principles of the federal agencies. The astronomical community will ultimately be responsible for the acceptance and implementation of these values; they cannot be successfully implemented if deployed in a "top down" fashion.[82] *The hope is that the Profession moves forward from the challenges of 2020 with a collective commitment to equity and scientific excellence, a clear plan as laid out in the following suggestions, and benchmarks for progress that can be evaluated in the future.*

N.6 GOALS AND SUGGESTIONS

The panel's overarching goal is to invigorate the Profession through training and workplaces that reflect equity-advancing values and allow the full human diversity of the nation to meaningfully and maximally contribute to the field. The panel's suggestions regarding the state of the Profession are situated within the current landscape and are intended to be actionable within the decade. As is typical for a decadal survey, the primary actors for most of these recommendations are the funding agencies that sponsored Astro2020. However, the panel also includes recommendations for the academic departments, private foundations, observatories, professional societies, government laboratories, and research centers where astronomers work.

In the following sections, the panel presents 7 goals with a total of 18 suggestions considered critical to begin to create a profession that promotes equity-advancing values in order to achieve scientific excellence. Each section follows the same format: first, research findings are presented to motivate each suggestion, and then example methods are provided that can help to carry out the given suggestion, identifying actors, impact, and estimated costs. The findings, suggestions, and methods that are presented in this report are not intended to be prescriptive but may include detail for clarity. Each agency would need to adapt the suggestions to work within their own context to achieve the proposed goals.$$

N.6.1 Goal 1: Collecting, Evaluating, and Acting on Demographic Data

Collect and analyze demographic data wherever astronomy research, education, or training is conducted and create internal agencies or society offices to review data and suggest policy change.

To achieve a diverse and inclusive profession requires a robust mechanism to (1) collect data pertinent to the values the Profession espouses, (2) report those data for transparency and accountability, and (3) use the data to compare outcomes to the desired state and adjust as needed. Without data, it is not possible to fully assess the state of the Profession or determine progress toward desired outcomes.

N.6.1.1 Current Practices in the Collection of Demographic Data

The panel requested data on astronomy-related programs from NASA, NSF, DOE, and management organizations for major astronomical facilities. Demographics of staff, contractors, review panels, proposers, awardees of grants and fellowships, and proposal success rates were also requested. Last, the panel sought data on agency programs and funding to promote broader access to opportunities and reduce barriers to achieving success in the field for underrepresented groups.

Minimal data were produced by the federal agencies. While all three agencies collect some demographic data (gender, race, ethnicity) on staff and applicants for funding, several issues are clear. First, the agencies do not collect and track the same quantity or categories of demographic data. NSF collects demographic information, but publishes it only at the highest level of aggregation, and data on

[82] F. Dobbin and A. Kalev, 2018, Why doesn't diversity training work, *Anthropology Now* 10(2):48–55.

people from underrepresented groups are often suppressed to maintain confidentiality.[83,84] After a 2015 critique by the Government Accountability Office,[85] NASA began collecting additional demographic data through its proposal submission website NSPIRES,[86] but the data are not yet publicly available. The DOE Portfolio Analysis and Management System (PAMS)[87] collects applicant demographic data, but it is not designed for analysis, and separate programs in the Office of Science maintain their own databases. Through their diversity-equity-inclusion website, the DOE Office of Science collects and reports demographic data on laboratory employees, although not on facility users.[88]

Second, the agencies have no consistent policy on releasing information. NASA shared the inferred binary gender of awardees based on given names and provided data on the number of unsuccessful proposals in various programs. By contrast, NSF declined to share information of this type, reserving the data it gathers for use in internal reviews and assessments. Third, even if the requested data were collected, it was not readily available, or the panel had to aggregate the information itself. Last, none of the agencies appear to evaluate the efficacy of programs funded to promote diversity and inclusion.

