# Recommendations for an NSF Convergence Accelerator Track on Community Science A Community Science Report of an NSF-funded Convergence Accelerator Workshop Facilitated by the American Geophysical Union

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## About AGU

The American Geophysical Union (AGU; www.agu.org) is a global community supporting more than half a million advocates and professionals in the Earth and space sciences. Through broad and inclusive partnerships, we advance discovery and solution science that accelerate knowledge and create solutions that are ethical, unbiased, and respectful of communities and their values. Our programs include serving as a scholarly publisher, convening virtual and in-person events, and providing career support. We live our values in everything we do, such as in our net zero energy renovated building in Washington, D.C., and our Ethics and Equity Center, which fosters a diverse and inclusive geosciences community to ensure responsible conduct.

AGU was established in 1919 by the National Research Council and operated as an unincorporated affiliate of the National Academy of Sciences for more than 50 years. We were independently incorporated in 1972.

## Acknowledgments

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# Executive Summary

This proposal recommends to the National Science Foundation (NSF) that the agency develop a convergence accelerator track for community science.

Community science is the equitable collaboration between scientists and community members for the benefit of both science and communities. The foundational principles of community science are mutual benefit, cocreation, and the belief that science is a universal human right. Community science enhances our collective ability to tackle challenges like climate change, environmental injustice, economic and social inequity, and scientific mistrust. The practice is squarely in line with NSF's commitment to convergent science, real-world impact, and diversity, and can catalyze a larger cultural change within and beyond the sciences.

In October 2022, the American Geophysical Union (AGU), with grant support from NSF, hosted a virtual workshop and collected online contributions about the potential for a convergence accelerator track on community science. More than 250 people from diverse backgrounds and experiences contributed. A steering committee composed of expert practitioners who understand NSF's mission and operations synthesized the contributions into the principles, participants, and practical steps needed for funded community science, as described in this report.

## Practices

A set of practices should be embedded in the design of a convergence accelerator track on community science:

1. Increase science funding to community groups.
2. Advance authentic community engagement.
3. Support infrastructure for community science.
4. Drive culture change in science.
5. Support data cocreated by and for communities.
6. Support community agency.

## Participants

The track would support two primary categories: a coordinator, which would be filled by a team led by a science-savvy and community-focused organization, and several Community Science Teams made up of coalitions of community-based organizations, science institutions, and intermediary organizations. These teams would leverage science to produce community outcomes and launch enduring collaborations; the coordinator would support these teams and partner with NSF to drive change.

## Practical Steps

Community Science Teams would be able to compete for funding by entering the community science convergence accelerator track at different phases, depending on the teams' experience level.

- The optional building phase would accommodate new teams that need support building partnerships, recruiting community and small organizations not yet familiar with opportunities available through NSF, and training in the development of community science activities and strategies to successfully compete for funding.

- Phase 1 would accommodate teams prepared to pilot strategies for achieving impact through community science.

- The final phase focuses on scaling successful strategies, expanding the network of participants, and building strong coalitions that advance systemic and large-scale change. The optimal outcome is one in which all Community Science Teams progress through all three phases to become self-sustaining networks.

# Introduction

In late 2022, the National Science Foundation (NSF) invited the American Geophysical Union (AGU) to lead an inclusive process to design a convergence accelerator track on community science and community resilience. Through a contributory web platform and a facilitated virtual workshop, AGU collected input from a diverse set of practitioners and experts engaged in community science, climate justice, and community resilience. Participants included community leaders, leaders of nonprofit organizations, university faculty and students, leaders of community-based organizations, data experts, boundary spanners, activists, government officials, and agency employees. Thirty-seven ideas for convergence accelerator proposals and tracks were submitted through the online platform, and more than 225 people participated in the 4-hour-long virtual workshop.

To guide these processes and ensure broad participation, AGU convened a steering committee whose members brought practical and academic experience in community-engaged research, community activism, academic transformation, research and data leadership, solutions science, resilience, and research-to-action. The steering committee used the input from the workshop and contributions from the website to identify the core principles of community science and design a way for NSF to build a convergence accelerator track on community science based on these core principles. This report shares these core principles and that track design. This report also shares the ideas participants offered for going beyond the convergence accelerator program and shows how a community science accelerator track has the potential to transform the practice of science. We also include, in Appendix 2, some of the potential topics workshop and online participants suggested for a convergence accelerator track on community science.

Community science[1] is the just and equitable collaboration between scientists, community members, and broader society [*Wandersman*, 2003; *Strand et al.*, 2003; *Wilderman et al.*, 2004; *Tebes*, 2005; *Pandya*, 2014; *Carrera et al.*, 2019; *Charles et al.*, 2020; *Rasmus et al.*, 2019; *Dosemagon*, 2020; *Barry*, 2022]. The core principles of community science are cocreation [*Kirkby et al.*, 2018; *ICBO Working Group*, 2022], mutual benefit and learning [*Brown et al.*, 2012; *Kovaka*, 2021], and justice and equity [*Chinman et al.*, 2005; *Varga et al.*, 2016; *Chicago Beyond*, 2018; *ICBO Working Group*, 2022; *McAteer and Flannery*, 2022]. Good community science benefits communities by advancing local priorities, building capacity, fostering trust, and repairing harms, including harms caused by science

[1]Community refers to any group of people connected to each other by a common bond including interest, identity, geography, etc. Science includes the social and physical, welcomes multiple traditions and many ways of knowing, and spans application, research, education, and synthesis.

[*Wandersman*, 2003; *Joint United Nations Program on HIV/AIDS (UNAIDS)*, 2011; *Charles et al.*, 2020]. It enriches science by welcoming many people, ideas, and ways of working [*Irwin*, 1995; *Whyte and Crease*, 2010; *Wylie*, 2015; *Allen*, 2017; *Ottinger*, 2017; *Kimura and Kinchy*, 2019]. Community science welcomes multiple ways of knowing and honors and interacts equitably with many traditions of inquiry and discovery [*Rasmus et al.*, 2019]. It engenders trust in science, public support for science, and broadens scientific understanding and engagement [*Spitzer and Fraser*, 2020]. It invites people from all walks of life, including professional scientists, to explore together fundamental questions about the nature, practice, and epistemology of science [*Tebes*, 2005]. Community science done well advances justice, repairs past harms, and acknowledges overlooked contributions [*Frickel et al.*, 2010]. And, in all this, community science builds our shared capacity to address overarching and even existential challenges like climate change, sustainability, and resilience [*Mach et al.*, 2020; *Barry*, 2022]. Indeed, collaborative and integrated approaches like community science may well be the most effective approaches to tackling nested, wicked, and existential challenges.

The scope of participation and the tenor of contributions to this workshop and the resulting report demonstrate that community science is an idea whose time has come. It draws energy from unprecedented, broad societal interest in advancing justice in the wake of the murder of George Floyd[2] and the racial, economic, and geographic inequities revealed by recent climate-linked natural disasters and the COVID-19 pandemic. Scientists of all ages, but especially those early in their career, described their hunger to contribute their science to societal goals and to build a sense of belonging that extends beyond the sciences. Community leaders described how science is essential to advancing their goals for their communities and helping communities navigate technological opportunity, environmental and health-related challenges, and the ways in which science can help them access power and build cultural capital. At the same time, NSF, universities, nonprofits, and science institutions are keenly interested in how they can advance collaboration with community groups, foster convergent and solutions-oriented science, and build a culture of belonging in science.

A timely investment in community science can take advantage of this moment to lift up decades of under-the-radar work spread across disciplines, underfunded work embedded in community-based organizations, and underappreciated work within boundary-spanning organizations. Such an investment can also broaden those impacts and bring this kind of work to communities that historically lacked the resources and opportunities to mobilize community science. NSF, because of its visibility and prestige, capacity to innovate, and culture of learning, and its support for multiple physical and social science disciplines, is ideally positioned to elevate and catalyze community science. A convergence accelerator track on community science would broaden awareness for

[2]George Floyd was one of many murdered Black people in the United States, and it is important to acknowledge numerous other murders just as egregious that did not spark an awakening or public attention.

community science, highlight practices that work, recognize and support long-toiling leaders, nurture emergent leaders, and provide a road map for larger systemic changes.

Our report began by making a case for community science as a way to engage, to tackle pressing challenges, to work toward a just, resilient future, and indeed to improve science, the support for it, and its impacts. In the next section, we outline a set of general principles to guide community science. After that, we describe a convergence accelerator track on community science that honors these principles. We close with a set of practices that can be adopted within and beyond the convergence accelerator.

# Principles of Community Science

Participants emphasized that community science needs to prioritize ways of working and acting over the topics worked on. As one workshop participant said, "If we know how to work together in a good way, we will be able to pick good things to work on." Workshop participants and online contributions illuminated practices and attitudes that have been barriers to community science and provided examples of more just and equitable practices that reduce those barriers. Participants emphasized the role of community-based organizations and offered many ideas for welcoming community-based organizations as participants, beneficiaries, and cocreators of science. From all these inputs, the steering committee was able to articulate the principles that follow.

## Multiple Benefits

The first principle of community science is that everyone benefits [*Charles et al.*, 2020; *Hart and Silka*, 2020]. Community science is designed for the benefit of communities, the sciences, and larger society. That means community science addresses community priorities, aims for community outcomes, and includes strategies that advance the shared capacity of community members to leverage science to support their decisionmaking, planning, and action [*Wandersman*, 2003; *Brown et al.*, 2012; *Kovaka*, 2021]. Community science advances science by welcoming new ideas, insights, approaches, and ways of knowing; contributing to the diversity of people, practices, and topics included in science [*Tebes*, 2005; *Whyte and Crease*, 2010]; coproducing new knowledge and advancing shared discovery; and nurturing public support for and trust in science [*Carrera et al.*, 2019; *Spitzer and Fraser*, 2020]. Community science tackles pressing global challenges by allowing communities to approach overarching challenges in specific contexts while working together on systemic changes that are regional, national, and international in scale [*Mach et al.*, 2020; *Barry*, 2022]. Community science nurtures creativity and seeds innovation by fostering and learning from the approaches many different communities take to similar problems [*Kirkby et al.*, 2018].

## Cocreation

The second principle of community science is cocreation; the distributed benefits are a product of working together, as equals, in all stages and all aspects of the work. This means that decisionmaking and governance responsibilities and opportunities are shared by community leaders and scientists [*Kyoon-Achen et al.*, 2018; *UNAIDS*, 2011]; that project goals, outcomes, and impacts are designed and achieved by a coalition of community members, scientists, and allies [*Annoni et al.*, 2018]; and that results are shared by mutual consent and for use by multiple audiences [*Center for Community and Citizen Science*, 2013]. Cocreation also means that resources are deployed and systems are designed so that everyone has the opportunity to fully participate in any or all phases of the project [*Gulati-Partee and Potapchuk*, 2017].

## Science as a Human Right

The third principle of community science is that science is a universal right[3]. All communities deserve the opportunity and resources to ask and investigate their scientific questions. All communities are invited and supported to guide, contribute to, and benefit from science. And all communities should help govern the conduct of science and weigh in on the appropriate topics for investigation and the appropriate use for science outcomes [*UNAIDS*, 2011; *Varga et al.*, 2016]. All communities also deserve the benefit from the fruits of science including the tools, resources, information, and solutions that emerge from the scientific enterprise [*Feliú-Mójer*, 2020]. Many communities have been denied these rights, and we recommend that community science prioritize work with those communities. In practice, this means focusing on communities that have been marginalized, oppressed, and colonized; and recognizing that the denial of the right of science is systemically entangled with economic, geographic, technological, and other inequities.

[3]The United Nations Universal Declaration of Human Rights states that everyone has the right to "share in scientific advancement and its benefits."

# Design for an NSF Convergence Accelerator Track on Community Science

NSF's convergence accelerator program funds cross-disciplinary and cross-sector teams to build on basic research and accelerate solutions toward societal impact. We propose a convergence accelerator track on community science that would develop community science capacity at NSF, support groundbreaking teams to do community science work, and inspire and guide additional community science. This convergence accelerator on community science contributes to intellectual merit by fostering innovation in the practice of science; and it contributes to broader impacts by increasing community-based organizations' ability to participate in, contribute to, and benefit from NSF activities.

As shown in Figure 1, our community science track contains two elements:

- A coordinator—an organization that helps NSF enact practices that advance community science and bring more communities into the accelerator program.

- Community Science Teams (ComSciTeams)—teams of scientific, community-based, and intermediary organizations[4] who receive funding from the convergence accelerator track to build relationships, pilot community science approaches, and scale them up.

[4]An intermediary organization, or boundary organization, connects scientific research or research outputs to sectors where that research is used. It might focus on a topic (e.g., clean energy), a method (e.g., vulnerability assessments), or a tool or technology (e.g., community data).

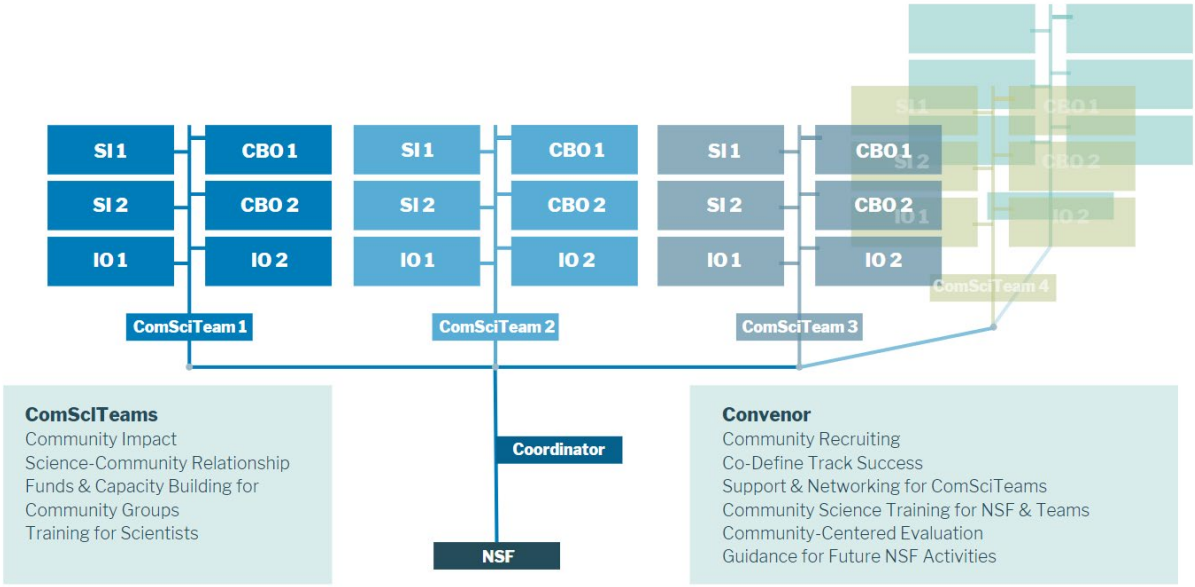


*Fig. 1. A conceptual diagram for the design of a convergence accelerator program, showing how NSF works with a coordinator (which itself is a team of community leaders, scientists, and intermediary organizations) to recruit, support, and coordinate Community Science Teams who innovate and scale community science practices. SI = science institutions, CBO = community-based organizations, and IO = intermediary, or boundary-spanning, organizations.*

## Coordinator

The convergence accelerator track's first request for proposal (RFP) would invite proposals for a coordinator team to work with NSF to bring community voice and participation into the leadership of the track. The coordinator role would be filled by a team that practices equity, includes community leaders and scientists, and has deep experience with community science. The team would draw from social sciences research and community experience to inform the design of the accelerator track on community science. This team would work to support NSF in learning about and leaning into community science, help community-based organizations who are not familiar with NSF learn about and participate in the track, and enhance NSF's ability to include community leaders in track design and oversight. Once ComSciTeams were awarded, the coordinator role would support the ComSciTeams by helping them network and work together, and identifying and meeting common infrastructure needs (e.g., data services, community-centered evaluation, communication, grant management, and knowledge sharing). In this way, the coordinator amplifies the collective impact of the accelerator and its teams.

## Coordinator Boundary Conditions

A coordinator should be a science-savvy and community-focused organization with the following:

- Experience connecting scientific and community-based groups and individuals to share knowledge, build trust, and create change together
- A track record of positive impact in communities and strong relationships with community residents and community-based organizations rooted in trust and reciprocity.
- Networks that bring resources and skills to support community work, including data, fundraising, knowledge management, community organizing, training, and evaluation.
- Demonstrated ability to work across cultures and contexts, especially in historically neglected, marginalized, colonized, and oppressed communities.
- A leadership team that reflects the diversity of our nation.
- Experience increasing funding, including federal funding, to community-based organizations.
- Familiarity with multidisciplinary approaches to community science, ability to draw from social and economic sciences to guide community science practices, and knowledge of the rich history of community-driven approaches to science.

