



A Consensus Report on Recommendations from the 2022 Advancing IDEA in Planetary Science Conference

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ADVANCING IDEA IN PLANETARY SCIENCE CONFERENCE

Consensus Report

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PREFACE

The Advancing IDEA in Planetary Science Conference was held virtually on April 25 - 29, 2022. The conference was motivated by the recent transformation of thought in the planetary and astrobiological sciences regarding the principles of inclusion, diversity, equity, and accessibility (IDEA). Over the past decade, NASA and other planetary science stakeholders have committed to fostering IDEA principles throughout their agencies and funded programs. NASA has added language to standard Announcements of Opportunity, requested information and feedback from the community on agency practices, and added inclusion as a core value. Additionally, for the first time, the Planetary Science and Astrobiology Decadal Survey "[Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023 - 2032](#)" (OWL) requested white papers on the state of the profession from the community and included those findings and recommendations in the survey report. The Decadal Survey on Astronomy and Astrophysics "[Pathways to Discovery in Astronomy and Astrophysics for the 2020s](#)", which partially covered planetary science, also included IDEA-related recommendations to advance the field. In the wake of these activities, the Advancing IDEA in Planetary Science Conference aimed to leverage this momentum to ensure that the planetary science and astrobiology community can make the necessary improvements towards advancing IDEA principles in the workforce over the next decade.

The conference paid particular attention to the many lessons learned and best practices from the experiences of other STEM fields. For example, the social sciences have revealed some of the psychological and sociological challenges that communities can face when confronting and dismantling structural and systemic problems and have provided evidence-based solutions. As such, the goal of the conference was to bring together the planetary, astrobiological, and social science communities to (1) lean into lessons learned to date, (2) identify opportunities for improvement by listening to those most impacted in the community, and (3) make recommendations for actionable and tangible measures for advancing IDEA principles within planetary science.

The conference received 70 abstract submissions and 427 registrants from across the planetary, astrobiological, and social sciences. Besides presentations based on contributed abstracts, the conference included talks from four keynote speakers. These presentations were intended to provide important context and set the tone for the discussion. Janet Vertesi (Department of Sociology, Princeton University) and co-speaker Stephanie Beth Jordan (Department of Communication Arts and Science, Michigan State University) presented on "Science in/as White Space: Ethnographic Observations from the Planetary, Earth, and Ocean Science Communities." Adia Harvey Wingfield

(Department of Sociology, Washington University in St. Louis) presented on “[Behind the Myth of Meritocracy: How STEM fields Perpetuate Racial and Gender Disparities.](#)” Orlando Figueroa (Orlando Leadership Enterprise, LLC) presented on “[Conclusions from the Planetary and Astrobiology Decadal Survey on the State of the Profession and Personal Observations.](#)” Phoebe Cohen (Department of Geosciences, Williams College) presented on “[Finding and Strengthening My Voice as an IDEA Advocate in Earth and Planetary Science.](#)” All presentations at the conference, for which authors provided consent, were recorded and are available in the [online program](#).

The conference also included three workshops to practice and delve deeper into some topics. The “[Designing and Sustaining Authentic Partnerships](#)” workshop explored the definition and characteristics of authentic partnerships and shared insights and implementation strategies on designing and sustaining such partnerships. The “[Listening Session](#)” workshop facilitated discussions with people from underrepresented communities to better understand their needs and the challenges they face. One of the potential pitfalls of an IDEA conference held within the physical sciences is that the discussion can become data-centric. The goal of this session was to mitigate such a mentality by centralizing lived-experiences, providing the space for perspectives directly from those most affected – in particular leaders and advocates from different communities within the planetary sciences. The third workshop was a proposal writing workshop titled “[Tips to Writing Proposals and Building Resiliency within Your Career](#)”, which focused on key points to communicating science through successful proposal writing and learning to understand one’s values and maintaining those through the process. This workshop helped to bridge some opportunity gaps faced by early career and new researchers in the planetary sciences in their understanding of the NASA proposal culture and system.

A key outcome of this conference was to identify community-led actionable and tangible recommendations to advance IDEA principles within the planetary science and astrobiology community. To do this, the conference organized discussions throughout the week into seven Working Groups: (1) Recommendations for Funding Agencies, (2) Recommendations for Universities, (3) Recommendations for Research Groups, (4) Recommendations for Professional Organizations, (5) Recommendations for Employers and about Employment, (6) Recommendations about Safety and Accessibility, and (7) Recommendations about Public Engagement and Outreach. The Working Groups were led by co-facilitators who led asynchronous conversations via Slack and two focused discussion sessions during the conference. After the conference, the Working Groups organized their recommendations into a summary report. This Consensus Report collates and summarizes the recommendations from the seven Working Groups.

It is important to note that this report is intended to supplement the work presented in the OWL State of the Profession chapter by providing an additional mechanism for community input, as well as facilitating the needed next steps to implement the OWL recommendations. Furthermore, this report represents the continuation of an important and long-lasting conversation that should take place within and external to the planetary science and astrobiology community. It is expected that this is the first of a series of consensus reports from such conversations facilitated through future Advancing IDEA in Planetary Science Conferences and/or similar conferences. As a first step in such a journey, this report is not all-encompassing, but rather the beginning of understanding and reporting on community-identified priorities and recommendations towards advancing the state of the profession.

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EXECUTIVE SUMMARY

In total, the Working Groups developed 46 recommendations of which 21 were identified as priority recommendations. The recommendations in this consensus report are aimed at funding agencies, universities, research groups, employers, and the planetary science and astrobiology community. Together we can advance the field towards a more inclusive, diverse, equitable, and accessible profession.