The panel requested demographic data from two management organizations operating major astronomical facilities for NSF: AURA and AUI. Both show commitment to the equity-advancing values of diversity and inclusion and provided demographic data to measure progress. The AIP Statistical Research Center collects longitudinal data and reports on the demographics and career outcomes of students and faculty in both physics and astronomy programs, such as those presented in Section N.3 above. The difficulties encountered by National Academies committees in gathering demographic data from federal agencies are not new.[89] The panel recognizes that the agencies must comply with a number of statutes and regulations governing the collection and release of data[90] such as that requested by the panel.

N.6.1.2 A Cost-Effective Path Forward

An effective path forward is illustrated by the National Institutes of Health (NIH). For decades, it has collected demographic information from researchers in its external grants program, ~80,000 applications/year, larger than the NASA, NSF, and DOE grants programs combined. The Office of Extramural Research manages the process through its electronics grant system, eRA. Applicants submit demographic data on a voluntary basis. As with NASA, NSF, and DOE, these data are not used in the grant decision-making process. However, unlike NASA, NSF, and DOE, the NIH has aggregated and published applicant data on funded programs in its Data Book[91] for decades while maintaining respondent confidentiality. The U.S. Department of Health and Human Services manages an even larger database—RePORTER. It draws information from databases of funded projects and is used by several major federal agencies.[92]

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[83] The NSF National Center for Science Engineering Statistics, www.nsf.gov/statistics/about-ncses.cfm#service.

[84] Report on Merit Review, 2019, www.nsf.gov/statistics/about-ncses.cfm#service.

[85] "Women in STEM Research: Better Data and Information Sharing Could Improve Oversight of Federal Grant-Making and Title IX Compliance," https://www.gao.gov/products/GAO-16-14.

[86] See nspires.nasaprs.com/external/.

[87] See www.energy.gov/science/office-science-funding/sc-portfolio-analysis-and-management-system-pams.

[88] See https://www.energy.gov/science/diversity-equity-inclusion.

[89] NAS (National Academy of Sciences), 2000, *Federal Funding of Astronomical Research*, 55, Washington, DC: The National Academies Press, www.nap.edu/read/9954/chapter/8#54.

[90] Notably, the Privacy Act of 1974 (P.L. 93-579) and the Paperwork Reduction Act of 1995 (P.L. 96-511).

[91] See report.nih.gov/nihdatabook/.

[92] See exporter.nih.gov/faq.aspx.

In 2011, working in collaboration with the NIH to obtain nonpublic demographic data on *submitted* grants, Ginther et al.[93] identified a significant gap in African American versus white applicant funding levels at the NIH. This result spawned creation of a Working Group on Diversity. Their 2012 report to the NIH[94] created a new Office for Scientific Workforce Diversity,[95] whose Chief Officer reports directly to the NIH Director, and new funding designed to sustain scientists from underrepresented groups.[96] Early reports on the progress made by the new funding for underrepresented groups show promise.[97]

To better utilize its vast amount of data, NIH plans to contract with an existing federal statistical agency to manage and analyze all of its information, including data on its intramural workforce, composition of review panels, and demographic information on submitted grants, not currently included in the Data Book or RePORTER. The federal statistical agency will have the data management expertise and congressional approval to provide high-level analysis and reports on NIH data to the public (such as the National Center for Health Statistics or the Census Bureau). NIH is poised to make significant change through these initiatives listed in its new Strategic Plan for Workforce Diversity.[98]

Goal 1, Suggestion 1: The panel suggests that federal agencies collect, analyze, and make available demographic, career, and workplace data on members of the Profession.