Examples of a coordinator could include a scientific society or science institution with strong community partners, a community-based organization with strong scientific and technical allies, or a boundary-spanning science institution with a long history of equitable community partnerships.

## Coordinator Goals

Working with NSF, the coordinator would help NSF engage community leaders to codevelop the following:

- A clear and compelling results framework for the entire convergence accelerator program on community science

- Guidance for future NSF activities that are responsive to ComSciTeams and to emergent community priorities

- Training about community science for NSF program directors

- An overall monitoring and evaluation program designed to ensure that the convergence accelerator track on community science is achieving its objectives, including identifying any midcourse corrections needed to achieve those objectives

- Supports and networks that help ComSciTeams thrive

## Coordinator Activities

The coordinator would help build awareness for the ComSciTeams' recruitment by designing and launching a vigorous public relations campaign that would reach people and organizations that don't normally participate in NSF, help form coalitions, and help prospective teams produce more competitive applications. The coordinator would not be directly involved in the selection of the ComSciTeams, although they would help NSF recruit, prepare, and support community leaders and others to participate in the review of ComSciTeam proposals.

Once the ComSciTeams are selected, the coordinator identifies and provides services to support those teams. Some of the services the coordinator might provide, either directly or by recruiting and managing partners, include the following:

- Development: Help the ComSciTeams in attracting funding opportunities or exploring business opportunities beyond NSF support. This could include bringing a network of agency, nonprofit, and market contacts and helping the ComSciTeams connect with those contacts in support of their team activities. This would also be a resource for individual community-based organizations—backstopping individual ComSciTeams' efforts to help advance their community-based organizations' financial development.

- Evaluation: Community-centered, culturally responsive, context-dependent evaluation is an area of active research and innovation. The coordinator would help leverage this research for the benefit of the ComSciTeams and translate team experience and questions into future research directions for NSF.

- Knowledge transfer: The coordinator would develop and implement a knowledge management system to identify and share lessons learned across the network of

ComSciTeams and share those knowledge management tools with the ComSciTeams themselves to use. The knowledge network would also provide a way for NSF to learn from the experience of the ComSciTeams and the communities that are part of those teams.

- Training: Our committee recommends supplementing the current convergence accelerator curriculum with content specific to community science. The coordinator will help develop and deliver that content, and share that content with NSF and other agencies who are interested.

## Community Science Teams (ComSciTeams)

This track would specifically encourage proposals from Community Science Teams that would be coalitions of scientific, community-based, and intermediary organizations working together to nurture multiple on-the-ground projects in communities and advance the theory and practice of community science through teaching, learning, and coalition-building. The teams should adhere to the principles outlined above. Some may be more mature and therefore ready for projects and outcomes immediately, and some may be developing capacity and knowledge around community science.

In the spirit of cocreation, instead of prescribing exactly how the ComSciTeams should work, we look forward to creativity and innovation in submitted ComSciTeam proposals and the opportunity to try out different ways of working. On the other hand, to ensure the cocreation is real—that is, it involves just and equitable participation of community-based organizations, places equal weight on both community knowledge and scientific expertise, and benefits both communities and the sciences—we offer proposed goals for the ComSciTeams and a set of boundary conditions for how they achieve those goals.

### ComSciTeam Goals

- Use community science to make concrete, positive impacts in communities that are part of the team.
    - Examples of concrete community impacts might include building new green infrastructure that protects neighborhoods from flooding; creating green spaces and community gardens for community well-being; collecting and using data to reduce exposure to urban pollution; implementing a new, just climate action plan that creates opportunities in redlined areas; addressing mental and physical health through community-led environmentally focused interventions; etc.

- Build enduring and trusting relationships between community-based organizations, science institutions, and boundary-spanning, intermediary organizations.

- Help individual and organizational participants build their capacity for community science, including:

    - helping individual scientists learn and hone their skills for working with communities

    - fostering institutional changes within science organizations

    - helping community-based organizations build their scientific skills, increase their ability to work with scientists and science institutions, and develop capacity to leverage science-related funding opportunities

    - helping community members learn, participate in, and benefit from science

- Develop and maintain multisector networks that support community science and the ongoing activities of the ComSciTeam participants

- Foster and support individual community science teams that actively connect science to community priorities and leverage scientific and community knowledge to make concrete impacts in communities

- Support and maintain sharing of lessons learned, data sharing, trust building, and retention of community priorities and knowledge

## ComSciTeam Boundary Conditions

- ComSciTeams should include community-based organizations, science institutions, and intermediary organizations that understand data infrastructure, project stewardship and governance, community organizing, policy, etc.

- ComSciTeams should include people or organizations with experience bringing together community leaders and scientists and bridging science to impact.

- ComSciTeam governance should be shared between nonscientists and scientists, and ComSciTeams should have clear, equitable, and participatory decisionmaking processes.

- ComSciTeams should strive for pay parity between scientific, community, and organizational leaders.

- ComSciTeams should distribute funds equitably. Community participants should be financially compensated, and community-based organizations should receive the resources they need to support their work with the ComSciTeam and help maintain their organizations.

## Selection Process and Eligibility

In keeping with the principles outlined earlier, all community science track proposals should be reviewed by balanced panels of community leaders, scientists, and representatives from intermediary organizations. NSF already compensates all reviewers who are not employees of the U.S. government, and review participation is of clear professional benefit to scientists and members of organizations that work with NSF.

To live up to the principle of mutual benefit, we suggest that participation in review be part of a suite of activities codesigned to benefit community leaders. One of the mutual benefits will be cocreation: Community leaders will not just participate in the review process; they will be invited to help refine and improve the review process. Other activities might include facilitated introductions to relevant scientists and science institutions, community-leader-centered networking events, education to better compete for NSF opportunities, the chance to weigh in on emergent NSF priorities, and opportunities to provide feedback on, and even suggest ways to overcome, the barriers that make community participation in NSF challenging.

For both the national coordinator and the ComSciTeams to receive funding, a successful proposal must demonstrate an active commitment to cocreation by including community, scientific, and intermediary partners and defining the nature and roles of all partners[5]. The proposers must also demonstrate their commitment to mutual benefit by outlining strategies for sharing resources equitably and achieving benefits in communities on-the-ground[6]. Finally, proposals need to demonstrate their commitment to science as a human right by focusing on issues important to

[5]This commitment could be demonstrated through signed partnership and governance agreements, for example.

[6]This commitment could be demonstrated through a percentage of the budget being awarded to community-based organizations, explicit subawards, or a mechanism for regranting to community-based organizations, etc.

communities that have been harmed by oppressive systems and practices and partnering with, or being one of, the organizations in and of those communities.

## Community Science Team Evolution

Because partnerships require time to develop and because different organizations will be at different phases in their community science evolution, we suggest a multiphased process that will enable ComSciTeams to enter the community science accelerator track according to their needs, the status of their collaborations, and their familiarity with NSF.

### Building Phase

To open the community science accelerator track to community-based organizations that haven't worked with NSF and minority-serving institutions with excellent community science credentials but less grant experience, we also suggest a building phase. The building phase option would allow an emerging ComSciTeam to develop relationships, host assessment and listening activities to understand community goals and priorities, map those community priorities to the disciplines NSF funds through its directorates, identify scientific and community partners, explore data needs, reach out to data partners, identify the tools needed to support connectivity and action, and identify and connect with other skills critical to accomplishing community goals. Emerging ComSciTeams could also use this building phase to research and harmonize the many historical and contemporary approaches to community science from academic and community-based backgrounds.

For example, a building phase proposal might fund a small group of community-based organizations to hold a community listening session that surfaces widespread worries about air quality. On the basis of that, the group might use its funding to reach out to include local science institutions with air chemistry expertise, social scientists who understand how to motivate behavioral change, health scientists, and climate scientists looking at the impact of climate change on air quality. The group might also reach out to grassroots community organizers and policy think tanks to explore strategies for political change. All of this is designed to position them to compete, together, for a piloting phase proposal.

## Phase 1: Pilot

To be eligible for a piloting award, a ComSciTeam is expected to be an equitable team that includes community-based organizations, science institutions, and intermediary organizations united around a shared purpose. Mature and experienced coalitions might choose to apply directly to a phase 1 proposal and skip the building phase. In the pilot phase, the ComSciTeam is expected to pilot strategies and methods for equitably supporting community-based organizations and community members; nurturing impactful cocreated projects that deliver real community results; providing training to community and scientific participants; building up the capacity of participating community-based organizations; and fostering connections between community-based organizations and scientists.

A prototype of a successful pilot phase proposal is a concept developed by Metro Atlanta Urban Farm that was submitted by two of the steering committee members. The proposal is led by a community-based organization with experience working with scientists and NSF, includes a regional network of faith-based community-based organizations, has strong partnership with several regional science institutions—in this case, minority-serving institutions—and offers science-related educational pathways for community members. It has a strong plan for shared leadership, includes funding to community-based organizations, and offers capacity building to the community-based organizations and experiential learning to the scientific partners. The proposal focuses on a topic that was identified collaboratively with community leaders—urban agriculture—and describes several intermediary projects. Because the concrete example was so helpful in thinking through this phase 1, we include it as Appendix 3.

## Phase 2: Scale

In the final phase under a community science convergence accelerator track, a ComSciTeam focuses on scaling successful strategies and methods, expanding the network of participants, and building strong coalitions that advance systemic and large-scale change. In this phase, the ComSciTeam is expected to grow the number of communities it works with and the number of scientists and scientific institutions who participate in community science, and to welcome more intermediary groups. One goal in this phase is to lift up effective community science practices developed in the pilot phase and share those practices to launch and support cocreated projects that are rooted in a specific community context. Another goal is to connect participants across community science projects so they can drive larger-scale changes. Careful expansion in this phase will build strong and enduring coalitions, share successful practices, help organizations embed the most successful practices, and inform larger-scale changes.

An example of a successful phase 2 might be a community science concept around heat. Heat is both a subject of scientific priority and a topic of initiatives that can be incredibly impactful in communities. Heat is broad enough to embrace and support a range of cocreated projects and linked enough to point toward coalition building around common interests. Heat impacts all forms and shapes of communities, from direct effects like heat waves, to indirect effects like forest fires, or difficult breathing conditions from smoke. Several community-based organizations are already providing on-the-ground resources in times of need, and looking for ways to expand their services, address causes, and prevent heat from getting worse. Heat is also the subject of a research priority, as NSF supports efforts around resiliency (in particular, NSF's Civic Innovation Challenge has included a track around resiliency in two of its iterations). A scaled ComSciTeam would take successful strategies for advancing community science and a strong network of partners and offer them in support of deeply contextual and community-centered heat-related work while building a coalition that could share strategies and identify and work for systemic changes to reduce heat vulnerability.

## Phase Transitions

NSF's convergence accelerator structure currently includes extensive mentoring and coaching of the phase 1 teams toward a low-fidelity prototype of their solution and a phase 2 proposal. The existing curriculum of human-centered design, team science, communication, and storytelling and pitching is well suited to community science. To this curriculum, we suggest adding topics that support community science, including cultural competency and humility, community organizing, equity, and equitable decisionmaking. We recommend that this curriculum be cocreated and suggest that the coordinator should take the lead in designing and implementing this curriculum. Because the coordinator is selected, in part, for including community leadership, this means NSF would be learning about community science directly from community leaders.

Down-selecting from a large number of phase 1 projects to a smaller number of phase 2 projects, as in the other convergence accelerator tracks, would mean that some ComSciTeams would have less than a year of funding, which is not enough time for cocreation, creating shared benefits, or tackling unjust systems that restrict access to science. Ending projects after a short phase 1 could even leave communities feeling abandoned, damage relationships, and erode trust in science. Instead of reducing the number of teams and narrowing approaches to community science, the goal should be to advance every team that is meeting the success criteria designed by the national coordinator and evaluation service provider. This would ensure that projects can continue even if their next stage is not part of the NSF convergence accelerator. To advance this goal, the national coordinator and NSF

would actively work to connect all ComSciTeams with broader opportunities to continue their work, including seeking additional funding sources.

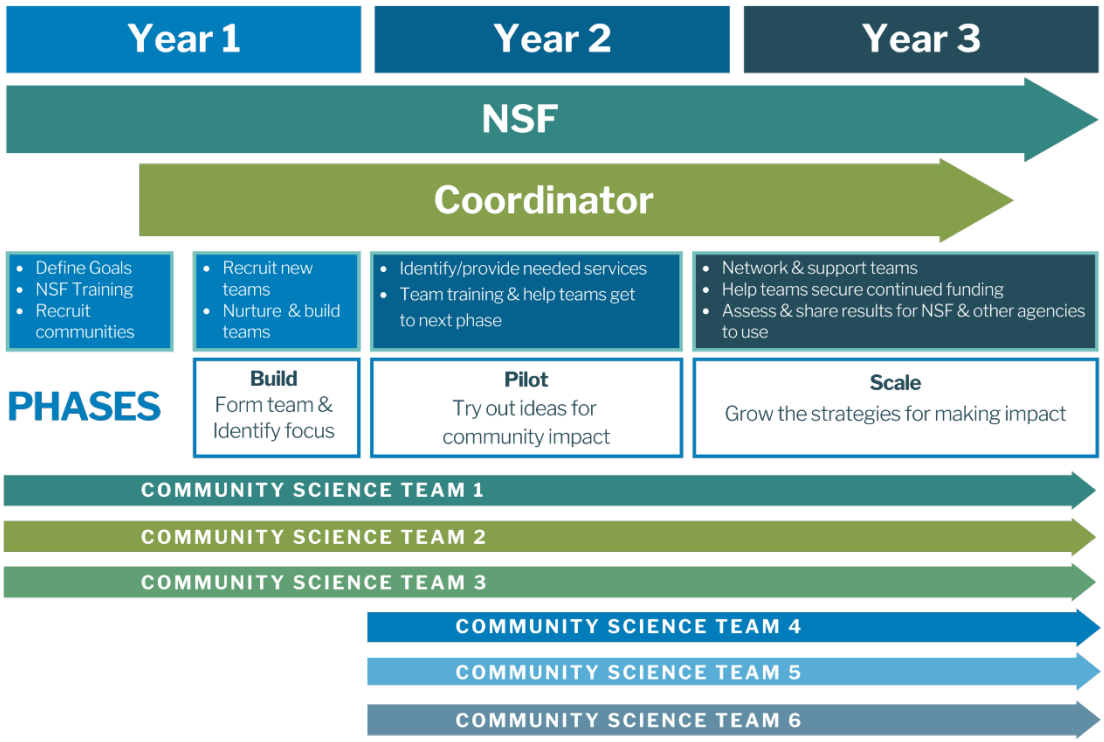


*Fig. 2. A timeline for a convergence accelerator track on community science.*

## Potential Community Science Team Topics

To maximize the opportunity for cocreation, we suggest an open approach to the scientific and societal foci that ComSciTeams take on. A team could be focused on a particular topic that unites many communities (like urban agriculture, gun violence, or mental health impacts of climate change); a team could focus on bridging between science and community-based organization members (like helping faith-based organizations access whatever science is most interesting to their members); or it could be about nurturing broad science-community connections within a geographic region (like a team that matches community-based organizations in a tristate area to local scientists who work on issues the organization cares about). A team might even choose to combine these elements.

We understand the risks of an open-ended approach to the selection of subject matter drivers of science. In our view, this includes the possibility that community-guided processes might land on topics outside the scope of NSF science. Workshop participants were equally concerned, however, that the preselection of topics would create less room for communities and deny NSF the opportunity to better map the current scope of its science or consider new opportunities. As part of our community workshop, we invited breakout groups to consider the ways in which community priorities connected to science, especially around community resilience, and a summary of the connections is presented in Appendix 3. Even in the short time available, the conversations demonstrated a rich set of potential topics and reassured us that an open invitation for ComSciTeam proposals would generate several submissions that speak to multiple NSF directorates.

Our suggestion, therefore, is that as part of its application to be a ComSciTeam, a prospective team be invited to show how and why the themes it has selected are appropriate and of interest to the community partners, how these themes have been generated through an inclusive and community-centered process, and how they connect to several NSF sciences. This is critical in phase 1 and should be revisited in phase 2.