Generally, the recommendations fell into five themes:

Recommendation Theme 1: The community, funding agencies, universities, and employers should follow best practices in building authentic partnerships when working within IDEA spaces. (Traced to recommendations A.8, C.6, D.1, D.2, G.3, G.4.)

An authentic partnership is guided by honoring, respecting, and valuing individual differences and contributions and through this ensuring that all partners grow, develop, and learn. Fundamental to such partnerships are trust and reciprocity, as well as providing space for all partners to be involved throughout all project phases (e.g., development through implementation). Many times, engagement events have been one sided with, for example, a researcher giving a talk to a community; however, without developing a partnership and understanding with the community, such activities may not have the desired effect.

When approaching IDEA spaces, such as activities intended to promote inclusion via broader access to information (e.g., the [NASA Science Mission Design School](#) and the [PI Launchpad](#)), it is important to first develop a relationship with the intended audience to understand the best ways of working together. In particular, it is important to identify the opportunity gaps faced by the intended community and the best ways those can be mitigated in order to improve the effectiveness of such work. Authentic partnerships should be a guiding framework for all IDEA work within the field. In this report, the recommendations emphasize that the voices of those historically excluded must be included when building future initiatives and activities.

Recommendation Theme 2: The community, funding agencies, universities, and employers should acknowledge that a vital part of “doing science” is “how we do science”, which should be guided by IDEA principles and best practices. (Traced to recommendations A.1, A.2, A.6, B.5, C.1, C.4, C.5, D.4, E.3, F.1, F.2.)

Diversity and inclusiveness along multiple axes of representation is a social, business, and institutional imperative for NASA (e.g., [Strategy 4.1, A Vision for Science Excellence](#)). Organizations that embrace diversity succeed in increasing creativity and innovation (e.g., [Richard, 2000](#); [Hong and Page, 2004](#)). As such, implementation and adoption of IDEA principles are fundamental to doing innovative science. Yet, IDEA and other service work is often seen as outside of the scientific endeavor. To advance not only our scientific progress but also the state of the profession over the next decade, the planetary science and astrobiology community along with funding agencies, universities, and employers should move towards understanding the multiple vital roles IDEA efforts have within the field. As such, IDEA work should be valued as part of the job of being a researcher. For example, IDEA efforts should be part of annual performance evaluations, promotion plans, and considerations for hiring.

Recommendation Theme 3: Employers and funding agencies should fully support the professional endeavor of planetary science and astrobiology, including service work. (Traced to recommendations A.3, A.7, A.10, E.1, G.5.)

If the community values service and IDEA work and places importance on it, then this work (i.e., the time and effort) must be financially supported. As noted in several of the recommendations, another way for the community to set up a culture where IDEA work is part of the profession is to fund and support such work. Additionally, many researchers in the field volunteer their time to work on various service-related activities (e.g., manuscript reviews, journal editorships, proposal reviews, involvement in NASA assessment and analysis groups). Furthermore, in many cases service work is disproportionately done by researchers from historically excluded communities (e.g., [SSFNRI, 2017](#); [Miller and Roksa, 2019](#); [Domingo et al., 2022](#)). Because this work is not considered or valued by their employers, this unfair share of service responsibilities can disadvantage such members of our community. These additional burdens can lead to the field losing valuable talent.

Recommendation Theme 4: The community, funding agencies, universities, research groups, and employers should develop and implement codes of conduct with structures for accountability, as well as build a work culture that adopts these codes. (Traced to recommendations A.4, C.2, C.3, F.4, F.8, F.9.)

Harassment and bullying of all forms are real and occur within planetary science. Women, in particular women of color and LGBTQ+ women, have reported hostile work environments, harassment, and bullying within planetary science (e.g., [Clancy et al., 2017](#); [Richey et al., 2019](#)). By perpetuating an environment that complicitly enables harassment, the field creates and retains spaces that are fundamentally exclusive to

diverse participants. In order to reform the planetary science culture to reject harassment, bullying, and other forms of unprofessional and unethical behavior, the community should adopt Codes of Conduct (CoC).

As stated in the OWL, “An effective CoC describes behavior, how policies will be enforced, clear instructions on how to report incidents, and consequences/enforcement mechanisms for rule violations.” Mission, project, and other science teams should adopt, implement, and follow through on CoCs. These policies should be socialized through voluntary, not required, training. Research in the social sciences has shown that required training can have an adverse impact on promoting a diverse workforce, while voluntary training has been shown to have a positive impact (e.g., [Frank and Kalev, 2016](#)). As presented at the 2022 Advancing IDEA in Planetary Science Conference, it is important to standardize CoCs and diversity-related training to develop a culture that adopts and follows through on these imperatives. It is important to note that the primary responsibility to set those cultural expectations occurs first with those in power (e.g., management, leadership in funding agencies, project team leads).

Recommendation Theme 5: The community should develop, and funding agencies, universities, and employers should support, a trusted hub for IDEA-related work that includes a repository for IDEA best practices, a list of opportunities and activities, and a platform that enables community collaboration. (Traced to recommendations B.1, B.2, B.3, E.2, F.3, G.1, G.2.)

Similar to how the planetary community has centralized hubs for meeting dates, data archiving, and proposal information, the recommendations here support a centralized hub for IDEA-related information. Such a hub should include access to information on best practices (e.g., CoC templates), diversity-related trainings (e.g., bystander training), community groups (e.g., Planetary Scientists of Color, Women in Planetary Science, Queers in Planetary Science, Disabled for Accessibility in Space), the broad career paths that are available in the braided river (see [Batchelor et al., 2021](#)) that is the planetary science profession, resources for learning how to apply to graduate school, internship programs, faculty jobs, NASA Research and Analysis programs, and tips for developing and joining missions.