Method, impact, and programmatics and cost to achieve this suggestion:

- **NSF, NASA, DOE**
  - *Method:* Following NIH's lead, the agencies can arrange for an existing statistical federal agency to analyze and report their data for them. All existing data could be handed over now, including demographic data, surveys on workplace environment, training grants, and program assessments. Permission can be obtained from the Office of Management and Budget (OMB) to collect any new data. A shared interagency agreement on data collected will ensure that categories and formats are consistent across agencies, follow OMB standards, and allow for benchmarking progress.
  - *Impact:* Existing data and surveys will be publicly available for analysis, allowing for direct feedback on programs and processes. Effective programs can be expanded or emulated elsewhere to increase impact.
  - *Programmatics:* Achieve by 2025. Cost: $700,000/year for each agency's entire portfolio[99] in order to analyze existing data and establish consistent data collection goals across the agencies as a standard procedure.[100]
- **Academic Departments, Non-Federal Institutions, and Professional Societies**
  - *Method:* Following the recommendations of the AAS Task Force on Diversity and Inclusion in *Astronomy* Graduate Education, astronomy departments form a central data

[93] D.K. Ginther, W.T. Schaffer, J. Schnell, B. Masimore, F. Liu, L.L. Haak, and R. Kington, 2011, Race, ethnicity and NIH research awards, *Science*, 333(6045):1015–1019, pubmed.ncbi.nlm.nih.gov/21852498/.

[94] See https://acd.od.nih.gov/documents/reports/DiversityBiomedicalResearchWorkforceReport.pdf.

[95] See https://diversity.nih.gov/.

[96] See https://www.nih.gov/news-events/news-releases/nih-awards-31-million-enhance-diversity-biomedical-research-workforce, accessed 7 November 2020.

[97] See https://diversity.nih.gov/sites/coswd/files/images/docs/ACD_2019_June_13_Valantine_Wilson_FINAL.pdf.

[98] See diversity.nih.gov/sites/coswd/files/images/2018-06/SWD_StrategicPlan_layout_final_links-508c.pdf.

[99] Based on discussions with relevant actors within NIH, such a service will cost NIH, similar in size to NASA and DOE, a nominal fee of a few hundred thousand dollars annually. NSF may cost even less given their relative size.

[100] Based on discussions with relevant actors within the NIH, this would be a one-time cost for the effort.

collection and analysis unit at a relevant professional society to house their demographic and climate data.

— *Impact:* Institutions can collect and store sensitive demographic and climate data without the risk of *violating* respondents' confidentiality and measure progress toward their diversity and inclusion goals.

— *Programmatics:* Achieve by 2025. Cost: $150,000/year.[101]

Goal 1, Suggestion 2: The panel explicitly suggests that each federal agency consider convening a dedicated office to increase oversight, transparency, and accountability. The offices will use data to document progress toward the realization of equity-advancing values and thereby a Profession that evinces inclusion and workforce diversity.

Method, impact, and programmatics and cost to achieve this suggestion:

- **NSF, NASA, DOE**
  — *Method:* The panel suggests that each agency use this new office to carry out key functions of values-based, equity-advancing management of funds, programs, and assets. This office would regularly update an external advisory board composed of members of the Profession and stakeholders, which could include the Astronomy and Astrophysics Advisory Committee (AAAC).[102] While the specific implementation for each federal agency will depend on its regulatory structure, an example of the methodology an agency might pursue could include: (1) Sponsor annual "town-hall" style events[103] to provide opportunities for members of the Profession to engage with the new agency office. (2) Provide mechanisms for data-driven accountability to ensure that programmatics reflect equity-advancing values that are derived from agency founding documents. For example, by using the demographics gained from partnering with existing federal statistical agencies, the new office can identify and remedy structural inequities in resource allocation and access (including, as it relates to Americans with Disabilities Act [ADA]). (3) Build a set of agency-specific guidelines and procedures that ensure that the Profession engages ethically with all stakeholders.[104]
  — *Impact:* The Profession will gain data-driven insight regarding the realization of values-based equity in the field as evidenced by trends in demographic and other data collected by the agencies.

[101] The panel estimates one FTE society staff person would be needed to manage this effort for all U.S. departments.

[102] See https://www.nsf.gov/mps/ast/aaac/charter.pdf, accessed 24 August 2020.

[103] Ideally, these events would take place at different locations that are representative of the broad array of contexts in which professional astronomy is done, which could be a way to support equitable participation.