# Community Science Practices

In this section, we suggest practices that the formal scientific community, including NSF and those who receive funding from NSF, can use to advance community science and better support community participation, especially the participation of small community-based organizations that are so central to the practice of community science. These practices were derived from the workshop discussions and online contributions, synthesized by the steering committee, and incorporated into the design of the convergence accelerator track on community science shared above. In some cases, the practices also point toward larger structural changes, and the steering committee created this section to highlight the opportunity for NSF and other funders to have a catalytic role in advancing community science by exploring and sharing these practices more broadly. These practices are reflected in the convergence accelerator track on community science described above, and we pulled them out below so that they could be adopted more widely and in other contexts.

## Practice 1: Increase Funding to Community Groups

Community-led science requires equitable funding. Participation can't be equitable if one side of the community-science partnership (usually the science side) has most or all of the money. For many small organizations, the work required to directly receive federal funds is not worth the effort, so a common practice is for the major institution to offer subawards to community-based organizations. However, this can create a situation in which the community-based organization feels like it has to "walk on eggshells" or risk losing the subaward. It may feel that without control over its own budget it lacks leverage and equal positioning to direct goals, methods, or metrics of success. This arrangement also means the major institution gets a disproportionate share of the overhead, including overhead that could be used to support the community-based organization. If a community-based organization is a partner, it should have a budget to fund its activities and sustain its organization, in the same way that universities and other research partners collect overhead to sustain themselves. This works at an individual level as well: One way we value all contributions is to pay all contributors equitably.

In the convergence accelerator track, the coordinator and ComSciTeam roles both require that funding go directly to community-based organizations. Some strategies that NSF and other federal agencies can use to reduce barriers to funding for community-based groups include the following:

- **Fund community groups directly and let them hire scientific partners.** In addition to funding scientists and science institutions to find and work with community partners, can community groups receive funds that they can use to look for and hire the scientists they want to work with?

- **Reduce barriers to getting grants.** Make it less onerous to apply for, receive, and report on funding, especially for small community groups. Examine the existing processes for hurdles that are unnecessary or assumptions that are exclusive or more challenging for small nonprofits.

- **Explore creative approaches to funding small community organizations.** What if there were culturally competent fiscal sponsors who could help community-based organizations receive and manage NSF funds? Can NSF support an intermediate organization that receives and manages funding from NSF and passes that funding through to community groups?

- **Support for community organizations.** Small organizations need support for infrastructure and organization, not just for particular projects. This can be accomplished through funding for organization development or guidance for smaller organizations to negotiate more favorable indirect rates.

- **Inventory and adopt best practices.** A comprehensive review of funding approaches that nonprofits and other federal and even state agencies are using to advance equity in funding could identify additional best practices.

## Practice 2: Advance Authentic Community Engagement

Too often, community participation pursued by scientists and science institutions has been a kind of check-the-box exercise that results in no long-term community benefit and leaves the community feeling used. Extractive practices, in which scientists show up, collect data, do a little outreach, and disappear after gathering the data, still happen. This practice is common enough that it has been given colloquial names like “helicopter science” and “parachute science.” We even heard stories of cold calls weeks or even days before proposal deadlines with a request that a community sign on to a proposal that was almost completely developed without them. Even one example of this kind is one too many. Our proposed design of the convergence calculator on community science requires strong coalitions and provides ComSciTeams with funds, time, and support to develop those coalitions. NSF and other agencies can do several things to drive more authentic community engagement even beyond the accelerator:

- **Require clear agreements** that outline the roles, benefits, and contributions that community-based and scientific organizations make to the overall project; the processes by which decisions will be made; and the means for managing disagreement and conflict.

- **Require long-term plans** for continuing the community engagement beyond the life of the grant and require that these plans be codeveloped with everyone on the team. Offer workshops and examples of long-term engagement, perhaps led by (compensated) community-based organizations.

- **Include community in setting research priorities.** Science-based organizations could do a regular and systematic assessment of the challenges and priorities communities are working on today to identify the research questions of tomorrow. For NSF, this might mean including community leaders in NSF governance or oversight, or meeting community leaders in their spaces to learn about their assets, needs, and priorities.

- **Cocreate the measures of success.** Collaboratively develop new measures of success, using metrics built from the data and stories community-based organizations already collect. Use these community-centered ways of collecting and sharing community outcomes to evaluate progress toward collaboratively set programmatic goals.

- **Welcome community members in research governance.** NSF could foster this by requiring an explicit discussion or plan for community participation in decisionmaking and governance in any proposal that touches community groups. NSF could also model this by inviting community leaders into their oversight and advisory bodies.

## Practice 3: Support Infrastructure for Community Science

Many people and institutions that do community science have fewer resources and less visibility than those with more traditional research focuses. This is especially pernicious for minority-serving institutions and people of color. The convergence accelerator track on community science is an incubator for new infrastructure, and NSF and other agencies can expand that incubator through the following complementary activities:

- **Invest in community science leaders.** This could take the form of grants for individuals, perhaps based on programs like the NSF graduate fellowships or early-career awards.

- **Support centers for community science.** Regional, topic-based, or community-based centers came up in several recommendations. National or regional centers, built on the

successes of the ComSciTeams, could help connect community leaders with scientists and support them as they do community science projects and influence other science centers. These centers could also help coordinate work across agencies and help elevate emergent and common community challenges to guide future investment and decisionmaking. Existing centers of excellence in community science, especially those in community organizations or minority-serving institutions should be invested in first.

- **Cocreate community-centered tools and resources.** Invest in existing open-source, shared infrastructure and cocreate new tools that make it easier for community leaders and community members to find scientific partners and design scientific projects. Examples might include developing matching services, problem-scoping services, tools and standards for community data, and land grant extension services.

- **Relationship grants.** Agencies should offer exploratory grants that allow coalitions to develop and issues to be explored collaboratively. In the design of a convergence accelerator track on community science, this is explicitly modeled in the development phase.

- **Invest in the right institutions.** Minority-serving institutions with a strong history of community engagement, community colleges, and community-based organizations should receive the bulk of new funding for community science and should be the first groups approached to lead the development of training in community science. This is consistent with the federal government's Justice40 Initiative.

- **Community-ready outputs.** Make sure projects are conducted and communicated about using plain language and addressing language barriers by offering translation services or creating in multiple languages.

## Practice 4: Drive Culture Change in Sciences

We often heard that a key element in all this comes back to changing the culture of science: to make applied work as valued and rewarded as theoretical work; to celebrate local and contextual solutions as well as more global insight; to encourage humility as part of the science mindset; to respect many ways of knowing; and to position science as an ally for justice. This is mostly the work of the scientific community, and while it requires the guidance and input of nonscientists, it is not the responsibility of those nonscientists to do the hard work of changing hearts and minds of practicing and future scientists. The convergence accelerator track is a laboratory and spark for culture change; practices that can advance that culture change more broadly include the following:

- **Find ways to value outcomes that aren't publications.** Scientists and science organizations need to work with community advisers and evaluation specialists to design new ways to assess the impact of community science, and they need to incorporate those assessments into the criteria they use to reward and advance scientists.

- **Train scientists and future scientists.** Require community science training for all scientists and future scientists. These curricula should emphasize cultural humility, equitable facilitation, sharing leadership, team management, project management, conflict resolution, active listening, human-centered design, and participatory research methods, and training should be, itself, codeveloped.

- **Develop career pathways.** The career pathways for community science are literally being invented right now. To help people, especially people early in their career or people from groups historically underserved in science, simultaneously navigate and coinvent these emergent career pathways, structured mentoring, including peer mentoring, would be helpful.

- **Adopt guidelines/guardrails designed to protect communities.** Protections and processes for engagement with communities, like the ones we have for human and animal subjects, should be developed and enforced. Bans on publications from helicopter science are one example. There are several good examples to draw from, especially in the social sciences.

- **Challenge white supremacy.** This came up several times in the workshops: that the dominant or default ways of doing things in science are tainted by the legacy of colonialism and white supremacy. Helping people to recognize that history, and explore alternate ways of doing things, is essential to the success of community science and contributes to the overall success of science.

- **Foster interagency cooperation.** Develop an interagency working group on community science to share best practices for doing community science, strategies for supporting community science within the federal government, and, most important, helping connect individual community groups to the most appropriate agencies for their priority.

## Practice 5: Support Community Data

There is an unfortunate history of taking data out of communities and publishing data about communities without the permission and without benefit to the community. The antithesis was

expressed most powerfully as “nothing about me without me.” Some of the ways in which we can support community data include the following:

- **Design for data that are useful at community scales.** Scientific data are, by definition, designed for scientific advancement. Community science data place equal design attention on the use and usability of data by community members. This is often an iterative process of learning about the decisions people want to make, translating existing data into information that informs those decisions, and identifying the new data that are necessary. It is also about cobuilding infrastructure and tools that make data available to and usable by nonspecialists. NSF-funded domain repositories provide an excellent home for modeling this principle and the ones below.

- **Support long-term community data curation.** There are relatively few repositories or archives that support community data curation, and it is a hard thing for many communities to tackle. We need to create ways for communities to plan, contribute to, and participate in data collection, and to share or, if appropriate, retain their data. Current repositories may need help in supporting or including community-led data.

- **Require community data plans.** Every community science project should include an explicitly negotiated agreement about how data will be collected, managed, and shared, and who will make decisions about data in the event of a disagreement. Because of the community engagement in these plans, this goes beyond traditional NSF data management plans. For instance, the data plan might include a community data board that reviews the data before they are shared more publicly and a public statement about how the data plan was created. To advance this, share examples of existing community data plans and provide guidance on best practices, for example, the CARE principles (Collective benefit, Authority to control, Responsibility, Ethics), for Indigenous data governance. Special consideration should be given to the most marginalized members of any community.

- **Community and open science.** Much of the work of open science is focused on access and usability by and for professional scientists. Agencies can expand the conversation and broaden participation and convene around openness that includes sharing data and enabling action for community science projects, community organizations, and community leaders.

## Practice 6: Support Community Capacity

The capacity to engage in science is embedded within and supported by a wider and deeper set of capacities, and so any effort to support community groups has to support these larger capacities.

NSF should support opportunities for communities to self-organize, define their own measures of success, and celebrate and advance their own leaders and history.

- **Better communicate grant opportunities.** By inviting community-based organizations to our workshops, we learned that several had never heard of opportunities to engage with NSF. Overall, we learned that many community-based organizations, local governments, and tribal governments find it challenging to learn about and navigate the federal resources that are available to them.

- **Grant concierge.** An easy-to-navigate, community-friendly service for community leaders to learn about relevant grants would be very welcome by community leaders, especially if it included a human touch and connections to the kinds of scaffolding and support that could help communities become eligible for those opportunities.

- **Develop community-centered reporting.** Consider alternate forms of reporting that might be better aligned with the priorities of community-based organizations. Are there products or artifacts that are inherent to the project that could be submitted as evidence of accomplishment? What practices can encourage a wider variety of data types (e.g., storytelling by video or oral history) to be honored in evaluating community science?

- **Networks for communities** to learn from one another, share tips and strategies, and provide introductions to helpful partners. This would foster community-to-community learning, build a more welcome space in science, and provide important feedback in ways that protect community organizations (it can be risky to individually offer feedback to your funder).

- **Community ambassadors.** Many science institutions have community engagement specialists—what if community organizations had funded science engagement specialists? These could help community members connect to science, to advocate for science in the community, and to advocate for communities in scientific settings.

- **Address community priorities that precede science.** We heard from community members that they cannot spend time writing a science-related grant if people in the neighborhood are hungry or traumatized. Can science groups be a broker to other partners so that these priorities that are perhaps even more critical can be addressed?

- **Community-centered communications.** Materials need to be cocreated in multiple languages and formats.

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# Appendix 1: How This Report Was Prepared

## Steering Committee

The steering committee played a vital role in the success of this initiative by ensuring we had guidance from a variety of stakeholders. The committee was composed of a mix of academics, community members, practitioners, and boundary spanners (people who operate at the intersection of the categories above) who convened virtually on a weekly basis. They provided feedback, guidance, troubleshooting, and direct suggestions for how to frame the process and proceed.

The steering committee worked with AGU staff to determine a plan of action that involved soliciting the public for ideas about tracks, inviting a broad range of stakeholders to an open and free virtual workshop to further develop track ideas in a facilitated setting, and a hybrid steering committee meeting to turn those suggestions into a final set of recommendations for NSF.

As part of its work on this project, the steering committee developed a set of definitions that guided both the larger project and the expectations for participants who shared their ideas and insights during the workshop and submission period.

> **Science:** We mean science in an inclusive way: activities, ways of knowing, and processes that develop, refine, and apply knowledge about the world by modeling, deducing, experimenting, observing, experiencing, classifying, and/or reasoning, etc. Science activities include research, application, education, and synthesis or integration. We invite all approaches to science including Indigenous, Western, and Eastern.
>
> **Citizen science:** Initiatives that engage members of a community—including nonscientists—in scientific research such as data collection, data analysis, and problem solving.
>
> **Community science:** Community science is the equitable collaboration of science and research with communities, aimed at outcomes for the benefit of communities and science with a focus on prioritizing community benefits. Work can be led by collaborative teams of researchers and community stakeholders or be community-led.
>
> **Community resilience:** Ability for communities to adapt, recover, or withstand adversity and challenges, especially adversity or challenges related to climate change, in a sustained manner. At its best, resiliency addresses the underlying causes of inequality, repairs past harms, and addresses future injustice. Resilience isn't just about bouncing back from disaster. It's about bouncing back better and undoing the inequities and injustices that made

and continue to make communities vulnerable in the first place. Resilience is about breaking cycles, not just surviving them.

## Website, Idea Solicitation, and Promotions

The above definitions were compiled along with information about the NSF convergence accelerator process for a website that went live 8 September 2022: https://resiliencethruscience.org/. This website provided a central portal for sharing information about the project such as how to provide suggestions, participation in the virtual workshop, and goals of the initiative.

Using this information, invitations went out to engage a wide range of stakeholders to register for the virtual workshop and/or contribute suggestions for a potential track via https://community-science-resilience.feedbear.com/. Potentially interested audiences were reached through a combination of personal invitations via the networks of the steering committee and AGU staff, posting to various relevant outlets such as the Thriving Earth Exchange newsletter, sharing on social media, and chain-referral methods. AGU internal teams created graphics, suggested language, designed the website, and purchased ads for relevant markets to support this effort.

Promotional efforts resulted in 35 unique idea submissions to the FeedBear site; 1,300 website visits, of which 600 were unique; 20,843,777 impressions on Twitter, resulting in 69,646 link clicks; and 90,709 impressions on Instagram, resulting in 380 link clicks. Stakeholders were also invited to register for the virtual workshop, which garnered 442 registrations of which 232 attended.

## Virtual Workshop

The workshop was held via the app Zoom on 7 October 2022, from 11:00 a.m. to 3:00 p.m. ET. In preparation for the event, 27 volunteer facilitators were trained by Tim Mealey, a senior fellow at the Meridian Institute and facilitator for the grant. Eight volunteer notetakers were also enlisted to ensure that breakout group discussions were captured.

The workshop began with a plenary that introduced attendees to the purpose of the workshop. This included a presentation by Aurali Dade of NSF to ensure that all participants understood the goals and processes of the NSF convergence accelerator. Attendees were then invited to join breakout groups of their choosing. The first set of breakout groups focused on the “how” of a funding track with such topics as “Capacity Building Within NSF and Institutions of Higher Education,” “Equitable Community Engagement Practices,” and “Data Gathering, Management, Ownership.” The second round of breakout groups focused on the “what” with such topics as “Climate Change Impacts,” “Mental Health and Well-Being,” and “Transportation Justice.” Organizers also added an “Environmental Justice” breakout group at the request of attendees. Each breakout period was

approximately 1 hour, and attendees were guided by one of the trained volunteer facilitators while a notetaker captured their conversation.

Of the 232 who attended, 63 took a postworkshop survey indicating that 30% were from the nonprofit sector, 58% were academics/researchers/scientists, 14% were community representatives, and the remaining indicated "other or not applicable." Twenty percent indicated they had lots of previous experience with community science, 31% said they had a fair amount, 35% had some experience, 11% had very little, and 1% had no previous experience with community science.