In the following pages, the recommendations from the Working Groups are collated. Our guiding principle was to ensure this report represented each group’s discussion in order to truly reflect a community consensus. As such, although there were devoted groups for recommendations to funding agencies, universities, and employers, for instance, we retained each group’s recommendations regardless of their intended audience. The order of the recommendations and their prioritization was also retained.

A. RECOMMENDATIONS FOR FUNDING AGENCIES

I. Priority Recommendations

Recommendation A.1: Create an outward-facing position within the NASA Science Mission Directorate (SMD) to advance and implement IDEA principles within NASA.

The OWL stated that “Starkly, involvement of members of underserved communities, especially African Americans, show a deeply troubling stagnation at all levels. It is for NASA leadership to step-in immediately and decisively to understand and improve this state of affairs.” This problem is significant enough that, given NASA’s core value of inclusion, a dedicated position needs to be created.

The goal would be to leverage NASA’s programs within SMD to promote and advance inclusion, diversity, equity, and accessibility within STEM communities, including planetary science, and empower the community to move beyond compliance to truly embrace IDEA principles. This would provide a point of contact for missions and other community groups. This position would focus on the community defined broadly beyond NASA centers and employees, and, as such, would be separate from the NASA Office of Diversity and Equal Opportunity. Although this recommendation specifies NASA, other funding agencies, as well as large institutions (e.g., universities, non-profit institutions) should create similar positions.

This outward-facing position needs to have the resources (including staff), authority, and responsibilities for guiding action. Therefore, this position would be best served by a civil servant rather than a contractor. The position/office should be empowered to implement multiple policies that work together in a systematic way to make it an agency-wide and community-wide endeavor. The position should have expertise and knowledge in IDEA policies and procedures and be familiar with NASA’s policies and procedures, particularly within SMD. NASA needs to ensure that they have adequate support to initiate, manage, and oversee the SMD-wide IDEA initiatives.

Recommendation A.2.1: NASA should consider team diversity when selecting and extending missions, projects, facilities, and other large teams.

Recommendation A.2.2: In order to retain that diversity, project teams must also implement policies for creating inclusive and safe environments, including but not limited to codes of conduct and bystander intervention training.

For example, team diversity, specifically along multiple axes, should be an actual selection criterion and called out explicitly in the call for proposals. Another example is to

involve the position from *Recommendation A.1* to help apply IDEA principles in the selection process. NASA should consider team diversity and how it has improved since conception during senior reviews for extended missions.

In addition to team diversity, NASA should consider how proposed missions plan to provide opportunities for early career scientists to gain experience during mission development and mission operational phases, as well as opportunities to progress in mission roles over time. The OWL recommended that “PSD should implement Codes of Conduct (CoC) for funded field campaigns, conferences, and missions, and should expect acknowledgement of receipt and understanding.” CoCs need to include policies on enforcement and consequences for violations. It would be helpful if NASA could use the known best practices to create a draft CoC that would be included in future Announcements of Opportunity (AOs) that teams could then tailor to their needs.

Recommendation A.3: NASA should fund members of the community for their IDEA service work within planetary science and astrobiology.

The OWL found that important contributions “tend to be distributed inequitably across individuals and appear to fall disproportionately on members of particular groups.” This is particularly true of IDEA work, which is disproportionately done by underrepresented and historically excluded communities. To support such service work, NASA should broaden the definition of “doing science” to include “how we do science” and allow or encourage proposals to include funds to improve group dynamics, which could support, for example, bystander intervention training. Additionally, a program within the Research and Analysis (R&A) budget could be created to solicit and fund proposals to do IDEA work with the relevant science community. Another example would be to enable scientists to include IDEA work within their R&A proposals, in a similar way to how the NSF considers “Broader Impacts”. We acknowledge that the community is generally unaware of the restrictions faced by NASA as a funding agency to support such work. Thus, the intent of the above examples is to encourage NASA to find a way to support the community in important service work.

Finally, NASA could support IDEA work through mission opportunities. Mission teams should be allowed to have a specific budget for IDEA training and work. Such work could be encouraged through the use of Inclusion Plans when the missions or instruments are selected. Another option would be to have a specific mission line to forge authentic partnerships with institutions serving underrepresented groups, such as Historically Black Colleges and Universities (HBCUs) or Tribal Colleges and Universities (TCUs).

Recommendation A.4: The community and NASA should define professional ethics more broadly than only financial conflict of interest and, in particular, should treat harassment the same way as any other type of research misconduct.

The Astronomy and Astrophysics 2020 Decadal survey discussed how the effects of harassment impact scientific research integrity. The report concludes that “parts of the federal government and several professional societies...focus more broadly on policies about research integrity and on codes of ethics, rather than on the narrow definition of research misconduct.” Indeed, scientific integrity must include how researchers treat people: “Research culture and policies are quick to denounce plagiarism, data fabrication, and mismanagement of funds, yet we have too long ignored the mistreatment of people.”