[104] The panel has identified a partnership framework, described in the section "Goal 6: Cultivating Local and Global Partnerships," that is gaining traction in scientific and industrial communities. For example, U.S. Endowment for Forestry and Communities, "The Status of Community Based Forestry in the United States," https://www.usendowment.org/the-status-of-community-based-forestry-in-the-united-states/, accessed 24 August 2020; Viswanathan, et al., 2004, "Community-Based Participatory Research: Assessing the Evidence: Summary," *AHRQ Evidence Report Summaries*, https://www.ncbi.nlm.nih.gov/books/NBK11852/, accessed 24 August 2020. A list of internal policies and external resources is provided on *Community Engaged Research* by Ohio State University—Office of Responsible Research Practices, https://orrp.osu.edu/irb/research-participants/community-engaged-research/, accessed 24 August 2020.

— *Programmatics:* To be achieved in 1–5 years. Cost for events: $500,000/year/agency; one-time cost: $250,000/agency.[105] At the time of the National Academies mid-decadal review, sponsoring agencies can have an office in place with a strategic plan and be able to demonstrate progress toward values-based, equity-advancing outcomes and data-driven accountability structures.

N.6.2 Goal 2: Leveraging Power

Leverage funding structures to expand diversity through inclusive workplaces and equitable practices.

Recent National Academies[28] and AIP reports[25] summarize research that shows that science workplace and higher education experiences differ across demographic groups. Individuals with historically marginalized identities report feeling less comfortable than those from dominant groups, and are disproportionately subject to microaggressions, bullying, and harassment to the detriment of their focus and productivity. Conversely, positive mentoring and interpersonal connections built through networking can instill a sense of belonging within the scientific community, ameliorate negative organizational climates, and aid in performance and retention. These findings highlight the significant impact that improving the experience of higher education and the workplace for all scientists can have on excellence in science.

The federal agencies fund basic research nationwide. The organizations that make up the Profession train, promote, and reward astronomers as they advance in their careers. Together the agencies and the Profession can form a powerful partnership to (1) *motivate* the building of equitable and inclusive workplaces and higher education settings; (2) hold each other, as well as members of the Profession *accountable* for engaging in these efforts; and (3) *assess* their progress on this goal.[106]

N.6.2.1 Motivate Individuals to Enhance Effective Mentoring Practices

Individual scientists significantly impact how other community members experience the workplace, most obviously through mentoring.[107] The agencies have uneven requirements for mentoring plans, and the Profession does not adequately train mentors.

Goal 2, Suggestion 1: The panel suggests that federal agencies partner with organizations in the Profession to motivate and support individual PIs to create healthy workplaces, by updating the grants system to require: (1) demonstrated knowledge of evidence-based mentoring practices as well as resources for mentees; (2) reporting and assessment of mentoring built into proposals and reports systems.

Method, impact, and programmatics and cost to achieve this suggestion:

- **NSF, NASA, DOE**

[105] The panel arrived at this cost by estimating three agency representatives and one administrative staff person for each agency. The one-time allocation would support the development of the ethical guidelines and procedures to the field.

[106] Note that AAS is already partnering with SEA Change, which institutes a reward system to encourage positive culture change. The panel's suggestions focus on using the unique resources and position of federal agencies as an additional avenue for this work.

[107] NASEM (National Academies of Sciences, Engineering, and Medicine), 2019, *The Science of Effective Mentorship in STEMM*, Washington, DC: The National Academies Press.

- — *Method:* (1) Require Mentoring Plans (MPs) in all individual grant proposals that include funding for mentees, whether students, postdoctorates, or staff; (2) utilize NIH's National Research Mentoring Network as an educational resource for evidence-based professional development; and (3) devote 2 percent of grants awarded[108] to work on inclusion or broadening participation.
- — *Impact:* Encourages PIs to enhance mentoring skills through self-assessment, planning, and access to resources; improves mentor/mentee relationships.
- — *Programmatics:* No cost. Could be implemented immediately.

