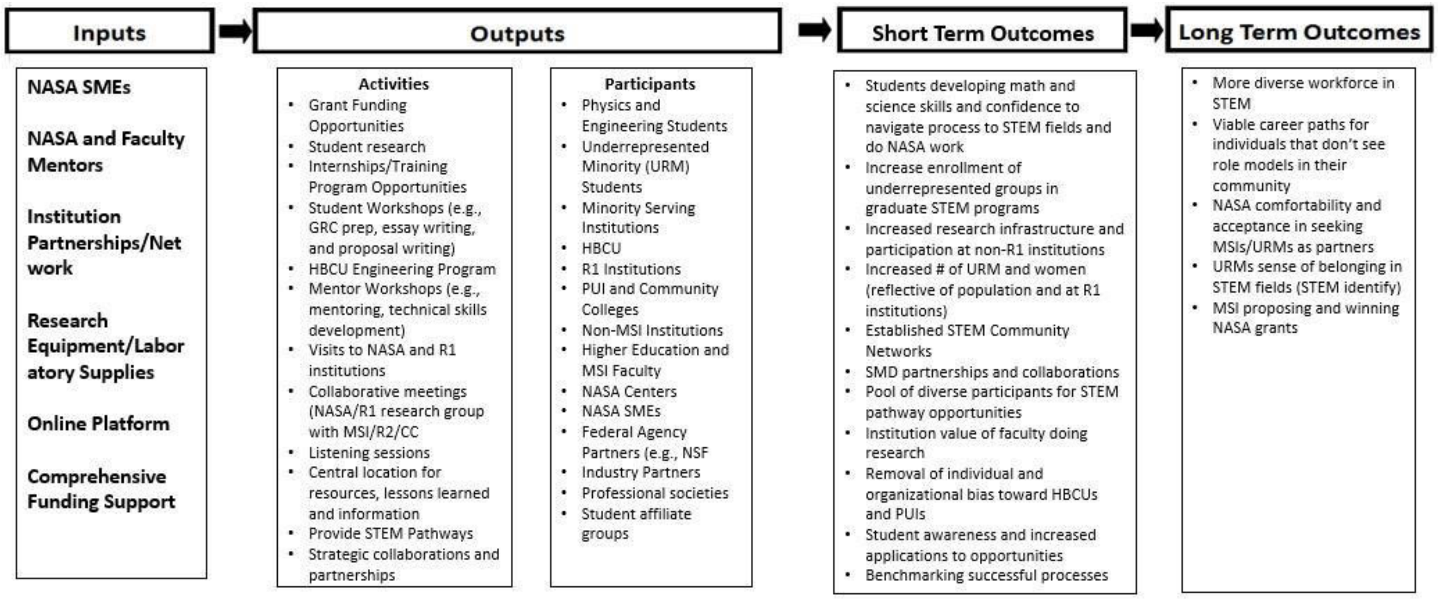
The input captured regarding suggestions on goals and objectives for the SMD Bridge Program were coded producing the themes in Figure A4.3, below.

Figure A4.3: Input from Workshop Participants

Goals:	Objectives:
• Broadening Participation	• Provide/Increase research/employment opportunities for students
• Institutions	• Support for faculty (capacity building, proposal training)
• Attract, Train, Support, Retain	• Reduce barriers for MSIs to bid on proposals
• Sense of Belonging	• Supports for students
• STEM Pathways	• System for measuring progress towards goals

The following draft logic model (Figure A4.4) was developed based on participant input and findings on inputs, outputs, short-term outcomes and long-term outcomes of the SMD Bridge Program.

Figure A4.4: Draft Logic Model



The input captured regarding suggestions on needs/concerns, findings, and key elements for the SMD Bridge Program were coded producing the themes below.

Needs/Concerns:

- Increase consultation efforts with external partners/organizations institutions
- Improve organizational infrastructure/funding
- Improve support services
- Program evaluation design
- Tailored outreach efforts to increase access/awareness

Recommendations:

- Increase partnership with external organizations/professionals
- Implement well and evaluate
- Improve support services for participating institutions
- Tailored outreach efforts

Key Elements:

- Securing resources
- Outcome measures
- Capacity building

Findings in line with Guiding Principles

In line with the core tenants of the NASA SMD Bridge Program, the following findings are presented for consideration.

- Complete elements of **STEP 1: Program Ideation** of the Evidence-based Program Design Process – Review and document relevant federal and NASA goals, objectives and directives that the SMD Bridge Program will support and advance
- Complete elements of **STEP 2: Situational Analysis** of the Evidence-based Program Design Process – Conduct a literature review and benchmarking study to align SMD Bridge Program to evidence-based practices and strategies for implementation and performance and evaluation management

- Complete elements of **STEP 3: Design a Program** of the Evidence-based Program Design Process
    - Develop Problem or Needs Statement
    - Review program goals and objective themes above in order to establish and document the final set of SMD Bridge Program goal(s) and objective(s)
    - Review draft SMD Bridge Program Logic Model in order to finalize the inputs, outputs (i.e., activities and participants), short-term and long-term outcomes of the SMD Bridge Program Logic Model
    - Develop a Theory of Change

- Complete elements of **STEP 4: Manage Performance and Evaluation** of the Evidence-based Program Design Process
    - Identify a Third-Party Evaluator to develop a performance and evaluation strategy/plan for the SMD Bridge Program
    - Develop performance and evaluation requirements for the SMD Bridge Program Announcement of Opportunity (NOFO)

- Review and commit to strategically execute elements of **STEP 5: Evidence-based Decision Making** Process and continuous improvement
- Leverage NASA's Office of STEM Engagement (OSTEM) projects, STEM content, and expertise to support development and implementation of the SMD Bridge Program.