The House of Representatives Committee on Space, Science, and Technology in 2019 held a hearing to investigate efforts to combat sexual harassment in STEM fields. In her opening statement, Chair Eddie Bernice Johnson said, “The public investment in research needs to draw on all of our nation’s talent to return the best possible science for the benefit of society. To reach this goal, we must do more to ensure that all researchers have access to a safe work environment.” Furthermore, as stated by Marín-Spiotta ([2019](#)), “Harassment, bullying, and discrimination damage science at the individual, community, institutional, and societal levels and cause health problems, fear, mistrust, depression, and trauma.” It thus follows that additional consideration needs to be given to safe social spaces, termed “counterspaces,” which provide support and reinforce the sense of belonging in STEM.

II. Further Recommendations

Recommendation A.5: Information collected by NSPIRES (NASA Solicitation and Proposal Integrated Review and Evaluation System), such as personal and demographic information should be made more inclusive.

This should include ensuring that the system accepts diacritical marks and hyphens for names and has no limits on name length. The demographic questions should be asked following best practices, including multiple options for gender.

Recommendation A.6: NASA should continue to support, including by funding meetings, such as the Advancing IDEA in Planetary Science Conference, ways to increase IDEA in the planetary science community.

Such conferences are an excellent opportunity for experts from different disciplines to work together on recommendations to make progress on IDEA efforts in planetary

science and astrobiology. Furthermore, conferences focused on IDEA efforts should aim for no registration fees, and minimum overall costs on registrants (e.g., the Advancing IDEA in Planetary Science conference was fully virtual and had no registration fee).

Recommendation A.7: NASA should make it explicit and clear that accessibility accommodations are allowable expenses in PSD R&A programs.

Information about these allowable expenses should be included in training for proposal evaluators. It needs to be clear to grant review panels that specific accommodations are set at an individual's institution level and once those accommodations are in place, the associated costs are allowed in NASA proposals.

Recommendation A.8: Following the model of developing authentic partnerships, NASA should create an Office of Tribal Relations, similar to offices at other Government agencies (e.g., the [US Forest Service](#) and the [USGS](#)).

Indigenous communities around the world have long-standing relationships to the Sun, Moon, and sky, as well as deep knowledge and traditions of exploration (e.g. [Kaluna et al., 2021](#); [Kamai et al., 2021](#)). Within the US context, it is essential that NASA seek out and listen to the voices of the Indigenous peoples who are a part of our national fabric and give serious consideration to their views on matters of site selection for ground-based facilities and missions, as well as ethical exploration and resource management as we continue to explore the solar system. We note that several other national agencies have similar offices of tribal relations.

Recommendation A.9: We support and reiterate the recommendation in the OWL that: Funding agencies, such as NASA, should leverage workplace climate surveys for projects, missions, and other facilities that are funded by NASA.

As NASA does not necessarily have the expertise or infrastructure to create and execute such surveys, NASA should seek outside expertise through a grant or other funding vehicle to implement such workplace climate surveys. Additionally, it is especially important that funding agencies both set the expectation that workplace climate surveys are required by projects, missions, and facilities and provide funding for projects, missions, and facilities to hire the appropriate experts to conduct them.

For example, NASA could work with professional societies to fund and organize demographic and workforce climate surveys. Surveys such as these were highlighted in OWL. We further recommend that demographic surveys include questions about national origin (current and past) and citizenship and that workforce climate surveys consider the

experiences of foreign nationals, since such individuals are an important but relatively little-studied part of the US planetary science community. It is important to account for and facilitate data collection to study intersectionality within any demographic survey of the community. Surveys should adhere to best practices such as accounting for non-binary gender identities, and multiple racial/ethnic identities.

Recommendation A.10: NASA should provide funding to support programs that provide opportunities for early career scientists to gain experience during mission development and mission operational phases, as well as opportunities to progress in mission roles over time.

Programs such as the [NASA Science Mission Design School](#), the [PI Launchpad](#), the DART Borders program, the Dragonfly Student and Early Career Investigator Program, the Europa Clipper H2O Program, and the InSightSeers Program are excellent examples of providing broader access to information on mission development. NASA should encourage these programs to evaluate their effectiveness and the demographics of participants and, based on the results, adjust the programs to enable/enhance participation by members of underrepresented communities for ongoing and future missions. Furthermore, NASA should explore avenues to include foreign nationals at US-based institutions in these programs, as is already the case for some, but not all, of the aforementioned programs.

B. RECOMMENDATIONS FOR UNIVERSITIES

I. Priority Recommendations

Recommendation B.1: The university community should develop a centralized hub to increase access to information for students, faculty, and scientists at institutions.

For example, universities can host a Wiki or repository for information related to institutional requirements for prospective graduate students and early career scientists. Such a repository should include templates for students, such as detailed guidance on how to apply to graduate programs, templates for required forms, and information on how to join professional organizations. Additionally, a widely used community-based discussion forum, such as through Slack, should be developed to facilitate discussion and collaboration.

Recommendation B.2: Universities should create a framework and resources to develop and sustain research and teaching partnerships across institutions with reciprocity.

Many institutions do not offer coursework or major options in the geosciences or planetary sciences. It would be beneficial for the students at these institutions if coursework was offered in partnership with a university with those degrees. This could look like: virtual coursework taught by faculty at the second institution, shared field trips, internships, mentor sharing between the institutions, shared or remote lab space, and/or inter-institutional degrees. In this framework, R1 institutions could partner with non-R1 MSIs, community colleges, and other two-year institutions. The emphasis must be on reciprocity and relationship-building, as the institutions involved would both have personnel, resources, and time involved.

Recommendation B.3: Universities should provide resources to support faculty and students in the creation and evaluation of IDEA efforts.

The resources could be educational support such as trainings, workshops, and/or symposia, or financial support such as microgrants to develop and implement IDEA policy, seed grants to begin new IDEA initiatives, and/or larger grants to provide funding for relationship building across institutions and underserved communities.