- **NSF, NASA, DOE**
  - — *Method:* Make career development of mentees a focus of federally funded programs. (1) Improve graduate programs by (a) giving student stipends to faculty teams within Ph.D. departments charged with reviewing and updating training and mentoring practice, such as NIH's Institutional Predoctoral Training Grants T32[109] and NSF's Research Traineeship Program;[110] (b) engaging institutions to support, assess, and hold accountable research teams to participate in agency-sponsored surveys and assessments of mentoring; and (c) aggregating this data nationwide and longitudinally and reporting to their respective dedicated office to assess the effectiveness of mentoring. (2) Improve development of junior team members through multi-institutional grants, following NASA's Theoretical and Computational Astrophysics Networks model, but requiring explicit mentoring and equity-advancing goals alongside research outcomes.
  - — *Impact:* Encourages researchers to work in teams to proactively support junior researchers; builds mentor networks for trainees and channels for information, support, and professional development; encourages establishment of support and accountability for effective mentoring at the institution and within grant structures; collects survey, demographic, and outcome data to assess programs.
  - — *Programmatics:* Following NIH, each agency would transfer 10 percent of graduate student support from research grants to individual PIs to team-based programs. Create partnerships with organizations in this work through Institutional Commitment Letters.[111]

N.6.2.2 Incentivize Teams to Support Career Development for Their Members

Current teams leading observational surveys, facilities, and missions do not reflect the diversity in the field in part because diversity considerations are not yet fully incorporated into the funding process. Accessibility in terms of ADA compliance and training in the use of data are not required in data management plans. Agencies do not require reporting of demographics or climate. Diversity of the team is not a consideration in selection, and all-male proposal teams are common.[112]

Equitable access to training is needed for junior scientists to become PIs. For example, there is clear bias in the gender and career stage of leaders and participants in proposals submitted over the past decade to NASA's Explorer-class mission calls. The data suggest that barriers to participation exist in the

[108] For a typical individual grant, this would range from a few thousand to several thousand dollars, a scale that encourages deliberate thought about how to spend it—for example, on hiring an undergraduate for a summer.

[109] See https://www.nigms.nih.gov/training/instpredoc.

[110] See https://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=505015&ods_key=nsf19522.

[111] This method comes from the NIH model, where 10 percent of graduate students are supported with training grants.

[112] J. Centrella, M. New, and M. Thompson, 2019, Leadership and participation in NASA's Explorer-class missions, white paper submitted to the Astro2020 Decadal Survey, https://arxiv.org/abs/1909.10314.

development of mission leaders, in the selection of proposals to receive the institutional support required to be competitive, and in a selection process that in practice does not value diverse teams.

> **Goal 2, Suggestion 2:** The panel suggests that federal agencies urge teams (collaborations, projects, facilities, and missions) to adopt evidence-based practices to (1) address demographic disparities in recruitment, retention, and advancement of scientists; (2) provide facilities and data that are accessible to all; (3) implement strategies to improve work environments for all; and (4) assess their own progress.
>
> *Method, impact, and programmatics and cost to achieve this suggestion:*
>
> - **NSF, NASA, DOE**
>   - *Method:* Expect teams applying for awards to (1) describe plans to demonstrate diversity among members, including technical and leadership; (2) participate in agency-sponsored demographic and climate assessments; (3) have an explicit leadership selection process; (4) have clear mentoring and advising plans for students and postdoctoral fellows; (5) have demonstrated a plan for increasing accessibility for facilities, with open and equitable access to data, software, and training sets; and (6) demonstrate funding and resources devoted to the work above and broadening participation more generally. Approaches would be agency specific. For example, NASA might give extra weight in its selection process to missions with diverse leadership and participation.
>   - *Impact:* Sets the expectation for the field; recognizes scientists and their work environments as essential to the development of science itself; aids development of a diverse cohort of future leaders.
>   - *Programmatics:* No cost beyond development of assessments.