## Report Development and Feedback

Following the workshop, the steering committee met in a hybrid meeting on 25 October 2022 to review the notes and outcomes of the workshop and develop a plan for the set of recommendations for NSF. During this meeting, the committee determined that this would include a firm plan for a potential track within the NSF convergence accelerator as well as a summary of the important suggestions, principles, best practices, and recommendations that emerged from the idea submissions, the workshop conversations, and the committee's own knowledge on the topic. Once a draft was developed, a copy was shared with the attendees of the workshop to invite comments and suggestions. This provided one additional way that broader stakeholders could engage with the process and ensure it reflected their voices and priorities.

# Appendix 2: Examples and Ideas Submitted by Steering Committee Members, Virtual Meeting Participants, and Online Contributors

### Building Air Quality STEM Curriculum to Empower Students and Communities

Author: Hillarie Sales

1. Title & Brief Description

a. What is in your air?

b. The Oregon DEQ and USFS, in collaboration with Lichens CitiSci and Sunny Wolf Charter School in Wolf Creek, Oregon, have developed a longitudinal citizen science environmental monitoring project called “What is in your air?” Connecting youth with outdoor spaces through environmental monitoring and resource management is critical as they will be our future leaders and stewards of natural resources. They are the future of citizen science efforts and can become empowered through learning about and participating in actual resource management. This work is necessary now, more than ever, especially with increased wildfires, urbanization, habitat loss, and declining biodiversity. These opportunities can create accessible STEM career pathways for them. One real-world environmental problem to solve is that underserved communities are often disproportionately exposed to higher levels of air pollution. We want to empower youth in these communities to think about local air impacts by sharing expertise in air resource management and monitoring through What is in your Air?

2. Challenge

a. The challenge is to create a comprehensive indoor and outdoor curriculum.

b. Citizen science opportunities help to make science and nature accessible while encouraging participants to contribute first-hand. It can be difficult to make an argument with society that biodiversity matters, it is more accessible to make an argument that air quality matters because everyone breathes air and is impacted by air quality. At Sunny Wolf Charter School the students know firsthand about the impacts of bad air quality from wildfires and private trash fires.

c. This project currently focuses on one small community in Oregon, building awareness to air quality issues and helping the residents become knowledgeable about their own air quality. The curriculum has the potential to be scaled up to the high school learning level and the flexibility to be used anywhere in the nation.

3. Plan

a. Partners and Stakeholders

i. Partners for this project include students (middle and high school students in any community), educators, local environmental agencies (e.g., Oregon DEQ or Josephine County Environmental Health professionals), scientific experts and community representatives may be included in the curriculum.

b. Activities

i. Three phases of learning including hands-on exploration about air quality monitoring protocols, fieldwork at their school and on National Forest land, analysis of data (collected and historic), discussions about what is in the air and why it matters.

ii. The students will have ongoing access to experts in-person and digitally.

iii. They will learn to use real scientific instruments, tools, and data to plot, collect, and document sites as a part of an environmental practice.

iv. The project will introduce the Clean Air Act and what resource managers at local, state, and federal levels do to protect the air.

v. Zoom and in-person lectures are planned to show how air monitoring data corresponds to the CAA and to evaluate lichen to support the monitoring data and enhance understanding of air toxics and that it plays an important role in monitoring.

vi. Professional development is planned for educators with continued support.

vii. Classroom activities include:

1. Breathing exercises, observational sketching of lichens, creative brainstorming on impacts to air, creative writing exercises exploring ecological impacts from air pollution on their community, photo essays of lichens, reviewing and analyzing historic air quality data to examine trends (state/local), research of local air pollution impacts, final reports to be shared with the community and stakeholders at the school-hosted science and math night.

4. Impact

a. Deliverables

i. The creation of a curriculum with national applicability that can be scaled up or down to accommodate any community with concerns about air quality.

ii. A showcase of learnings for community and stakeholders

iii. Connecting kids with natural resources recognized for their ecological, geological, scientific, cultural, and educational value and empowering them to participate in actual resource management

b. Continued work

i. This project lays the groundwork for continued curriculum building around STEM topics that are frequently removed from application in careers and the green or environmentally focused concepts

ii. This program provides supporting information on career opportunities and the many ways to preserve natural resources by connecting students with air quality experts and professionals.

iii. This has the potential to work in any community and can be scaled to work at any level of K-12 learning.

iv. This will work with any local or state government, any educational facility, and creates opportunities for students to work with scientists and scientific partners with low time requirements from professionals.

v. This project can bring in the entire community to learn about their air when the students present their projects, and it will empower students, their families, and their community to ask important questions and find answers about their own air quality.

5. Equity

a. This track invites local, state, tribal, and federal governments, and partners to participate in projects with students.

b. Underserved communities are often disproportionately exposed to higher levels of air pollution. This project empowers youths to think about local air impacts and helps to inform the community.

c. This project can identify air quality trends and patterns in historical and current data.

d. Communities without existing organizational infrastructure benefit from the expertise of local, state, tribal, and federal partners, and air quality science experts.

6. Project Examples

a. This curriculum is currently being constructed for the Sunny Wolf Charter School in Wolf Creek, Oregon. It is a Title 1 school and a Provision 2 school providing free lunch to all students. Funding for the pilot project is provided by an awarded 2022 Greening STEM grant.

i. The funding provided 2 PurpleAir monitors to the school, iPads for students, pays for lichen biomonitoring fieldwork training, sample collection, and lab analysis. It allows for expertise from the Forest Service and Oregon DEQ, providing high quality data and analysis.

b. Funding for this track will help to create the nationally applicable curriculum that can be used in any community to empower youth by learning why the quality of air matters and what actions can be taken to protect it.

7. Recommendations

a. By funding this project, NSF will allow local, state, and federal governments to assist underserved communities with the implementation of this curriculum.

b. This should include tribal partners, local air quality experts, and science educators.

## Facilitating Access to NSF by Communities

Author: Lora Harris

I envision a new funding track that has thought through the challenges of access to federal funding for communities. This is particularly true around proposal paperwork requirements that may not be applicable to community members and effectively exclude them as PIs and co-PIs. There are models elsewhere at NSF to help diverse applicants participate - for example small businesses. For community members, barriers in my experience have included: current & pending and COI requirements, institutional approval (when there is no institution), federal registration, etc. Can a new program find ways so that proposals can fully include community members as co-PIs when so much of these aspects of the application are not feasible?

## Improving Equity in STEM Education Through Place-Based, Culturally Relevant Pedagogies

Author: David Porter

Diversity initiatives in STEM education often fall short of desired outcomes. The replacement of deficit-focused, color-blind pedagogical models with approaches that build on local cultural knowledge and integrate a critical awareness of the entanglements of STEM disciplines in locally

relevant historical contexts might be expected to improve outcomes for under-represented student populations and for research and educational practices in STEM fields.

## Citizen Science/Community Science in Museums

Author: Laura Trouille

Engaging millions of museum guests across the world each year in real research through citizen science, community science, people-powered research. Image is from the Adler Planetarium in Chicago U!Scientist Galaxy Zoo multi-person collaborative touch table experience. Funded by an NSF-AISL pathways proposal. So much potential for more of these spark experiences in museum settings with long-term engagement through online citizen science communities like Zooniverse. So much potential to scale; across disciplines, across communities, across cultural organizations, etc.

## Conference to Expand and Enhance Equitable Access to NSF Funding Opportunities in Marginalized and Underserved Communities

Author: Metro Atlanta Urban Farm

A two-day conference with break-out sessions, panel discussions, and networking opportunities, co-led by professionals and community leaders to identify and support the needs of conference participants who plan to seek funding from the NSF. This conference will review the processes and criteria for funding to ensure equitable outcomes and success in their requests for funding.

Challenge
Underserved and marginalized communities in the past has not had access to these types of opportunities from the National Science Foundation. Therefore, it becomes difficult for us to formulate our ideas and believe that they will be accepted for funding based upon trust and transparency.

There are those of us who believe that after receiving our ideas, they will be used at a later date and time within our communities by other organizations that have typically have access to this type of

funding.

Many of our constituents who work in these communities do not understand the language and the expectation that the NSF is requesting. We also believe that the NSF does not understand the language and the needs of marginalized and underserved communities. It becomes necessary that we find common ground that that we can work towards.

Plan

As one who has been engaged in projects that were funded by the NSF, I realize that we have been put under a tremendous time challenge to understand the language and the commitment that are needed to have a successful outcome for the projects that we anticipate will be submitted. Therefore, I feel that it is necessary for us to bring our community together.

1) To support the community if their projects are funded

2) To help communities build on the big ideas that they have for their communities that will have the impact that will change lives in the most positive way and have an impact on the generations that will follow

3) To host a two-day conference to help formulate the communities' ideas into a plan of action. If their ideas are not accepted, the conference will enable them to enhance and expand their ideas into a more acceptable format.

Impact

The impact of the conference will be, if these organizations' ideas are accepted, this conference will be able to provide support, leadership, and expertise to assure the success of the project. It will also provide an opportunity for an exchange of ideas as we build on the success and the failures of each other. The conference will be directed towards the 50-plus participants that we added to the data base as a support mechanism. Other will be invited to participate.

Equity

As one who has worked in the community for the community, we find this process of submitting ideas not to be equitable. The average person who works for a non-profit or other organization that is based in the community will find it difficult to complete the process of submitting an idea.

This conference that we are recommending will help enhance skill sets so that more community-based organizations will be better prepared to participate in the process from start to finish.

## Advancing Use of Community and Citizen/Resident Collected Data in Decisionmaking and Monitoring

Author: Shannon Dosemagen

Much of our focus on community-collected data is on singular use rather than systemic transformation. To build stronger models for community involvement in environmental governance, and crisis preparation and response, our systems for including science and data need to be transformed rather than just modernized (i.e. taking a legacy system and updating the software). This can be done through activities that cross many disciplines leading to multi-sectoral engagement in designing the environmental governance systems that will allow us to adequately address environmental and climate injustices.

## Designing for the Inclusion of Metadata

Author: Shannon Dosemagen

Metadata is essential in community science and understanding response to crises as it allows for nuances and social complexities of communities to become present. However, in environmental decision-making and governance, data that shares stories, experiences, and history in various formats is often not prioritized. Projects that demonstrate the impact and importance of metadata, and lead to guidelines for how metadata can be systemically used alongside other forms of environmental data can lead to more and better input and impact for communities.

## Community Climate Resilience Through Cultural Heritage

Author: Marcy Rockman

Every community holds history and heritage. This history has created places, practices, and knowledge that are important to each community. This history has also shaped where communities are located, how they have developed over time, and so is part of both exposure of communities to the climate impacts and their sensitivities to those impacts. However, knowledge and support to communities to work with their heritage to protect and manage it with regard to climate impacts and responses and work with it to plan for their future is nearly completely absent in the US. This proposal recommends a funding track on climate change and cultural heritage that will enable collaboration and innovation in understanding the impacts of climate change and human responses to them such as sea level rise and migration and relocation on community heritage, and social and physical science approaches to working with heritage as part of climate change adaptation.

Challenge

Every community holds history and heritage. This history has created places, practices, and knowledge that are important to each community. This history has also shaped where communities are located, how they have developed over time, and so is part of both exposure of communities to the climate impacts and their sensitivities to those impacts.

To date however, cultural heritage and the history of communities is not well represented or integrated in climate adaptation science, planning, or implementation. Several Indigenous communities have been eloquent and forceful in speaking about and organizing to protect their communities and heritage in relation to climate change, such as community of Isle de Jean Charles in Louisiana, and several Native Alaskan communities such as Newtok and Shishmaref. What should be recognized alongside their activism is how rare and sparse support is to help them document their history and heritage, carry portions of it forward to new locations, and work with their heritage to ensure it helps create a future they want to live in. And such gaps in support also raise barriers of silence and capacity for other Indigenous and non-Indigenous communities, including communities now recognized as environmental justice communities, to engage with their own heritage for resilience.

Places in which support for cultural heritage in relation to community adaptation should exist but don't are many. For example, the US National Park Service, which is the lead federal agency for cultural heritage, does not have an active program for cultural heritage and climate change, nor does the National Trust for Historic Preservation. This has left major gaps in methods and data for identifying, monitoring, and managing diverse physical impacts of climate change on across all forms of tangible and intangible heritage. Climate Adaptation Science Centers, which are overseen by the US Geological Survey, occasionally review proposed heritage-focused projects, but do not hold a range of staff with heritage expertise. State Historic Preservation Office and Tribal Historic Preservation Offices have roles in planning for impacts to cultural heritage and supporting communities but are also historically underfunded and are now facing increased numbers of

environmental reviews as projects funded by the Infrastructure Act gets underway. These situations have led to gaps in support to communities in working their heritage in relation to climate adaptation and mitigation.

Therefore, there is need to build knowledge, skills, and network capacity to support communities in protecting and working with their heritage in relation to climate change.

Plan

This proposal is inspired by two existing projects, a center in the US and a citizen science/community engagement approach in the UK. More about both of these and the sample projects that could be funded through this track are described below under Project Examples.

Work in this track would engage partners across multiple sectors, including: social science researchers (anthropologists, archaeologists, historians, geographers) in research/university and professional practice roles; Indigenous communities and related or Indigenous lead organizations; historic preservation practitioners and heritage managers (including federal, state, Tribal, and local government staff); cultural resource management companies; landscape and building architects; landscape and other engineers; photographers and other fields working in documentation, at least to start. Work under this track may be based at universities, but also should be accessible and responsive to work proposed and hosted by SHPOs or THPOs, museums, or non-profit or non-governmental organizations.

Impact

The current lack of support for cultural heritage in climate change resilience (described above) has become its own reinforcing cycle- no one is engaging with heritage in a nationally visible way, so it has become and remains acceptable to not fund or work with communities with respect to their heritage. If the Project Example projects were funded through this track, three years of work through the Center and particularly deployment of at least several HEART teams would begin to build a body of case examples of how communities can work with their heritage. This in turn could have the impact of sparking engagement and attention to heritage across agencies and institutions that currently do not recognize it.

Benefits of heritage are difficult to quantify economically. In fact, cultural heritage is listed as part of non-economic loss and damage by the UN Framework Convention on Climate Change, via the Warsaw Mechanism for Loss and Damage. One of the approaches of the HEART teams in collaboration with the Center (see again Project Examples), would be to capture qualitative community responses about how they feel about working with heritage and whether it appears to have made a positive difference in their approaches to climate adaptation. Comparison with other

non-heritage focused adaptation programs, such as the NOAA Regional Integrated Sciences and Assessment Programs, could be another project to track whether engagement with heritage makes a difference in form and outcome of adaptation projects.

Equity

Heritage as it is intended to be addressed through this proposal will support and build equity. Heritage in this project are places, practices, and knowledge that communities identify as being important to them, not as they are listed in the National Register of Historic Places, state registers, parks, or other formal designations. While there has been attention in recent years to improving the diversity of such lists, they remain weighted toward priorities and histories that are wealthy and white.

Careful groundwork and procedures should be developed for this track as a whole or in relation to the Project Example projects to help understand community backgrounds and to take best possible steps that work with heritage in the community does not exacerbate existing tensions or create new ones. Not all heritage is pretty or easy and many communities now recognized as environmental justice communities have experienced deep trauma across their history. One partner that will be sought for this project is the International Coalition for Sites of Conscience, which is an international network of sites and organizations who specifically care for places with difficult histories. The Coalition has developed approaches to community-based dialogue that have made it possible to bring individuals together to talk about very difficult times and events. Drawing again from the Project Examples, in this sense, the work of HEART teams will differ in some regards from SCAPE in that a goal for some communities may not be to hold onto or carry forward part of their past, but work through it to understand better some of the climate vulnerabilities their past has created and identify steps to address those vulnerabilities.

With regard to Indigenous knowledge, the premise of this project that every community has history and heritage recognizes and will seek to incorporates and engage well with the deep and complex Indigenous history of the US. Many places that are no longer designated as Tribal territory hold places, traces, and patterns of Indigenous life and may remain important to affiliated Tribes. Work of this track (and the Project Example projects) should include building partnerships with Tribes and Tribal organizations to find and share best approaches to working with Indigenous history and heritage across many communities.

Project Examples

This proposal is inspired by two existing projects, a center in the US and a citizen science/community engagement approach in the UK.

The inspirational US Center is the NSF-funded Natural Hazards Center (NHC), located at the University of Colorado, Boulder. The NHC is widely respected across fields of disaster risk reduction, disaster, response and emergency preparedness as a source and translator of relevant social and physical sciences and their practical applications. The NHC hosts an annual conference, the Natural Hazards Workshop, which brings together researchers, planners, emergency responders, government staff, and others to share and discuss common topics and issues. The NHC also coordinates a range of grants to address both emerging issues and major disasters, and publishes newsletters that highlight new research.