II. Further Recommendations

Recommendation B.4: Universities should include science communication/writing courses within their planetary science and astrobiology curriculum. Such courses should count towards completion of the degree.

Such courses could support students in learning how to communicate science with the public, write proposals for funding institutions, and write effective research publications. This recommendation is primarily targeted at graduate programs but would be beneficial in undergraduate programs as well.

Recommendation B.5: Universities should include work towards IDEA efforts as part of the annual performance evaluation of faculty.

Many universities require a DEI (Diversity, Equity, and Inclusion) statement as part of the application for faculty and students. However, to ensure that an emphasis on such work continues throughout employment, universities should also evaluate faculty on this work, including during promotion and tenure. Such work should also be supported and facilitated by universities.

C. RECOMMENDATIONS FOR RESEARCH GROUPS

I. Priority Recommendations

Recommendation C.1: NASA should consider funding a workshop that brings together researchers of all career stages, coupled with industrial/organizational psychologists to discuss best practices for small research group management in the planetary science and astrobiology fields.

The goal of such a workshop would be to produce a written guide (or training seminar) that can be used as a resource for anyone who manages teams of people in planetary science and astrobiology. New Principal Investigators (PIs) have a lot of expectations levied on them as they begin to build their programs. They must transition very quickly from an independent researcher to a personnel and lab manager, a teacher, a mentor, and an accountant, among many other tasks. Through all this transition, most new PIs receive little to no training in these areas and are forced to navigate with a limited tool kit. These new lab leaders, field course/research leads, or anyone else newly managing a research team need a centralized source of information to learn about best practices for building and maintaining these teams. For example, new lab leads need to learn best practices for setting up communication and support infrastructure for members of their research group. This includes items such as mentor contracts, Codes of Conduct, team and individual expectations, etc. Field leaders need access to resources to learn about how to implement mandatory First Aid training within their team to ensure this skill and capability is available. They also need to understand how to manage the needs of their individual team members during field expeditions (e.g., food, medical, and culture/religious needs, etc.). This information is not easily or readily available, especially in interdisciplinary fields such as planetary science and astrobiology. Hence a workshop dedicated to discussing these topics, assembling best practices, and developing a centralized and sustainable way to share/distribute this information with incoming PI's would be extremely useful to the community.

Recommendation C.2: Research group leads should formalize preferred communication practices and expectations for research groups and field teams by using tools such as mentor contracts and field guides that include a code of conduct to outline agreements, expectations, and accountability.

A cornerstone of a well-managed team is a communication strategy that outlines agreements, expectations, and accountability so that it is clearly understood between all team members. Research leads can do this at the individual level by using independent mentoring contracts and at the team level by developing a group code of conduct for both

lab and field activities. On an individual level, mentor contracts provide both the PI and the mentee a clear mutually agreed upon framework for how they will communicate and resolve issues, and what each person's expectations are for the other. This will allow the PI to have an equitable process for how they communicate with every member of their team, while also being able to consider each person's individual communication style and mentoring needs.

Recommendation C.3: Research leads should implement interpersonal support strategies as a tool to aid in authentic partnership building within research groups.

Creating authentic partnerships is an essential component to building successful teams. Making time and a safe space for team members to share experiences with each other will provide needed foundation for successful authentic partnership building within the team. An example support strategy for research group leads is reserving the first 15-20 minutes of regular (weekly, etc.) research group meetings as a defined time and safe space for interpersonal and social support discussions. Research group leads could also plan and implement interpersonal and social support deep-dive team events activities such as doing a team obstacle course or having an annual team retreat. Team leads should also engage with organizational and industrial psychologists who specialize in this kind of social support in the workplace to create, revise, and refine their respective team interpersonal and social support strategies.

II. Further Recommendations

Recommendation C.4: Research leads should learn best practices for preparing to manage expectations and meet needs within groups and should ensure that non-work research group social events are family-friendly.

People are very diverse in their needs and being a part of a research lab or field team is no exception to that diversity. Understanding that there is no one-size fits all solution, research team leads should take the time to manage their expectations for team members while also accounting for each individual's need in the lab and/or field setting. An example is preparing for a field expedition. It will be important for a field lead not to make assumptions as to what will be acceptable for accommodation, food, and scheduling based on assumptions or their own personal experience. Field leads will need to take the time to understand each individual's needs for food and housing, physical abilities, and cultural/religious requirements and then budget and plan the field expedition accordingly to best accommodate the identified needs, while also understanding that accessibility accommodations are allowable expenses.

Recommendation C.5: Research leads should work with their institutions to ensure that their teams receive regular IDEA-centered training such as sexual harassment prevention, bystander intervention, microaggression awareness, and implicit bias awareness.

Many institutions already have established training programs and capabilities that often include diversity training. Research leads should work to become familiar with their respective institution's training capabilities and work with the institution to ensure that those training resources are available to the PI and their team.

Recommendation C.6: Universities, as well as other employers, should provide discretionary funds to research leads for social and team-building activities.

An important interpersonal and social support strategy is providing extracurricular interactions between team members. This can be a significant challenge in the academic/research setting where income-limited students and postdoctoral researchers are involved, and/or at research institutions where soft-money PI's have little to no discretionary funds. Therefore, universities, and other employers, can contribute to diverse team development by making discretionary funds available to research leads.

Recommendation C.7: Research leads should consider developing and implementing social media use policies for their research groups.