N.6.2.3 Strengthen Oversight of and Accountability for Funding

The barriers that hinder individuals with historically marginalized identities from choosing and continuing in physics and astronomy, or advancing to positions of power and influence, are elucidated throughout this report. A key barrier is lack of accountability: good mentoring is not trained for or rewarded; there are few consequences for identity-based harassment or bullying; and there is inadequate support for reporters of such problems. The resulting discriminatory loss of talent is unacceptable if the Profession is to maximize innovation and scientific excellence. NIH has made significant efforts to systematically address these problems over the past decade, with the establishment of several groups responsible for the oversight of funded programs, such as the Division of BioMedical Research Workforce and the Diversity Program Consortium. These groups have distinct roles in contributing to the overall agency strategy on workforce development.[113]

> **Goal 2, Suggestion 3:** The panel suggests that DOE, NASA, and NSF build on NIH experiences to strengthen their resources and expertise for education, monitoring, and assessment of proposals and grantees.[114] Accountability policies and processes, tied to proposal rejection or even suspension of funding in extreme cases, would be implemented as part of the funding process.
>
> *Method, impact, and programmatics and cost to achieve this suggestion:*

[113] See https://diversity.nih.gov/sites/coswd/files/images/2018-06/SWD_StrategicPlan_layout_final_links-508c.pdf.

[114] Through the dedicated agency-specific offices suggested in Goal 1.

- **NSF, NASA, DOE, in Partnership with Institutions**
  - *Method:* Use dedicated offices (in Goal 1, Suggestion 2) to support Goal 2, Suggestions 1 and 2. (1) Associated with grant solicitations, provide expectations and resources for the development of several existing components of proposals, including Broader Impacts, Mentoring, Data Management, Facilities Plans, and Institutional Support Letters. For grants to teams, this would further include the development of new plans for self-assessment, leadership, and support of junior members. (2) These components of each proposal would first be reviewed by the agency office and these ratings incorporated during the scientific review process. (3) Proposals would articulate goals and benchmarks outlined in (1), and annual reports would document progress on these to be reviewed by the agency office.
  - *Impact:* Motivates self-education and institutional action toward equitable practices and creating inclusive workplaces. Positive response to a solicitation or a history of effective practices becomes an influential condition for funding. Builds on NIH experience.
  - *Programmatics:* $0.25 million/year/agency office for consultant work to change proposal and annual reporting processes.[115]

N.6.2.4 Increase Funding and Recognition for the People Who Lead the Recruitment, Retention, and Advancement of Individuals from Historically Underrepresented Groups

For those who lead the recruitment, retention, and advancement of individuals from historically underrepresented groups, many of whom are members of historically marginalized groups themselves, this important work can take time and energy that compromises their professional well-being and career.[116,117,118] Grants supporting this work (e.g., NSF S-STEM, REUs) often have rigid funding models that do not acknowledge the loss of scientific productivity of leading PIs or their need for administrative support.

Goal 2, Suggestion 4: The panel suggests that the federal agencies provide material support to researchers who build and lead programs designed to retain, recruit, and advance historically underrepresented people.

Method, impact, and programmatics and cost to achieve this suggestion:

- **NSF, NASA, DOE**
  - *Method:* Increase budget size and funding flexibility for grants to advance equity-advancing values (e.g., reduce barriers to diversity and equity; create inclusive workplaces) to allow individuals to fund (1) their research program (e.g., pay for graduate students, summer salary, computing resources); and (2) administrative support staff, including program coordinators and evaluators.

[115] Cost scaled from $1 million budget for NIH's Division of Biomedical Research Workforce that serves a similar role.

[116] K.B. Porter, J.R. Posselt, K. Reyes, K.E. Slay, and A. Kamimura, 2018, Burdens and benefits of diversity work: Emotion management in STEM doctoral students, *Studies in Graduate and Postdoctoral Education* 9(2).

[117] V. Lerma, L.T. Hamilton, and K. Nielsen, 2020, Racialized equity labor, university appropriation and student resistance, *Social Problems*, 67(2):286–303.

[118] D.R. Hekman, S.K. Johnson, M.-D. Foo, and W. Yang, 2016, Does diversity-valuing behavior result in diminished performance ratings for non-white and female leaders? *Academy of Management Journal*, 60:2.