Taken together, this proposal envisions a Center for Climate and Heritage that would serve as a hub for coordination, fundraising, research and knowledge development and sharing, that will work in collaboration with regionally based HEART teams (final name may change, HEART here standing for Heritage Engagement and Resilience Training). The SCAPE team in the UK is currently just three people for all of Scotland working around the coast (of which there is a lot in Scotland); an eventual goal for the US would be at least 5-6 teams who would work with not only with coastal erosion but also many other climate impacts such as wildfires, droughts, economic transitions, etc.

This plan would engage partners across multiple sectors. The Center for Climate and Heritage would be based, like the NHC, at a university. Work of the Center would bring together social science researchers (anthropologists, archaeologists, historians, geographers), historic preservation practitioners and heritage managers (including federal, state, Tribal, and local government staff), cultural resource management companies, landscape and building architects, relevant engineers, photographers and other fields working in documentation, at least to start. HEART teams may be based in various institutions depending on region - such as universities, affiliated with SHPOs or THPOs, museums, or other locally respected non-profit organizations.

## Building Training Programs for the Next Generation of Data Managers, Scientists, and Implementers

Author: Shannon Dosemagen

The majority of our focus in community science and disaster management is in better training communities (already over-capacity) to deal with project and data management, learning how to analyze and use data, etc. In addition to these types of capacity-building efforts, doing the same type of training for data scientists, enforcement and compliance officers, etc would help to enable a multi-directional learning and sharing model for using science to deal with crises. For instance, teaching

topics like facilitation, conflict resolution, and community-centered design could ensure that we're all responsible for the ways we work together.

## Research at Community-Relevant and Community-Approved Scales

Authors: Omega Wilson, Brenda Wilson, Ayo Wilson - West End Revitalization Association

Community science research supported by the National Science Foundation should collect data at the community level and not at the census-block level. Census-block level data (often the default unit supported by federal agencies) does not reflect communities. Reliance on that unit therefore dilutes data, findings, and outcomes including regulations and funding allocated for corrective action. NSF should support research where protocols for data collection are community-vetted and approved for collecting data at a level that reflects the scope of impact.

## Restoring the Broken Bonds: Governance, the Environment, and Ethics in a Disruptured World

Author: Andre Francisco Pilon

Earth's regeneration and mankind's regeneration, as faces of the same coin, are addressed simultaneously, in space and time, for their mutual support. Development policies, technological solutions, binding nature to financial domains, often ignore social, cultural and environmental impacts and reinforce current paradigms of growth, power, wealth, work and freedom embedded into the political, technological, economic and educational institutions. Viewing climate change as an isolated scientific problem requiring technological solutions derives from dominant climate and energy programs, policies and priorities, that aggravate inequalities and perpetuate economic and political dominant privileges and power. Political and economic systems endorse the abuse of nature by monopoly companies through devastating wood extraction, mining exploitation, coal, oil, and gas energy projects and industrial chemical production (plastics) and agribusiness (seeds, genetically modified crops, fertilizers, pesticides). Institutional capacity, judicial neutrality, transparent information, opening up of new social spaces for enlightened participation are fundamental for transformative actions, implying public scrutiny, accountability and independent clearance bodies. In

this sense, a multidimensional ecosystem approach is posited for diagnosis and prognosis of environmental, cultural, educational, political and economic interrelated problems, encompassing all dimensions of being in the world (intimate, interactive, social and biophysical), as they interact to elicit, maintain or transform the events. Instead of being trapped into pre-established problem-definitions, in the social-cultural learning niches, spaces are opened for allocation of new meanings, heuristic-hermeneutic processes develop a capacity to ask wider questions, reframing the problems, unveiling their dynamic and complex configurations, altering definitions and ways to deal with the issues, encompassing public policies, advocacy, communication, research and teaching programs. Endurable and consistent results depend on the non-partition of knowledge, encompassing human, exact and natural sciences; all areas are considered and validated; instead of taking current prospects for granted and project them into the future, the definition of desirable goals and the exploration of new paths to reach them contemplate a set of values, norms and policies that prioritizes socio-ecological objectives, human well-being, natural and built environments, the aesthetic, ethical and cultural meaning of the existence. The proposal is fundamental in catalyzing a shift away from narrow technocratic approaches to climate, energy, and sustainability.

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## Infrastructure and Tools for All

Author: Laura Trouille

Critical that there is funding to support the maintenance and sustainability of the shared tools and resources that make community science and citizen science possible.

See, for example, Astro 2020 White Paper: "Citizen Science as a Core Component of Research Infrastructure" (https://baas.aas.org/pub/2020n7i144/release/1; recommendations begin on p5).

The same recommendations for supporting citizen science tools and infrastructure for free access for all apply across the disciplines.

## Engaging Faith Communities in People-Powered Research to Advance Science, Diversity, and Inclusive Climates

Author: Grace Wolf-Chase

Description: The idea I describe below combines elements and lessons learned from a project I recently led with the AAAS Dialogue on Science, Ethics, & Religion (DoSER), Engaging Faith-based Communities in Citizen Science through Zooniverse, with a project I proposed over a decade ago to NSF's no-longer-existing Informal Science Education program, PARtners in Science Education & Communication (PARSEC): Scientists, Educators & Religious Leaders Building Bridges to Enhance Science Literacy. PARSEC was a proposed multi-institutional effort that envisioned creating a national network of local partnerships between cohorts of scientists, educators, and religious leaders who would co-design science projects that addressed the needs of specific religious communities in diverse locations (e.g., urban, rural) over a 5-yr time period. The proposal was well-received, but ultimately not funded. The purpose of the Engaging...project was to facilitate the participation of faith communities in existing citizen-science projects, or help these communities create their own projects. It was funded by the Alfred P. Sloan Foundation. Results of this project are described in a summary article on DoSER's website (https://sciencereligiondialogue.org/resources/engaging-communities-through-zooniverse-summary/) and an evaluation report on informalscience.org (https://resources.informalscience.org//engaging-faith-based-communities-citizen-science-through-zooniverse).

Through this proposed NSF funding track, I envision engaging diverse faith communities in people-powered research (both online citizen science and in-person community science) via a coordinated effort to recruit and partner scientists (or other researchers) and faith leaders/communities through different approaches, such as:

(1) forming affinity groups, where geographically distributed faith communities interested in particular issues (such as environmental justice and climate change) are trained (via remote online workshops) to participate in one or more of the many existing online citizen-science projects that can

be accessed through platforms such as Zooniverse, SciStarter, NASA Citizen Science, etc. Such distributed participation might involve challenges, where participants could pledge to achieve a certain number of classifications, or time spent, on the project(s) of common interest.

(2) addressing environmental (or other) challenges motivated by the needs of local communities through co-designing and implementing in-person community science or online projects.

Projects proposed for this NSF track should be accompanied by detailed media plans to disseminate stories of the partnerships and results to both local and national news media. The program track would utilize a leadership committee (described further under the Plan section) that would create an online networking site to facilitate connections among potential participants.

Challenge: Research through the Religion and Public Life Program (RPLP) at Rice University indicates that scientists need to talk about religion to address racial and gender disparities in science. Racism and discrimination continue to be prevalent in scientific culture and practice, and the level of trust is affected by the representation of one's own culture within a given community. Minority scientists who belong to religious communities, in particular, have a critical role to play in building bridges of trust to support ethnic and religious diversity and inclusion in science. By engaging in actual projects with religious communities, scientists can play an important role in diversifying science and ensuring that science and its applications are responsive to the concerns and priorities of all people.

Working together on projects of common interest is a powerful way to foster greater understanding between different cultures. Participation in science puts a human face on science and empowers people to take ownership in the results of research. My own work with religious communities has also demonstrated that people who get to know scientists personally are more likely to view scientists in general more favorably.

Scientists and faith communities share many common values. Environmental justice, in particular, is highly valued across diverse religious traditions, as evidenced by the network of interfaith environmental organizations coordinated by Interfaith Power and Light, a national leader in engaging faith communities in environmental stewardship and climate action. Additionally, there is growing interest and engagement in creation care specifically among evangelical Christian communities, as evidenced by organizations such as the Evangelical Environmental Network, whose Board of Directors includes Dr. Katharine Hayhoe, Chief Scientist at the Nature Conservancy.

Plan: This track would require a Leadership Committee/Board composed of scientists, faith leaders, representatives from organizations devoted to building bridges between science and faith

communities, representatives from existing citizen-science platforms, media/communication experts, and a Public Relations Coordinator (to develop a track-wide public communication strategy). This committee would identify potential partners and develop an online networking site to facilitate connections among potential participants. Organizations (not an exhaustive list—I can provide more suggestions) whose input would be particularly helpful in this regard:

(1) DoSER, which has years of experience in science engagement with religious communities, and maintains numerous contacts with seminaries

(2) The Clergy Letter Project, which could help connect scientists and religious leaders

(3) American Scientific Affiliation, Biologos, Evangelical Environmental Network, and the Emerging Scholars Network, which could facilitate the engagement of evangelical Christian communities. (e.g., the American Scientific Affiliation has chapters that could connect with local churches.)

(4) Interfaith Power and Light, which coordinates interfaith environmental organizations across the U.S. (Chicago's chapter is Faith in Place, which includes among its Board of Directors representatives from Christian, Jewish, and Muslim traditions)

(5) Interfaith Youth Core, a national nonprofit that equips the next generation of citizens and professional with the knowledge and skills needed for leadership in a religiously diverse world.

I note that, although NSF's particular interest is in resilience to climate change, this track could fit into any type of research in the sciences or humanities that requires, or benefits from, the efforts of many people working together. Furthermore, funding to proactively engage religious communities in science has historically been enabled solely by grants from Foundations, which provide significantly lower overhead costs than government grants. This is a huge stumbling block for scientists employed by nonprofit institutions that are unable to operate on the lower overheads. Opportunities for funding citizen science to proactively engage faith communities through government agencies would particularly encourage grater involvement by scientists working in nontraditional positions outside the ivory tower.

Impact: Although there are many organizations devoted to increasing the interest of faith communities in urgent scientific issues (such as climate change), there is little "if any" coordination between these organizations. This track could provide a means to leverage these diverse resources to create an online network that would facilitate connections between potential partners and at the same time focus national attention on building positive relationships between scientific and religious communities. The leadership committee, in particular, would be instrumental in building these relationships and helping to ensure that new projects are driven by the needs of communities.

Products could include archived design templates/models of diverse collaborations that could be replicated in different communities and learning settings across the country. These templates would be maintained in a digital collection demonstrating the creation and/or implementation of citizen- or community-science projects that advance environmental justice while serving the needs of local communities. Collaborations will produce positive, long-term relationships and communication between scientists and faith leaders, leading to the establishment of a national network of partnerships between scientists and faith communities, which will in turn facilitate innovation via a national network of community-based efforts.

Since people-powered research spans many areas of research across the sciences and humanities, this track could easily scale across other government agencies, such as NASA & the National Endowment for the Humanities (NEH). Indeed, NASA already supports citizen science through partnerships with different citizen-science projects and platforms, and CitizenScience.gov is an official website designed to accelerate the use of crowdsourcing and citizen science across the U.S. government.

Scientists and faith communities will both benefit from the interactions that result from this track â€“ scientists will better understand the concerns of faith communities and faith communities will develop a better understanding of scientists and the scientific process. Thus, this track will make it easier for scientists and scientific partners to engage in community-centered projects in the future through building relationships with communities that have been largely ignored in the past. By building bridges of understanding across different cultures, this track will also encourage young people in faith communities to consider STEM careers.

Equity: Research conducted by the RPLP indicates that people belonging to communities of faith have often reported encountering chilly climates in scientific circles. This funding track would help repair perceived hostilities between science and religion, and would demonstrate that people who hold different worldviews can work together to affect positive changes. It would also encourage scientists leading or planning to lead citizen-science projects to work with diverse faith communities, thus putting a human face on science and enabling faith leaders and communities to personally connect with scientists; such connections have been demonstrated to produce more favorable views of scientists among the general public.

As mention in the Plan section, this track would also facilitate the involvement of scientists in nontraditional settings that don't have the access to funding available at large research institutions.

By providing funding for projects that encourage online as well as in-person participation in science, this track would improve accessibility to science by individuals who may be housebound by virtue of age and/or health. Likewise, community-science projects may be more accessible to individuals with limited online access.

Project Examples:

(1) Organization of an Earth Day Challenge: This project would utilize the affinity groups' approach to engage diverse faith communities located in remote locations in online citizen-science projects connected to environmental justice issues. For example, during a single week of the pandemic, 25,000 new people registered with Zooniverse and 216,000 participants made 5.2 million classifications across 100 active projects. Participation amounted to 48 full-time employees working for a year, or one person working for 48 years. A research team member for the project Rainfall Rescue commented, Never imagined we would complete a whole decade in 1 day! Zooniverse currently engages more than 2 million people worldwide; however, an organized, targeted effort that leveraged the numerous faith and interfaith environmental organizations to help mobilize their local constituents could engage a hitherto largely untapped audience, using Zooniverse and/or another platform for citizen science.

(2) Mobilizing Churched African-American Youth and their Families to Participate in Environmental Community Science: This project would utilize the second approach outlined in the Description section. Dr. Sharon Grant is a Professor at Hood Theological Seminary, a historically black graduate and professional school in North Carolina, sponsored by the African Methodist Episcopal Zion Church. She was the recipient of a DoSER Science for Seminaries grant to incorporate science into her seminary classes. Professor Grant also directs the International Center of Faith, Science and History (ICFSH), which sponsors many community engagement activities, including an intergenerational summer camp that involves primarily African-American youth and their families in science activities. In 2021, the camp focused on environmental and climate themes, and ways families could contribute to greening their communities. Professor Grant could be an ideal person to lead or advise a team that co-developed a community-science project with local African American churches.

Recommendations: I strongly encourage NSF to consider a track that would help diverse communities of faith engage with scientific research, particularly research related to the environment and climate change, but this track could easily embrace research in virtually any area of the sciences or humanities, since citizen-science projects are motivated by the need for large numbers of people to help mine large datasets, and community-science projects are driven by community needs. I think I've covered most of the "why NSF should consider this" prompts in previous sections, but I'd like to reiterate that proactively seeking to include faith communities in scientific research embraces a type of diversity that has often been neglected in the past, or portrayed negatively in media attention that highlights a widespread, but erroneous, perception that religious worldviews must be hostile to science (and vice versa.) This perception has sadly contributed to feelings of exclusion from science by many individuals in faith communities.

One way that NSF could help facilitate collaborations between scientists and faith communities would be by highlighting the many resources available on DoSER's website. For example, DoSER's series of videos (https://sciencereligiondialogue.org/resources/engagement-video-series/) will help scientists to engage more effectively with religious communities. These short videos provide practical guidance to scientists who may be reticent or feel ill-equipped to work with multicultural partners holding diverse worldviews.

## Sustaining Funding for Community Leaders and Organizations

Author: Skye Kelty

While I never worry whether my university will be around in a decade or my tenured professor will be in economic peril, I am often worried about this for my community partners. Any ways to set up some of our most powerful community leaders as salaried members of national research organizations or of their local research institutions would be hugely beneficial. Additionally, providing staffing or operating budget support to some of our most established and productive community organizations would be hugely helpful to make sure solutions are sustained over time--research institutions are NOT good at keeping communities fired up about long term solutions.

## Research Development and Sourcing for an Impervious, Nonpermeable, Fire-Resistant Material That Is Environmentally Sustainable and Easy to Manufacture for Hydrogen Storage Containers and as a Lifting Gas Envelope

Author: David Marini

The goal is to introduce a material product that can initiate a national change on the ban of hydrogen as a lifting gas for commercial and private transport. At present, helium is a finite resource and is prohibitively expensive as a lifting gas. Demonstrating that modern materials have surpassed and eliminated all of the downsides associated with hydrogen airships of the past, we could lower carbon footprints, minimize fossil fuel usage and decrease the transport times of personnel, food, medical supplies and equipment. The Federal government is currently supporting the use of hydrogen as a sustainable fuel source; we need to return it to the public as a safe lifting gas for people and

materials.

When a community is in trouble, cheaper, smarter, faster becomes the only mantra. With climate change, affecting every neighborhood in America, emergency response needs to be fast, clean, effective and low-maintenance. High performance hydrogen lifting bodies are a solution. Puncture proof (trees, electrical towers, flying debris) hydrogen lift capability addresses resilience and the community science challenge simultaneously. With the availability of a superior material for hydrogen airships, communities can make emergency aerial transport and drones at the local level. Less hydrogen is required per lifting pound than helium so affordability of an all-purpose response vehicle becomes far more cost effective. Currently drones and helicopters suffer from their ability to stay aloft because of the energy drain from lift. We have removed that problem with low-cost hydrogen.