Social media has become an integral communication platform in the border community, and it can be a very useful tool within the research group settings. Platforms such as Slack can help create effective team communication. Additionally, Twitter and Instagram are great places where PI's can publicly acknowledge team member accomplishments. It is important, though, for research leads to be careful to avoid crossing personal boundaries.

D. RECOMMENDATIONS FOR PROFESSIONAL ORGANIZATIONS

I. Priority Recommendations

Recommendation D.1: Professional organizations should employ a multi-faceted approach to ensure meetings and conferences are welcoming, friendly, and inclusive.

Conferences and meetings should be redesigned to be outwardly positive spaces acting as a counterweight to microaggressions and imposter syndrome. Prior to conference planning and location decisions, community and professional organizations should solicit input from their members regarding barriers to participation and how these may be mitigated. Additionally, organizations should reach out to groups that represent historically excluded communities for feedback on how to create a more welcoming space during meetings.

Professional organizations should have a strong emphasis on retention, specifically by creating space for “people and their identities” in addition to space for “research and science”. Professional societies should make it very clear at meetings that this is a respectful and inclusive event. In particular, codes of conduct should explicitly list acceptable and unacceptable behavior and the investigation process and consequences for violations.

Recommendation D.2: Professional organizations should develop authentic partnerships with organizations that serve historically excluded communities.

For example, the American Astronomical Society (AAS) Division of Planetary Sciences (DPS), the American Geophysical Union (AGU), and the Geological Society of America (GSA) should develop authentic partnerships with organizations such as the National Society for Black Physicists (NSBP), the Society for the Advancement of Chicanos/Hispanics and Native Americans in STEM (SACNAS), and the American Indian Science and Engineering Society (AISES). Additionally, professional societies should include groups within the field that advocate for historically excluded communities, such as the Planetary Scientists of Color, Women in Planetary Science, Queers in Planetary Science, and Disabled for Accessibility in Space groups. The partnerships should emphasize the mutual benefits/sharing of resources, and importance of entering such a partnership with respect for the autonomy and expertise of the group that serves the underrepresented populations in planetary science. There should also be targeted aspects of these partnerships that focus on students, early career, and new scientists in the field.

II. Further Recommendations

Recommendation D.3: Professional societies should create opportunities for child/dependent care at conferences/meetings.

One way to make conferences inclusive is to ensure that they provide support for those with family care responsibilities.

Recommendation D.4: NASA Analysis and Assessment Groups should incorporate IDEA sessions within their meetings.

The community-based analysis and assessment groups should include consideration and discussion of IDEA work. In particular, as groups representing the community, they should hold the community and NASA accountable in working to advance the planetary science and astrobiology community towards a more inclusive, diverse, equitable, and accessible workforce.

E. RECOMMENDATIONS FOR EMPLOYERS AND ABOUT EMPLOYMENT

I. Priority Recommendations

Recommendation E.1: Employers should (1) fully support the professional endeavor of planetary science, as well as (2) mitigate financial burdens faced by researchers.

The planetary science and astrobiology profession can place a significant financial burden on people, especially graduate students, early career researchers (ECRs), and those from a disadvantaged socioeconomic background. For example, planetary scientists are expected to do a significant amount of service work that is typically unpaid (e.g, proposal and manuscript reviews, service on the NASA Analysis and Assessment Groups (AGs), IDEA work, public engagement events, etc.). Such tasks, which are essential to the field but cannot currently be directly charged to research grants, should be fully supported by employers.

Additionally, researchers are often required to pay for their travel costs upfront and wait for reimbursement. Employers should mitigate such financial burdens on the workforce by providing travel advances and/or purchase cards, timely reimbursement for all costs related to travel (e.g., within two weeks of return from travel), and support for living in expensive housing markets, potentially in the form of down payment/mortgage assistance, a realtor dedicated to helping new hires locate a home, cost of living adjustments, and bonuses. These resources should be clearly communicated to current and prospective employees and students.

Recommendation E.2: The planetary science and astrobiology community, funding agencies, and employers must proactively and broadly inform current and prospective researchers on the range of job opportunities in the field, their scope of work, funding profiles, and benefits (e.g., flexibility on work location).

As reported in the [2020 Survey of the Planetary Science Workforce](#), conducted by the American Institute of Physics and funded by the AAS Division of Planetary Sciences, the planetary science workforce is currently primarily employed in the University / four-year college sector (41%) and the research institute / non-profit sector (36%). Furthermore, the top three positions held by planetary scientists are tenured or tenure-equivalent (30%), soft money (26%) and hard money or regular employee (20%). With such a range of jobs in the field, it is important that the community, specifically those advising or mentoring ECRs, and employers communicate the different career options that are part

of the braided river that is the profession of planetary science. Furthermore, it is important that the community removes the stigma of working outside of the traditional university-based academic environment.

Large institutions, such as NASA and universities, should work to provide connections to careers outside of traditional academia for current and prospective researchers, potentially through new, focused partnerships and programs (e.g., NASA Astrobiology Program's [PAWS](#)). Furthermore, universities should provide opportunities for undergraduate and especially graduate students to explore these non-traditional paths via internships, co-operative education programs, and work-study opportunities without penalizing them in their academic program, particularly if summer pay is not guaranteed. Internships for undergraduate students are marketed well to them; however, the availability and visibility of internships for graduate students is much lower than for undergraduates. Universities should provide resources for potential internship experiences for graduate students either through their own department connections or through a partnership with their university career services team, as is done in other fields (e.g., engineering).

Recommendation E.3: The community should acknowledge the detrimental and non-equitable impacts the COVID-19 pandemic has had on the planetary science and astrobiology workforce.