— *Impact:* Increase the respect for the work it takes to lead and build such programs as well as the ability of scientists to engage in such efforts while maintaining active research programs.
— *Programmatics:* Estimated at $1 million/year/agency to provide extra support for 5–10 grantees (DOE, NASA, NSF).[119]

N.6.3 Goal 3: Reimagining Leadership

Develop, select, and sustain diverse cohorts of leaders who lead by exercising equity-advancing values.

Expanding astrophysical knowledge in the 2020s requires reimagining leadership. The panel envisions a profession that develops and sustains broadly diverse cohorts of leaders who lead by exercising equity-advancing values. Leadership is a social process by which an individual or a group of individuals with a shared vision act to influence, guide, and motivate members of a group to achieve a desired outcome. The Profession currently relies on hierarchical leadership structures that oversee teams to achieve collective research goals.[120] Leaders also oversee the processes that distribute resources, evaluate performance, and recognize scientific excellence. How leaders are cultivated, and how they are encouraged to lead, will determine the advancement of the Profession and the individuals within it.

N.6.3.1 Develop and Select Diverse Leaders Who Practice Equity-Advancing Values

Diverse teams can outperform and out-innovate homogeneous teams.[121] Currently, the absence of an equity-based values framework and the associations of leadership with whiteness, masculinity, and elite education[122] together cause the Profession to preferentially select leaders from over-represented identities and perspectives.[123] These selection processes do not take into account the diversity of skills required to support, advance, and execute the scientific mission. Aspiring leaders are expected to change their leadership styles to conventional norms.[124] Consequently, the Profession's power structure indirectly, but systematically, discriminates and perpetuates the underrepresentation of leaders who lead in diverse ways, including those from historically marginalized groups.[125] Current and future generations of scientists are looking for leaders not only with conventional scientific reputations but also with expertise in the knowledge and skills to combat systemic inequality within the Profession.[126] Therefore, there is an acute need for training leaders with multimodal expertise at all career levels. Such leaders are

[119] Cost calculated based on 10 PIs per agency with grants of about $100,000 per year to support their research efforts. This is comparable to current NSF AST spending on REU.
[120] NRC (National Research Council), 2015, *Enhancing the Effectiveness of Team Science*, Washington, DC: The National Academies Press, doi: 10.17226/19007.
[121] V. Hunt, et al., 2018, "Delivering Through Diversity," The McKinsey Report; C. Díaz-García, A. González-Moreno, and F.J. Sáez-Martínez, 2013, Gender diversity within R&D teams: Its impact on radicalness of innovation, *Innovation*, 15(2):149–160, doi: 10.5172/impp.2013.15.2.149; D. Rock and H. Grant, 2016, Why diverse teams are smarter, *Harvard Business Review*; S.S. Levine, et al., 2014, Ethnic diversity deflates price bubbles, *PNAS*, 111(52):18524–18529; doi: 10.1073/pnas.1407301111.
[122] H. Liu, 2018, Redoing and abolishing whiteness in leadership, after Leadership, 101–111; L.A. Rivera, 2016, *Pedigree: How Elite Students Get Elite Jobs*, Princeton, NJ: Princeton University Press.
[123] E. Cech, 2015, Engineers and engineeresses? Self-conceptions and the development of gendered professional wdentities, *Sociological Perspectives*, 58(1):56–77, doi: 10.1177/0731121414556543.
[124] S. Cheryan and H.R. Markus, 2019, Masculine defaults: Identifying and counteracting hidden cultural biases, *Psychology Review*—under review; S.S. Levine, et al., 2014, Ethnic diversity deflates price bubbles, *PNAS*, 111(52):18524–18529, doi: 10.1073/pnas.1407301111.
[125] See https://www.nature.com/articles/d41586-020-01741-7, accessed 26 August 2020.
[126] See https://aas.org/press/aas-endorses-vision-statement-inclusive-astronomy.