It addresses resilience by allowing for substantially smaller urban airships with higher maneuverability for hard to reach places - city streets, flooded towns, inaccessible roads, medical team insertion and evacuation, all for indefinite durations while potentially producing zero-emissions. If the transport needs to stick around, it can, without the need of refueling. A low cost aerial transport could also afford neighborhood kids and families opportunities to visit every public cultural institution within the state in minutes rather than hours because of traffic and unnecessary winding roads. Food pantries could receive goods from farms and warehouses in neighboring counties and boroughs at accelerated rates, cutting down on food spoilage or waste. Construction projects could commence faster and cause less disruption to communities. Upgrading the speed in which things get to people is paramount in good times and more so in bad.

To begin we would need technical advisors and patent holders of the most closely related materials to make the track idea possible. Those currently being MIT faculty Julia Ortony, Carlos Portela, Michael Strano, Yuwen Zeng as well as Sir Andre Geim with the University of Manchester and Dr. Penghan Sun. The Material 2DPA-1 would be the first to be investigated and moving on to Dupont chemicals for a myriad number of other existing compounds. We want to build relationships with chemical engineers, experts in polymerization and self-assembling nanomaterials. Investigations for precision sieving of gases through atomic pores in graphene for insuring perfect inflation and deflation of gases from or between containers are required. We need to review the catalogue of materials that are already under patent. Legal teams at the state and federal level are required to begin building a case for submitting documentation for the removal of the ban on hydrogen as a lifting gas once sound physical and reproducible examples can be made for review.

Every business with a technical capability in a community needs to be a partner so that new material prototype samples, along with video and technical manual instruction arrive securely to the

participating individuals, and industries. This will allow local groups to run their own domestic product sample tests with community oversight.

The scientific activities that need addressing are the ease of manufacturing, rapid prototyping, molding, shaping, and retention of forms and whether the material is dope-able with other elements to expand performance. Intense experimentation of emergent properties of materials for pliability, strength & puncture resistance to include projectile weapons, resistance to extreme temperature gradients, insulation, conductivity, etc. Risk versus reward analysis of production techniques.

Beyond the financial support, insuring that partners have access to reliable sources for chemical acquisition and a clear avenue of providers that can help in understanding how pre-existing infrastructure can be reorganized to use current industrial and commercial tools to manufacture the new material. We want to make it apparent that local businesses do not have to retool and buy new expensive equipment to get the concept off the ground. We also want communities to see that scientists can figure out ways to integrate with communities to get ideas initiated.

Communities will participate in the development of the hydrogen economy. Any neighborhood could develop a micro grid with the ease of transporting hydrogen across towns and districts without concerns of catastrophic situations. Study of fuel cells to convert hydrogen into electrical power on a public scale will support the creation of simple backup generators. Using hydrogen for electricity produces zero-emissions, except water, which could be stored and reused for drought stricken areas or neighborhoods without clean water. The technical skill of pliable, custom configurations of impervious inflatable vapor/fuel containers could become its own industry. This could support the development of an ammonia, methane, or any other chemical economy as well. Leak resistant bio digesters are a simple byproduct of this technology. Local food waste could be stored in these light foldable non-permeable containers to produce methane, liquid fertilizer, and compost, without concern of releasing the harmful greenhouse gas into the atmosphere.

If communities incorporated these techniques for the creation of impervious envelopes that skill could then double as a business for moving chemicals, rocket propellant storage or expanding into airtight habitation for space modules, space suits, air locks, etc. Having the capacity to contain and hold pressures all while having no leakage is an ever-growing industry currently in the U.S. Team members would gain knowledge that would make current day limits appear like thresholds that could have been broken decades ago. Once we start looking at matter from a material scientists perspective, success is truly just a trial and error game, the impossible no longer exists.

Impervious materials are critical for law enforcement, heavy construction sites, bridge building, and coatings for aircraft or boats, parachutes, gliding fabric. Agriculture produces vast amounts of plastic waste in farming, greenhouses, tarps and bundling hay. Having an impervious material would allow for reusability rather than just dumping the material in the trash. The Art world as well is constantly

using single use material—impervious material could change that industry so it does not present a problem.

The skills that this track would develop would be in transforming drone hobbyists into potential airship delivery businesses, fuel delivery businesses would be able to transport more at lower weights to reduce their fuel transport costs, local printers could develop techniques to produce the material into unique forms and configurations increasing commercial and industrial outputs. High school students could learn how to make hydrogen through simple chemistry courses. Community colleges could develop 3D modelling & design courses for custom made containers that embed into any vehicle or industrial location that requires the maximization of limited physical spaces.

You never hear about communities going into academic institutions looking to resolve an immediate need with theoretical engineering. Most innovative ideas sit idle until a specific industry, corporation or the military finds interest in the development. Those developments relating to making things cheaper or more effective at specific tasks or both. Developing this kind of program would turbo-charge towns with a history of fabrication. Metal shops, car repair garages, salvage and smelting, obscure airfields all would get an opportunity to provide inputs. If we get those with capabilities to team together, then very sophisticated things can be produced right up the block.

This track would make this easier because as soon as a community commits to this degree of development scientists would instantly volunteer to participate in a revolutionary future. There is a saying, which goes “build it, and they will come.” This is most certainly true with state of the art materials existing outside of the academic sphere of influence.

The NSF could reach out to all of existing programs that are currently trying to make neighborhoods more energy efficient or resistant to climate change. The organization could make recommendations to every state governor to apply federal funding for this track to every county in within the state that records higher rates of lower economic status populations. The immediate and apparent uses for government agencies that could apply this technology right at the start would be those that do weather tracking, data collection, and analysis, internet transmission. The U.S. Postal service, FEMA and disaster support, and all U.S. Armed Forces to include the reserves and National Guard would have a need. Others would be the National Security Agency, the Environmental Protection Agency, the National Parks Services, Customs and Border Patrol, Dept. of Transportation interstate maintenance, the Federal Air Administration air traffic control, the Dept. of Agriculture and the Bureau of Land Management.

Before the destruction of the Hindenburg Airship in 1937, it had safely crossed the Atlantic 34 times, carrying 66,000 pounds of mail and freight and more important 3,500 passengers in great luxury. If we can improve on a system that worked very well, but had an engineering design flaw, correcting that flaw should have been a priority over what came after, inefficient jet fuel guzzlers. This can help

inspire this generation to reimagine airship technology for modern times, for everyday people looking to make their lives easier, more sustainable and intelligent.

Community Field trips on chartered flights could provide visitation to sites of interest, national parks, university campuses, and much more. Farms could use the fuel savings of driving a heavy tractor through rough terrain, and insure crops are planted/harvested on time. Sharing equipment would be much easier, as things can return quickly and directly from where they left. A local exchange system can develop for the community to help with cultural events, individual businesses and industries that support the development of the technology.

This track is open to creatives of every ilk to participate in the design configurations of the transport once all of the engineering is standard operating procedure, and redundancy measures are simple enough that children can understand how it works. Many of us have experienced balloons, they just need to know how buoyancy and chemistry work together to float objects off the ground.

An example would be to give a state of the art hydrogen airship to World Central Kitchen, a not-for-profit non-governmental organization devoted to providing meals in the wake of natural disasters. This organization is limited in its help to people if local infrastructure is devastated from extreme weather or other catastrophes. Environmental Terrain is the biggest problem when it comes to saving people from disasters. The National Guard could be at a disaster site to offer relief in hours versus days if roads were overwhelmed or unserviceable. The local airship will visit every aviation and science center to explain and show the science at work.

If the community decides it wants to utilize hydrogen for its local transport initiatives, it would make good sense to manufacture that hydrogen locally, thus opening hydrogen as a local clean power source as well. Due to the non-permeable material used for the hydrogen envelope, you would only need to fill it once or during maintenance, but the hydrogen production capacity could continue indefinitely making the community more accessible to power.

Based on federal funding for disaster relief, paying for a reliable safe emergency vehicle may present itself to be a wise investment. Other modes of funding can come from local tax revenues, federal grants, collaborations with local aerospace companies or by start-ups using open source basic parameters and material requirements. Community approved state and county inspectors will certify the safety and flight worthiness of each produced design. The community can determine the crafts best public usage. Beyond all of the above, inspiration from watching, a local airship flying about could make the difference in many a child's and citizen scientist's imagination.

Project Examples

1. Proof of concept for reintroducing hydrogen lifting gas airships for drone use and personnel/cargo

transport. A hydrogen airship could drastically eliminate the use of fossil fuels, eventually making it zero to transport goods across the American landscape. This would mean that landscape would no longer be a concern for why things cannot get places. Obstructions become meaningless, and you eliminate any shortcomings of other existing aircraft, like the inability to stay in a specific location for an extended time because of the continuous pull of gravity. You also eliminate exorbitant lift costs because helium is not affordable from a commercial standpoint.

2. The creation of impervious lightweight customizable form chemical containers. This is a game changer for the new hydrogen economy. With the ability to create unique forms for containers you could retrofit every existing vehicle to hold pressurized hydrogen for fuel, or instantly retrofit chemical transports to maximize cargo volumes. Existing gas cars could have their fuel tanks removed and replaced with customized fuel containers that would now allow upgraded hydrogen fuel cells installed in gasoline vehicles. Impervious foldable containers would also be a boon for local agriculture. The ability to indefinitely store and move chemicals like ammonia, nitrogen, phosphorus and then when finished fold and store in a cabinet would be a major savings in space, time and money.

Recommendations

Start promoting regularly that you need thinkers, doers and dreamers on social media and traditional media. Get universities to stop making calculus a requirement to be a scientist, only %1 percent of the planet ever uses the math, so stop keeping an obscure mode of thinking from minimizing brilliance from affecting the broader public, not everyone wants to be a rocket scientist.

We need to remind the public that science is an offshoot of Art, same as math, and literature, and so on. The distinction is that Science is empirical and verifiable through consensus of evidence. If science is to become a stronger public Art form then we need to approach the public through this understanding. Kids respond to Art at the earliest moments of awareness, we need to nurture that until it develops into something that could benefit humankind.

## Residents Leading Adaptation to Climate Change

Author: Elizabeth Gibbons

*Brief Description*

Climate change impacts continue to worsen, and as they do more people across the North America are impacted by floods, heatevents, wildfires, and sea level rise. People who are facing these impacts are often overlooked as experts in climate adaptation and resilience practice. Through this proposed track we want to turn that paradigm upside down and recognize that residents in places experiencing climate impacts have the expertise and authority to lead every part of climate change adaptation work. This includes work to understand climate impacts, climate change adaptation planning, taking action to reduce climate risk and build climate resilience, and evaluating the impacts of climate adaptation efforts. For this reality to be recognized we must create a two-way channel of knowledge, learning, and connection between the scientists involved in that work and residents' lived experience.

*What community-resilience and community science challenge(s) does this track idea advance? How?*

The impacts of climate change are recognized by more and more communities each day and season. In 2020 We saw: 1.2 Million American displaced by extreme weather events, 1 in 7 Americans experienced dangerous air quality levels due to wildfire smoke, and nearly 1 in 3 Americans experienced some type of climate related risk or impact. These increasing impacts in our lives have translated into most communities now recognizing a need to take action. Unfortunately, there is still a lack of resources and perceived lack of expertise to develop strategies to address those impacts. This lack of expertise can be addressed through two mechanisms: 1) recognizing the existing, lived expertise of people at the forefront of climate impacts and 2) providing accessible and credible training opportunities through higher education institutions including community colleges, training centers, and universities.

Through this track we anticipate addressing a number of challenges which currently exist in applied science, community science, and co-production settings:

Exploitation in data collection and harmful outcomes of data use

Over-reliance on traditional economic valuation methods for adaptation investment (part of the core of this is property values and/or worker productivity driving risk assessments)

Elitism and over-professionalization in education requirements/opportunities for work in the climate adaptation space

Dominance of western epistemology in acceptable methods for studying climate impacts and evaluating climate adaptation outcomes of work performed

Risks for current science to lead to top-down policy that exacerbates climate injustice.

*What activities and partners, including science activities and non-scientific partners, would need to be funded in order to address this challenge?*

This track will need to engage people living in communities most impacted by climate change with the fewest resources to adapt who are acting as formal or informal leaders in their communities. These community leaders are most reachable through community based organizations, faith-based organizations, and via boundary organizations with existing efforts which recognize and transfer power to those community leaders.

The track will require engagement of policymakers using climate information to make decisions that affect the climate resilience of communities, ecosystems, and economies. These policy makers might be serving at a local, state or federal level and ideally the track would engage policy makers across regions and at multiple levels of government.

This scope will also engage scientists from disciplines relevant to these three categories: 1) collecting and analyzing data for local and regional climate assessments, climate change vulnerability assessments, and adaptation planning; 2) developing and testing strategies to adapt to climate impacts; 2) developing and testing techniques for peer learning across diverse backgrounds. These may include such disciplines as: Climatology, Climate impacts and adaptation, Geography, Environmental science, Sociology, Education, Economics, Behavioral sciences

Building strong relationships between community leaders, policy makers and scientists will require sustained effort across the cohort, specific resources for each caucus within the cohort, and honest recognition of historic and ongoing harm caused by policy makers and scientists to many community groups. Some tactics needed to build strong relationships include:

Providing relationship-building opportunities between scientists and community community leaders and the people residing in communities. Opportunities should go beyond academic workshop spaces and include shared meals, retreats, storytelling opportunities, and reciprocal exchange of services. Authentic relationship building will require scientists and policymakers entering into community (with invitation) and fully engaging in community activities.

Identifying scientists or policy makers with roots in the community and providing them with opportunities and support to serve as a bridge between these spaces.

Providing cultural sensitivity and anti-racism training to scientists.

Providing knowledge- and skills-building opportunities to people from communities most affected by

climate impacts with the fewest resources to adapt.

*What will be different in 3 years if proposals are funded within this track?*

The goal of this track is to center the expertise of people at the forefront of climate change as we develop climate solutions, train future scientists and do this through authentic relationship building from the community level through to university. Though relationship building and reorienting the scientific process to center community knowledge and expertise will take more than three years, there are outputs we envision occurring within the first three years of the track being activated:

Increased awareness among scientists of why equitable and effective climate resilience-building can only be achieved through the leadership and power-building of community residents.

Stronger relationships between scientists and leaders in communities most affected by climate impacts with the fewest resources to adapt.

Increased knowledge of how to blend traditional scientific methods currently used for collecting and analyzing climate data and developing adaptation strategies with place-based lived experience of climate and climate change impacts.

Increases in the number of community college programs that are teaching climate adaptation and resilience.

Increase in the number of place-based courses and curriculum featuring community leaders as experts in climate adaptation and resilience

Increase in the number of students matriculating through community college programs into four year universities studying environmental science, engineering, geography, sociology, business, etc all with an interest and sustained focus on climate change.

*How does the track center justice, equity, diversity, and inclusion in its practices and outcomes?*

This track puts the experience of leaders from communities that are currently highly exposed to climate risk and have fewer resources to adapt because of oppressive systems and historic marginalization at the center of the information and knowledge that informs climate resilience-building. The track completely reimagines what constitutes best available science and decolonizes the science and practice of climate resilience.

*Project/Proposal ideas:*

Collaborating with community colleges on the development adaptation and resilience tracks and accreditations that bring in community leaders as experts and connect students with communities facing climate change impacts in their communities.

Developing new methodologies for collecting and analyzing data for local and regional climate assessments, climate change vulnerability assessments, and adaptation planning that blend Western scientific methods with the local knowledge of leaders in communities most affected by climate impacts with fewest resources to adapt.

developing and testing techniques for peer learning, relationship-building, and trust-building between scientists and leaders from communities most affected by climate impacts with fewest resources to adapt.

Investigating what collection of knowledge, skills, and competencies - across Western science and lived experience - create optimal project-based outcomes of climate adaptation projects.