The pandemic exacerbated already-existing mental health issues within our community (e.g., [Vance et al., 2021](#)) and created new ones. The planetary science and astrobiology community, and in particular employers, should acknowledge that the pandemic happened and continues, and should recognize the detrimental effects it has had and continues to have on the workforce.

For example, employers, especially those in positions that determine hiring, promotions, and awards, should adjust their evaluation metrics to reflect the hardships the pandemic inflicted unequally on different members of the community, by minimizing the importance of the publication record and productivity during this time period. Additionally, the planetary science and astrobiology community should strive to create and maintain a culture where talking about and supporting mental health needs is the norm. Employers, managers, and institutions must work to support best practices to cultivate a positive mental health culture. For example, employers should provide support for mental health, including allowing for mental health days, reasonable accommodations for mental health (e.g., remote work, flexible work hours, etc.), and support for mental health care through health insurance.

II. Further Recommendations

Recommendation E.4: NASA should seek alternate methods of supporting postdoctoral fellowships other than through a stipend.

Many fellowships, most notably the NASA Postdoctoral Program (NPP), pay fellows a stipend rather than a salary, which places financial and administrative burdens on the fellows. For example, because income tax is not removed, fellows must handle additional administrative burdens. Additionally, fellows have difficulty qualifying for many benefits, such as mortgages, because of a lack of a salary. The language in the Announcement of Opportunity for the NPP and other fellowship programs should require non-stipend-based payments. The [NASA Hubble Fellowship Program](#) can serve as an example. This fellowship provides salary support as well as benefits.

Recommendation E.5: Employers should provide job/salary security for soft money positions. Additionally, NASA should provide information to track grant selection by job type (e.g., soft money vs hard money positions).

Soft-money positions (i.e., positions primarily dependent on grant funds) are inherently more unstable and insecure than permanent or permanent-track positions. Many planetary scientists who are members of underrepresented communities work in soft-money positions ([Rivera-Valentín et al, 2021](#)). With the decrease in selection rates across planetary R&A programs, soft money positions have become increasingly unstable. Tracking grant selection by job type (i.e., soft vs hard money) in addition to job sector (i.e., university, government, non-profit), would position NASA and the community to better respond to the needs of soft money researchers. Importantly, employers should help secure soft money positions by providing significant salary support outside of grant funding, such as through the overhead gained through grant awards won by PIs.

Recommendation E.6: The field should acknowledge the human right to live where and with whom one chooses and should facilitate flexibility with on-site versus remote work.

People have a right to choose where they live and to live with their partners, significant others, families, and communities. The pandemic has demonstrated the ability for flexible job arrangements. Although this may be difficult for some work, such as laboratory-centered researchers, employers and the community should seek ways to support flexible work arrangements. Employers should also provide support for those seeking jobs alongside a working partner, also referred to as the two-body challenge.

F. RECOMMENDATIONS ABOUT SAFETY AND ACCESSIBILITY

I. Priority Recommendations

Recommendation F.1: The community should build accessibility and safety from the beginning into programs and activities via consultation with existing resources and experts.

The guiding principle is to center and raise the bar for accessibility and safety to ensure that all members of the planetary science and astrobiology community can contribute to the best of their ability. Accessibility should be the guiding design principle for all community spaces and events because building accessible spaces (both physical and virtual) is easier and cheaper than adapting existing spaces to be accessible. Additionally, events should be designed with flexible modes of participation (i.e., multiple and equitable ways to attend, contribute, and present science).

To facilitate the implementation of accessibility best practices within teams, all teams should appoint an individual or office to be responsible for accessibility and safety work. This contact should be a person of authority who can act as a contact for issues/concerns including reports of misconduct, harassment, or unsafe conditions (e.g., an accessibility coordinator for a meeting, a safety officer for a conference, a non-team but affiliated person for small field teams). Furthermore, when designing lab and meeting spaces, accessibility experts should be consulted. While this may constitute a single large expense, the improvement in access and inclusion should provide savings over the long term.

Recommendation F.2: Organizations convening conferences should budget for costs related to safety and accessibility (e.g., interpreters and live captioning).

In order to address confusion regarding the high cost of conference registration fees, especially regarding virtual/hybrid options, meetings should adopt transparency in setting those fees and include a breakdown of the percent of costs going to different categories (e.g. facility rental, virtual platform licenses, refreshments).

All event schedules should include ample break time so participants can attend to personal needs and have some “down time”. Whenever possible, detailed schedules should be available ahead of time so participants can plan. All events should stick to planned schedules: when unforeseen difficulties arise (as is likely in field projects), participants should be notified about schedule changes as soon as reasonably possible.

Safety information should be included in meeting information and field project briefings and should specifically address the reporting of inappropriate behavior: what it is, how to report it, and what the consequences will be. This discussion should include potential risks from non-team members in the event location and appropriate reporting of any incidents. Reporting structures need to include non-project affiliated contacts to whom project members can report incidents without fear of reprisal from immediate supervisors.

Recommendation F.3: The community should develop and maintain a publicly accessible set of resources by and for those within our community who are working to increase accessibility and safety.

Our community is our strength. We should leverage our network of contacts to develop community points of contact for safety and accessibility issues, including institution-provided information about accessible transportation options to/from work sites, individuals who can be contacted for safety information and information on safety escorts, and other community-developed resources on accessibility/safety issues. Professional organizations can assist in sharing resources related to accessibility/safety, and that effort is taken to ensure resources are updated periodically.