## Read One Teach One

Author: Dennis S Murray Sr

Literacy and communications programs that focus and target youth STEM programs among underserved and rural and urban communities throughout the country. visit www.ydacbinc.org

## Building Capacity Toward Researching and Piloting Localized Data Collaboratives

Author: Emelia Williams, Open Environmental Data Project

The collective stewardship of community generated and community relevant data is critical to the success of building community resilience across sectors. Collaboratively managed data systems

have unique design considerations; ensuring that the conflicting social, cultural, and technical priorities in data management and sharing is crucial for making sure that decision makers at all levels have access to the information they need. Increased energy and effort needs to be directed toward researching and piloting new models of both data stewardship and collaborative governance practices around how the various forms of data are shared, managed, and used. There is a risk to misuse data and undermine resilience, especially in environmental and climate scenarios. For example, if proper data ownership and security considerations aren't considered, home value and risk information can be shared to insurers who in turn, won't insure specific vulnerable properties.

## Branching the Fields of Public Health and Social Science Through a Focus on Use of Community Science Toward Resiliency

Author: Katie Hoeberling

While “community resilience” may inadequately describe the complexities of how our communities experience the aftermath of disasters, working towards communities who are prepared to assess, mitigate and understand the characteristics of risk from crises, is critical. Community science can provide tools and methodology to help us do so and it can also make stronger connections between scientists and communities with important fields such as public health and social science. This idea suggests that building stronger bridges between the work of community science and the fields of public health and social science could build bridges and allies working towards crisis preparedness and mitigation.

## Empowering People to Drive Scientific Solutions to Climate Change

Author: Neil van Niekerk

Global warming is the increase in the average temperature of the planet, based on data from thousands of weather stations. But weather stations are not equally distributed on Earth and most places are far from the nearest observations and are affected by local climate factors, meaning we know very little about how climate is changing in those places. These places include wildlands that provide habitat for many threatened species. They also include communities that are

disproportionately impacted by climate change due to social or economic inequities. A lack of climate data in these places diminishes their voices in the climate conversation and impedes their ability to design and implement effective climate adaptation and mitigation strategies. Installing more weather stations in inner cities, rural communities, and wildlands is ideal, but unlikely for many reasons. Satellite data covers these places, but can be unreliable without ground truthing. Technology-driven community science initiatives present a way to reduce data gaps in these areas because they are home to, or are visited by, millions of people.

If even a fraction of those people carried a low-cost, automated sensor while they were outdoors, the millions of new observations they contribute would create a clearer picture of climate in the spaces between weather stations, giving scientists and decision makers information they need to design local-scale approaches that effectively and equitably address climate change and its effects.

Success is achieved by leveraging low-cost technology and an automated observing process. Most community science projects require active participation. That approach discourages many, including low-income and differently abled individuals. By making the observation process automatic and passive, participants do not need to put their attention to scientific activities, instead letting them focus on the activities that brought them outdoors. As with any community science effort, participant retention is important. In our model, retention is driven by feedback that identifies data uses and acknowledges participant contributions. Through this approach, a global community of climate observers can greatly enhance our understanding of Earth's climate.

## Guidance for Community Partner Compensation

Author: Skye Kelty

We should develop a standardized MINIMUM compensation expectation for community partners similar to the national standards for grad student and post doc compensation. This will at least give teams a place to start with their budgets and can be adjusted based on local economy, experience, time commitment, etc. Should also address benefits for any community partners expected to work part time. Should be based on research institution pay scales NOT on often much lower nonprofit organization pay scales. The community researchers should be formally valued in compensation as INTELLECTUALS, LEADERS, and EXPERTS.

## Community-Based Environmental Research Internship and Green Infrastructure Curriculum for High School

Author: Arlo Townsley

PROJECT DESCRIPTION:

What if climate science was taken into the hands of the communities that are most affected by climate change? What if there was an avenue for highschoolers, the future of our communities, to engage with community science? The Center for Sustainable Engagement and Development (CSED) has been developing an Environmental Research Internship for local youth to conduct community based research. With a focus on serving minority youth, the internship has enrolled 20 students from various communities around New Orleans LA. Now in its second year the internship provides students a crash course in scientific research, from design to presentation, taught by a college level professor and qualified research assistants. The interns focus on the quality of their environment by collecting data on water, air, and soil quality. They also study the urban temperature effect by collecting temperature data on their surroundings. The interns learn to develop a college level presentation and present their findings at the Mayor's Neighborhood Summit and to their families. The internship is paid, showing the interns that their time is valuable and directly investing in the communities the research is based in. CSED is collaborating on another program designed to implement a green infrastructure curriculum into New Orleans High Schools in underserved areas. The year-long curriculum builds student experience with the outdoors and environmental science and culminates in the students designing and implementing their own green infrastructure micro-projects. These are two examples of the high impact opportunities this funding track could help facilitate.

CHALLENGE:

It is well established that marginalized and underserved communities suffer the most from the effects of climate change yet these communities are often denied access to the scientific conversation. This track addresses this issue by providing an opportunity for young people to conduct and present scientific research that is based in their communities and provides data on the environment that their community is situated in.

One of the main drivers of marginalization in communities is the lack of opportunity for upward mobility. A sustainable solution for this issue is to provide opportunities for jobs focused on sustainability and green infrastructure. Providing an environmental science focused internship for young people of color addresses this challenge head on. The interns gain relevant work experience

for a broad range of green jobs and gain valuable research and presentation skills that increase success in college careers and job opportunities.

IMPACT AND EQUITY:

If there is a designated funding track for community based science programs like CSED's Environmental Research Internship the impact would be exponential. Investing in community based science and providing valuable workforce skills for underserved youth has a ripple effect that uplifts many people beyond just those enrolled in a single program. The research internship program has the potential to advance college success rates and employment opportunities for those in the program. Providing avenues of upward mobility for members of a community impacts those around them and builds capital within communities. Looking at the scientific research side, the community based data that is gathered and shared is a valuable resource in furthering our understanding of climate change, especially its impact on underserved communities. This track directly connects the communities most vulnerable to the impacts of climate change to the scientific conversation regarding their very future. Community agency in the scientific discourse around climate change is a necessary aspect of community resilience. Community science programs are a high impact approach to building that kind of agency. It is also a two way street, allowing scientists and scientific partners an avenue to engage directly with communities. Investing in local organizations that have spent years building the connections necessary for community science and resiliency is the most efficient way to guarantee the funding has the highest impact.

A funding track designated to Community Science and Resilience would be a major step in repairing the past harms of Science. Historically science has sidelined communities of color and even advanced due to the detriment of such communities. Providing funding sources for community science will engage the folks that have suffered the most from these abuses and establish a foundation of protection against future harm and a path to a greener more sustainable future on a global scale.

## Tiered Budget Options to Weigh More to Communities

Author: Skye Kelty

Tiered budget templates to create expectations for equitable community research funding distribution. For example, contributory projects without direct benefit to the community should establish a supplemental community-owned fund to address a specific community need or support a specific community service. My community-university research team raised equal funds to our research budget to build a community garden since our data was unlikely to help residents within 5

years. We had to find really sneaky ways like renting a church for events or buying event supplies that would later be used for community center maintenance. I would have loved to just be able to give our community partner a check instead of going through all these hoops to fund our equitable relationship. Plus my dept admin would have appreciated not having to do so much paperwork to make a church an official university vendor! Template budgets representing the holistic costs of community research and relationship maintenance will be important to level the playing field across the wide variety of research institutions.

## Encouraging Citizen-Driven Climate Resilience Solutions Showcase: How About a Net Zero Residential Property?

Author: Indrani Pal

This year I learned that it is indeed possible to feel consecutive 100 degree days in New Jersey. It is possible to see the cracked soil right in my own backyard (wasn't that on posters showing California or Arizona fields before?). It is also possible to find many brown patches of dried grass on the lawn which always used to be lush green. It is also possible that kids stop counting dried trees all around because there are too many. The Northeast, in fact much of the country of the USA is facing drought and today, as a climate change and water resources researcher I am convinced that every single person on earth is a victim of climate change. But wait a minute. Don't we know that there would be an increasing number of intense rainfall events in the Northeast due to climate change? Whenever that happens, like it did during Hurricane Ida last year and my basement got flooded for the first time, what to do with so much water? As a water scientist and engineer I feel restless about doing something about the weather weirdness that will only increase over time.

Here is an idea : Can we store some of that water in a decentralised manner and use that when time comes, reducing economic and environmental costs associated with transporting water by pipes?

Here goes it further.

Vision: I enthusiastically envision creating existing residential campuses achieving net-zero water transport and paying zero water bills, starting with my own to showcase and communicate the benefits to neighbours, many of whom use much more water than I do already for their swimming pools or automatic irrigation systems, etc.

Mission: Demonstrate scalability of a residential property scale rainwater harvesting system. Collect as much as 200,000 cubic ft of rainwater in a residential home campus in one year. Showcase my own property as the first ever in the community leading a water sustainability & climate resilience solution showcase and an educational program for kids and young adults, in collaboration with local Girl & Boys Scouts. This is clearly an ambitious package as a scientist and as a house owner since it involves significant investments in the part time and money but it is completely achievable and worth committing to as an environmental steward and a mother of two toddlers.

Funding: The initial estimate is that the program may cost $100k to design and implement the facility. It is daunting but achievable. The first step will be to showcase my own property in its full complement at net zero concept. The showcase would warm up more funding to help us raise another $500,000. To prime up the raise of this sum, NSF will provide funding for one design and installation by an engineering firm (a MIT Startup that is NJ based), one research scholar, one communication intern, for three years to work with Dr. Indrani Pal and her collaborators.

Once one property is ready to be showcased, roughly within a year, we'll approach local funders to raise up to $500k to add more properties, including public places.

Dr. Indrani Pal will also lead a social impact study and produce a 25-pages impacts report.

One property can become a shining example of rainwater harvesting in and beyond the community. The program will also involve her own academic institutions (Columbia University, CUNY, Rutgers University) and other nearby ones such as Princeton University, as the breeding ground to not only tackle perennial water insecurity issues but solutions that are led and implemented by the citizens and communities. Via collaboration with Girl & Cub/Boy Scouts I also envision supporting national climate resilience building efforts and provide hands-on experiential training & research opportunities for the local children and other national as well as international scholars and professionals. The program also envisions developing small business cases and other collaborative efforts benefiting local communities and jurisdictions by joint research publications and organising workshops and conferences and grantsmanship opportunities.

Timeline: We can get started as soon as the funding comes through!

## Guidance for Community Partner Compensation

Author: Skye Kelty

We should develop a standardized MINIMUM compensation expectation for community partners similar to the national standards for grad student and post doc compensation. This will at least give teams a place to start with their budgets and can be adjusted based on local economy, experience, time commitment, etc. Should also address benefits for any community partners expected to work part time. Should be based on research institution pay scales NOT on often much lower nonprofit organization pay scales. The community researchers should be formally valued in compensation as INTELLECTUALS, LEADERS, and EXPERTS.

## Support of Funding Communities Directly to Increase Equity in Community Science Grant Making

Author: Mya Thompson

This submission is a reflection on the benefits of funding communities directly for work on community science. NSF has required a relatively large institution or university to receive grant funds, which can then be distributed to community organizations as part of a collaborative grant. This sets up a dynamic in which the institution receives a large amount of overhead funding and serves as a gatekeeper to funds earmarked in a collaborative grant for community organizations. This tends to lead to power dynamics that undermine the foundation of community science in which research is driven by and is designed to benefit local communities directly. In order to support community science, NSF can design methods to directly fund community organizations interested in working on community led science projects and moving the field of community science forward.

--How does this track make it easier for scientists and scientific partners to engage in community-centered projects in the future?

--How does the track invite and support partners who don't have large, existing organizational infrastructure?

By setting up equitable funding structures, the NSF will be supporting a collaborative environment where the community partners and science institutions can interact more equitably and without the strong power dynamics that come with community organizations needing to be included in an institution's budget as a subaward.

--How does the track redistribute power and resources to places and institutions that are excellent at community resilience and community and citizen science despite historic underinvestment?

This track could create new funding structures that lower the barrier for community organizations to receive funds through the NSF. This might include a rapid-response grant structure that could quickly respond to and fund climate resilience projects with the funding going directly to community organizations.

--How can NSF welcome and fund people who aren't historically participating in NSF proposals, but are critical to the success of this track?

NSF can fund community organizations directly or create a mechanism for community organizations to form legal structures to receive funds that meet the NSF's needs.

--Are there key partners that need to be included? How can NSF reach them and welcome their participation?

The NSF AISL funded Noise Project collaborators could be key partners for this work. The collaborators are listed on the Noise Project website and as authors on a 2021 Bioscience paper: Understanding the Impact of Equitable Collaborations between Science Institutions and Community-Based Organizations: Improving Science through Community-Led Research

--Are there cultural elements or attitudes in science that need to change to advance work on this track? What could NSF do to facilitate those changes?

Community leaders who have led community science efforts should be integral parts of the grant decision process, including on the relevant NSF panels for the strand.

## A Comprehensive Approach to Building a Community Science Movement

Author: Jean Schensul

NSF is our country's foremost institution fostering basic science/social science research of national and relevant international benefit. For decades there has been widespread recognition that while governments and the wider public may benefit from the results of scientific inquiry, these benefits do not apply widely to local communities, and communities made vulnerable by decades of economic and political neglect, and environmental marginalization and exploitation. Further, since the 1970s,

there have been active efforts to encourage our institutions to support science for the people with the engagement of those most affected.

At the same time, local communities solve their own environmental and health problems with the best knowledge available to them. Often they depend on historical successes in farming adaptation, water conservation, fisheries protection, safe and efficient building construction, and broader mechanisms for environmental monitoring. In the face of climate change and its consequences, communities both have knowledge and solutions to offer, and reason to need the input of scientific research. At the same time, many communities especially those most vulnerable, are suspicious of scientific intervention and subsequent exploitation and commercialization of indigenous or local products and practices. This is as true for the social and health sciences as it is for earth sciences. Nonetheless it behooves us to share the potential advantages and contributions of science in language that local communities and cultural groups can readily understand and take advantage of; at the same time it's important recognize that communities have a long history of utilizing culturally situated knowledge to solve their own problems. Bidging the science community gap can shed new light on intransigent and wicked local problems and disparities, benefiting communities and science simultaneously.

There are methodologies for bridging illustrated in the sciences through multiple examples supported by Thriving Earth and in the social and health sciences through interdisciplinary work using the CBPR/PAR (Community based participatory research) approach. My own experience derives for the most part, from the latter. In the social and health sciences, NIH and other funders have funded research that addresses the community science gap either intentionally, calling upon science/community partnerships to be effective (NIEHS) or by efault. We can learn from the efforts that such funders have made to increase community engagement in health science, that go beyond recruitment to fostering and rewarding full partnerships between local communities and scientists. Some of these efforts include:

1. Developing the field of Implementation science which recognizes 1. that context and setting are important to study outcomes and 2. That to generalize and scale up the results of a study it is important to test it in multiple settings and to adapt it so that local users (communities, clinics, providers etc.) can implement it with fidelity, AND fit.

2. Recognition of the importance of a multilevel approach to engaged health/social science for problem solving. By multilevel I mean that theory guided interventions take place in a complementary fashion at multiple socio-political levels to maximize impact (levels refers to individual, peer/family/friends, social network, organizational, community-wide, media, policy). Multilevel approaches are an attempt to address change collaboratively by introducing coconstructed knowledge based interventions in different key intervention points in a complex system.

3. Supporting participatory system science development, training and funding for addressing complex systemic problems in local communities.

4. Recent directives that call for addressing specifically the structural and policy related dimensions of health and wellbeing,

5. Calling for community voices throughout, and programs to develop and enhance community voice in science

Researcher/scientist responses to these openings have included:

6. Guidelines for the inclusion and full partnership and inclusion of multiple partners and stakeholders

7. Multiple examples of the cocreation of research and intervention design and implementation that recognize contributions to both science and local community welfare

8. Research addressing multiple forms of historical, situational and policy related inequities, and ways of redressing them at different levels in the distribution of resources, solutions and treatments to improve community health and wellbeing.

9. Ecological and implementation science that recognize that local settings are different and that when context cannot be held constant, new definitions of generalizability are required.

10. Research that calls for both inductive and deductive approaches, based on the judicious and rigorous use of mixed methods.

11. The recognition that changing complex systems is a long term commitment (e.g. one, three and even five years are not enough).

Thriving Earth projects have illustrated many of these dynamics in earth sciences with benefit for both science and local communities and the Community Science Exchange will serve as another means of supporting this direction.