We need to listen to our community. Surveys of the community should include questions and solicit feedback related to accessibility (including access to workspaces, travel, field, and conferences). We need to also share community resources on existing best practices for addressing accessibility and safety.

II. Further Recommendations

Recommendation F.4: All teams should establish a clear, distributed reporting and accountability structure to address harassment and safety concerns, with the expectation that this structure will extend outside the team.

An ideal first step to implementing a clear structure of accountability is a standardized code of conduct for all funded projects that includes clear information on how the code will apply across institutions with differing public standards.

Recommendation F.5: Virtual/hybrid meetings should be designed using best practices for these types of events.

Well-designed virtual/hybrid events are not simply recreations of a fully in-person event and have many advantages when approached as such, including increasing accessibility

and inclusivity. Organizers should select technology options with accessibility in mind and work with vendors to provide the most equitable access possible.

When events include both virtual and in-person options, these should be fully integrated to incentivize interaction between all participants. To enable full participation by all attendees, the community should normalize, and employers should facilitate, taking equivalent work time away for all events regardless of whether attendance is virtual or in-person. Grant proposals should be allowed to include appropriate costs for full virtual attendance (e.g., child care, paid time off) and institutions instructed to allow reimbursement of these costs when so budgeted.

Recommendation F.6: When selecting locations for conferences, organizations should prioritize accessibility and the safety of all community members.

Meeting locations should prioritize availability of gender-neutral bathrooms, parents' rooms, and quiet rooms. Room layouts should adhere to principles of accessible design and leave appropriate room for use of mobility devices. When contracting a hotel block, ensure availability of accessible rooms for participants who require them, as hotels do not always guarantee this type of "special request".

Recommendation F.7: The community should ensure that deliverables for all funded projects (e.g., images/videos, websites, documentation and manuscripts, datasets, outreach materials) should meet basic accessibility standards, including compatibility with screen readers, human-validated captions for audio, and descriptive alt text for images.

Information on accessibility standards and requirements for project materials should be provided to grant proposers and plans to provide accessible materials assessed in proposal review criteria.

Recommendation F.8: Safety should be the highest priority for all field projects.

Team briefings should include details of local environmental hazards and on-site safety expectations for all members (even those experienced in the field area), and no team member should ever be expected to work alone in the field. Field equipment should include appropriate first aid kits and emergency supplies for personal hygiene needs (such as OTC medications, menstrual products, and other toiletry needs). Field teams that include inexperienced participants (e.g., students) should recognize that not all in our community are familiar with proper field etiquette regarding personal and medical needs and should provide briefings as appropriate (e.g., [Greene et al., 2020](#)).

Recommendation F.9: All team projects should have clear policies regarding non-consumption of alcohol and other legal recreational substances during dedicated work time.

Field and meeting schedules should include debrief times for social discussion of projects that are outside of meals/events where alcohol could be present. It is critical to provide alcohol-free spaces for informal team engagement and discussion, as it can be difficult to find alcohol-free establishments for meals, which are often the only time when these interactions occur.

G. RECOMMENDATIONS ABOUT PUBLIC ENGAGEMENT AND OUTREACH

I. Priority Recommendations

Recommendation G.1: The community should implement best practices in public engagement rather than recreating or redeveloping such practices.

For many years, public engagement of diverse audiences has been aspirational rather than successful. Excellent research and resources exist in the literature and in the practice of science communication and education and public engagement. The planetary and astrobiology education and public engagement community needs to take these lessons and apply them to our efforts to engage diverse communities in planetary science and astrobiology. This will require moving beyond positive intentions. The organizations, teams, and individuals in planetary and astrobiology public engagement need to prioritize IDEA efforts. This priority needs to be visibly supported by leadership and a required component for proposals.

Recommendation G.2: The community, supported by NASA and/or other funding agencies, should develop an online central public engagement hub for best practices, community building, resources and diverse voices.

This site needs to be attached to a well-established organization which will legitimize it and make it clear that the IDEA efforts in public engagement are supported by NASA and the planetary science and astrobiology community. This centralized hub can serve as a repository for best practices in IDEA. It can include a searchable database of diverse voices, including early career planetary scientists and astrobiologists who the media can be encouraged to contact for science news stories, and who educators can contact for presentations. It can also include a mechanism to connect potential partners within the planetary science and astrobiology community and the education community, including Minority Serving Institutions.

Recommendation G.3: The community should prioritize intentional partnering with underserved communities in all public engagement efforts.

In order for the planetary science and astrobiology community to engage diverse communities, we need to include partners within those communities, and build long-term relationships that will survive changes in staff. This includes budgeting funding for partners in proposals, planning and co-designing activities and events with them, and

supporting partners' priorities. It could be supported through funding research and evaluation on best practices for partnering with organizations to better engage diverse communities. The education and public engagement community can assist in developing goals and standards for evaluating the success of these partnerships, and guiding principles in approaching public engagement efforts with partners.

It is important to emphasize to include the intended communities in all levels of planning. "Nothing about us without us." This is the key to building sustainable and authentic partnerships, which is a critical part of engaging diverse communities.

II. Further Recommendations

Recommendation G.4: Funding agencies should support a diverse range of planetary scientists and astrobiologists to participate in public engagement.

Funding for education and public engagement can provide researchers from underrepresented backgrounds the opportunity to serve as role models and provide inspiration for future generations as mentors and guides for first-generation college and graduate school students of all backgrounds.

Recommendation G.5: The community should include communications specialists in IDEA efforts.

Organizational and mission communications specialists can support IDEA by amplifying diverse voices in videos and press releases and directing the news media to early career planetary scientists and astrobiologists for responses to questions.

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