Structural changes in science and the relationship between science and communities are required to ensure the success of these approaches, and further learning. These may include:

a. Training and supporting new community oriented and community engaged STEM scientists, intersectionally diverse by class, race/ethnicity, culture, language, ability, geography, indigeneity, both to equitably reflect the demographics of the country and to repair and strengthen trusting

relationships between scientists and community counterparts.

b. More faculty supports (training, financial support, time allocations, prioritizing) to engage with local communities

c. More support and funding to build community organizational capacity and community research alliances that can both conduct and control their own research and collaborate more effectively with scientists on local problem solving.

d. More support for “field schools" that are university or community led, or jointly developed, where scientists, community actors and students can learn together, and produce knowledge of benefit.

e. More guidelines for equitable university-community resource sharing including funding directly to community organizations and stakeholder networks.

f. Sufficient indirect cost rates to cover administrative costs on the community side

g. Easily comprehended guidelines for grant applications and administrative paperwork. Community advisory board reviews of grant guidelines for community science applications would be helpful here.

Hopefully by learning from others experiences and through discussions such as this, NSF can craft approaches that will facilitate, strengthen and expand the community science movement

## Relationships Between Environmental Injustices and Educational Outcomes in K–12 Children

Author: Dr. Ayanna Cummings

What are the project’s goals and objectives during the grant period?

To gather data regarding the impact of environmental injustices on educational outcomes, including but not limited to air pollution, clean water and urban river water crises, and access to nutritious foods on academic attainment and other outcomes such as concentration, percentage of work completed, and number of hours devoted to school related activities.

What activities will you undertake to advance your goal(s) during the grant period? If available, please include quantifiable outputs/results that you expect to achieve by the end of the grant period.

We will collect data from local school sources who provide access to online survey data collection procedures upon approval. The data set will identify correlations between environmental injustices and relevant student academic achievement outcomes.

What does community involvement and accountability look like in this project? (Who is involved in decision-making for this project, or whose voice will be included in decisions? Who will not be involved?) The Founding Director of Dada Sisterhood Inc., Dr. Ayanna Cummings, is directly responsible for all decision making related to this project effort.

What change and ultimate impact will occur as a result of your efforts?

The effort will identify extant needs in the local community to create environmental justice where it does not yet exist, and advocate using data metrics for funding to eradicate injustices in these areas to improve student academic achievement outcomes.

What progress have you made to date on this project, if any?

Begun reaching out to persons who have access to local schools and sources of survey data.

Does your project involve collaboration with other organizations or stakeholders? If so, please name them and describe the roles they will play.

Yes, the Urban League of Greater Atlanta and National Urban League provide points of contact and help guide the thinking behind the project related to educational outcomes.

## Open Knowledge Networks to Increase Community Science, Recovery Worker, and Student Partnerships

Author: Paul Williams

Ecosystem recovery actions require labor and local knowledge. Students learn best when engaged in a meaningful experience. When students and recovery scientists collaborate, students learn and more work gets done. Our environment and communities need those gains to help maintain resilience as climate impacts increase. We can create the conditions that foster collaboration through providing information platforms. Imagine all the possible collaborations that could form if students, teachers and other community members had access to detailed information about their local environment - the services provided by the natural resources around them; the threats to those ecosystems; monitoring and restoration projects; the people doing the monitoring and restoration projects; and if no one is, the people who need to be told to make that happen. Information is power.

Open Knowledge Networks (OKN) are ideal platforms to house that information and empower youth and their communities. It can link to public databases to automatically draw in information, and people can add local information through forms. It can include tools to visualize and analyses data, and it can grow as people add to it. NSF just released a roadmap to OKNs. It's time to transfer the technology from academia to the community.

## Just Transition Demand Accelerator

Author: Tim Mealey

Brief Description

This track would be devoted to creating the institutional infrastructure and social relationships that will be needed to ensure that the significant amount of federal funding that is now or will soon be available under both the Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022 and, in particular the provisions pertaining to the National Green Bank, are used to advance community resilience for low-and-moderate income and/or historically underserved and disadvantaged communities.

There are a wide variety of data types and data sources that will be needed to ensure federal funds flow to communities that are most in need. This track would be aimed at using state-of-art

approaches for using both community and citizen science to collect environmental samples of contaminated air and/or water, temperature data in extreme heat situations, water levels in relation to sea-level rise and high-tide flooding, etc. that can serve as the justification and the “demand accelerator" for investments in historically underserved communities.

This track would be aimed at creating a robust network of community-based organizations that would receive the proper training and state-of-the-art tools to enlist citizens in the collection of the data that will provide the ability not only for these communities to adapt, recover, or withstand challenges related to climate change but to do so in a manner that addresses the underlying causes of inequality, repairs past harms, and prevents future injustice.

Challenge: What community-resilience and community science challenge(s) does this track idea advance? How?

The overarching challenge this track addresses is embedded in its title. It is to ensure there is rapid and strong demand from community-based organizations to channel federal funding from both the Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022 in a manner that will ensure a just transition of those communities to a more resilient, vibrant, and prosperous future.

The primary focus of this track will be to focus on creating a platform for both governmental and non-governmental representatives of low-and-moderate income and historically disadvantaged communities to make use of new federal funds to prepare for and adapt to whatever adverse climate change impacts are either already manifesting themselves or are likely to emerge in the future. As such, it is intentionally broadly inclusive in terms of the nature of community resilience challenges it focuses upon.

Similarly, the intention is for this track to be broadly inclusive of innovative and cutting-edge efforts to overcome the challenges our society faces to realize the full potential of both community science and citizen science. The track will focus on ways to build trust between scientists (from both the physical sciences and the social sciences) with community leaders and community members from low-and-moderate income, historically disadvantaged communities; AND to achieve tangible outcomes from this enhanced trust, i.e., federal funding that will repair past harms and build a more resilient future.

As is explained in the plan section, over time, communities of practice can emerge that focus on specific types of physical and/or social/psychological resilience challenges, as well as communities of practice related to community and citizen science.

Plan: What activities and partners, including science activities and non-scientific partners, would

need to be funded in order to address this challenge?

Given the scope and scale of this track idea, it will be prudent to initiate this effort on a metropolitan or regional scale to achieve its objectives. Regardless of the geographic scale of each effort, this track will require a consortium of civil society organizations to come together to achieve the vision that underlies this track idea including:

A lead entity for each region/metropolitan area, which ideally would be a non-profit, public-benefit oriented entity with strong roots and high credibility with stakeholders in the geographic area and, even more ideally, an entity with a track record of success in community science, citizen science, and/or community resilience;

Numerous community-based organizations within that geographic area with strong roots at the neighborhood and metropolitan scale that are motivated to engage in this effort;

Academic institutions to serve as partners with the community-based organizations in each of these efforts, which could serve as the lead entity as well; and

Existing state and local green banks and community development financial institutions (CDFIs) that are likely to serve as the conduits for at least a portion of the federal funding.

Philanthropies, including both geographically-focused philanthropies to support efforts at the regional/metropolitan/rural/ecosystem scales, as well as nationally focused philanthropies to support learning communities of practice. Philanthropic support can be used as matching funds for cooperative agreements, presumably administered by the lead entity described above.

The plan for this track would likely require an organization with the trust, credibility and wherewithal (i.e., skills and knowledge) to lead each of the regional, metropolitan, or rural / ecosystem defined geographic efforts. Similarly, at the local community level, community and faith-based organizations that have the trust of community members would need to be fully engaged in defining the needs of their communities. Academic institutions and other types of science-oriented non-profit organizations (e.g., museums) that are willing to devote time and resources to build trust with local communities can serve as the conduit through which both physical and social science rigor can be achieved. Lastly, existing CDFIs and state and local green banks would need to be engaged as partners in many if not most or all of these efforts, but this track idea does not envision that these entities would receive funding support from NSF.

The types of scientific activities that will be undertaken under this track will include data gathering that includes both biophysical and geophysical phenomena as well as rigorous social science related

data (e.g., from polling and other social science techniques). Ultimately, the types of science and data needed would be driven by the needs as defined by each community, and the rules and procedures that the federal government establishes for receiving funding to address community needs under the Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022.

This track idea can and should encompass several of the proposals in the AGU ideation process that focus on building the capacity of community-based organizations to enable them to be fully engaged in this process, including a kick-off capacity-building conference in each region / metropolitan area, training in grant writing, introduction to data gathering and data management tools. Exploration of alternatives for data ownership, etc. This track idea can also incorporate the ideas that focus on youth engagement, STEM education, etc. by incorporating these activities into proposals tied to federal funding for physical and social infrastructure development aimed at enhancing community resilience.

Impact: What will be different in 3 years if proposals are funded within this track?

The first thing that will be different in three years if proposals are funded under this track is that the significant amount of federal funding that are intended to address the needs of historically underserved communities will actually do so, and in a manner that is driven by the needs that those communities determine are most important.

Second, networks of place-based entities will be created in each region or metropolitan area that engages in this process that can have a life after the initial push that focuses on channeling federal infrastructure funding to address local community-defined needs. These ongoing efforts can focus on tracking implementation of the investments, including gathering environmental health related data associated with the implementation efforts, gathering and tracking socio-economic data to ensure that the expected benefits to these communities are forthcoming, etc.

Third, communities of practice that cut across geographically defined efforts can be established to share knowledge, lessons learned, etc.

The kinds of deliverables and work products this track could produce include robust and scientifically valid evidence of excessively high rates of water or air contamination that needs to be rectified with new infrastructure investments, high social demand for investments in renewable energy (e.g., community solar) and energy efficiency investments in low-and-moderate income housing units, etc.

Equity: How does the track center justice, equity, diversity, and inclusion in its practices and outcomes?

The transition to a low-carbon economy is essential if society is to avoid catastrophic impacts of

climate change. The Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022 are aimed at ensuring the United States makes a meaningful and real contribution to avoiding such impacts at the global level. This transition can occur in a manner that exacerbates existing economic inequalities both here in the US and around the world, or in a manner that diminishes these inequalities. A central feature of this track is to put in place the institutional infrastructure that can help accelerate the demand for a just transition to a low-carbon future here in the US, a future in which all communities are not only more resilient to the impacts of climate change, but vibrant and prosperous notwithstanding those impacts.

NOTE to Reviewers: Since I am serving as the lead facilitator of AGU's August 7, 2022 workshop, I will not be able to actively promote this idea. I am providing it to serve as an example of the scope, scale, and level of ambition that I believe NSF is looking for regarding ideas for funding tracks that use community and/or citizen science to advance community resilience. If anyone thinks this idea is worthy of further consideration, please feel free to build upon it at the workshop.

## Developing Capacity for Appropriate Review of Community Science Research

Author: Jennifer Shirk

Work that attends to community science principles and priorities can be difficult for science peers to assess (whether for funding, for publication, or for career advancement). Reviewers - and funders - must be prepared to develop and employ criteria, and elevate funding priorities/expectations, that are in line with this work. Resources will be required in new ways and with new criteria - attention will be needed not just to the research protocols but also to how time and funds are invested in the development of relationships and even research questions.

Additionally, things previously considered as broader impacts are core to the success of partnered projects. When research proposal goals and outcomes are framed around such things as resilience, reciprocity, and corrective action, more traditional reviewers may not be equipped to provide appropriate critique. Even more nuanced, reviewers must be prepared to understand the merits of the many different approaches and practices to partnered research (for one, co-creation has faced many challenges in review) and able to assess whether the proposed approach is being appropriately proposed and resourced. Reviewers will also need to understand parameters for equitable partnerships, including funding parity for community members and leaders.

This will all require careful articulation and consideration of review criteria relevant to community

science work, and processes/procedures for securing reviewers familiar with these basics. Next steps can help bring more clarity to the landscape of practices, and build a culture within agencies and scientific societies that brings visibility and appreciation to the value of these investments.

## Enable Community Science Careers and Cultures

Author: Jennifer Shirk

The skills and sensitivities needed for community science are not currently reflected in the ways STEM professionals are trained for or rewarded in their careers. As new funding streams encourage more scientists and scientific organizations to partner with communities, there is a need for both awareness of and access to the practices and principles for effective and equitable partnerships.

Professional learning and development opportunities are needed, as are mentorships, fellowships, and new career pathways. Funding should be allocated to develop and deliver trainings, and should look first to expert community leaders who, after decades of experience navigating relationships with academic and scientific institutions, have developed tools and strategies for guiding partnered research. Funding and time should also support, if not require, academic grantees for community science to attend relevant trainings - these partnerships are too consequential to be handled poorly.

Larger scale, intentional awareness and attention is also needed to shift institutional cultures and reward structures in order for community science work to be viable within STEM careers.

## Youth Community Science HUBS: Interdisciplinary Youth Participatory Science Action Research to Strengthen Climate Change Resilienceront Climate Change

Author: Jean Schensul

What community-resilience and community science challenge(s) does this track idea advance? How?

Young people are going to be among those most affected in the future by climate change and related environmental, health and infrastructural challenges to their safety security and well being. Urban youth of color, immigrant youth, rural youth and youth who lack resources or are coping with

disabilities, and who are marginalized from educational advancement opportunities will experience inequitable distribution of the burden of change. In some communities, up to 60% of young people do not complete high school, yet these are the youth we depend on to cope with environmental crises and to find innovative ways forward. To ensure their engagement and to maintain their hope and optimism for the future it is critical to make available educational opportunities that are supportive, progressive, and create spaces where youth have voice and can learn about and act collectively and in a science informed way on environmental and climate change issues that affect them.

Youth Participatory Action Research is a well established and evaluated approach that engages young people in research on issues that affect them directly that leads to action in their own community. It is very effective with marginalized youth when implemented in innovative and flexible learning environments. It has been demonstrated to build educational attachment, strengthen intergroup relationships, enhance communication skills, reduce conflict, improve mental health and bring about economic, health, mental health, and other needs structural and service changes. YPAR for climate change resilience applies this concept to climate change research and advocacy. Most YPAR programs utilize social and health sciences approaches to address social/political problems. YPAR for climate change requires interdisciplinary earth sciences as well as social science knowledge and skills to ensure that youth develop both the scientific results and social infrastructure for advocating for climate change. By engaging a community's most vulnerable youth, YPAR for climate change will result in more resilient youth and more resilient communities.

Most STEM programs for middle and high school age youth focus on the development of individual scientists, training youth in laboratories, clinics and other settings. They do not offer training in community settings and are not geared to solve community problems. Further, students work under individual laboratory or engineering or space scientist mentorships. Their mentors are not usually engaged in science for community problem solving. Thus students do not have the benefit of exposure to communities and their science needs or to community scientists with alternative ways of viewing the world. Finally programs are often geared for the best rather than the most marginal students.

There is a growing movement toward YPAR for climate change so there are pilot examples. Needed is a national effort to develop in and out of school learning environments and science academies run by community scientists who are linked to or embedded in local communities who are trained to engage marginalized youth in YPAR for Climate Change problem solving and resilience.

YPAR for Climate Change Problem Solving takes its lead from issues young people see as priorities in their communities. Some examples that have emerged in Black and Hispanic and other low income urban neighborhoods are studying factors contributing to the tossing of disposable plastic garbage and litter, addressing air pollution stemming from highway diesel or garbage dumps and burning in

Black neighborhoods which affects youth with asthma, studying land, air and water quality for the construction of sustainable urban farming linked to community gardening, ways of improving youth accessibility to currently youth unfriendly urban farmers markets, researching and preventing construction that destroys green spaces in urban neighborhoods and exploring urban foraging potential and engaging schools in urban foraging.

Plan

YPAR for Climate Change HUBS should be based in easily accessible community settings. These could be university arms in local communities, or independent settings. HUBS would need staffing with a mix of youth work, social science and earth/climate change science knowledge. Staffing could include faculty, students, conservationist or other community science personnel. HUBS would need to be connected to local and national expertise to solve local problems youth identify as priority. HUBS would need community stakeholder advisory boards to link youth to local community residents and leaders. Activities of the HUBS would include

1. YPAR for science training program that combines existing and tested YPAR for youth empowerment curriculum with local ecological knowledge and formal science knowledge, methods:outcome is a general integrated curriculum plus lesson plans for specific community science problems
2. Supervised rigorous youth led research design and implementation.
3. Organized stakeholder and academic science advisory boards managed by HUB program staff that include local leaders, stakeholders, youth advocates, scientists committed to community science, and funders.
4. Connections to local universities for expertise in water quality, land preservation, ecological cultural heritage recovery, permaculture and ecologically advanced urban farming, air quality and air quality measures, and relevant laboratories.
5. Links to educational remediation to ensure completion of high school and admission to college
6. Links to mental health counseling for youth with histories of trauma
7. Supports for college admission in STEM areas based on links with other youth serving organizations.
8. Training for science/social/public health faculty in principles of CBPR and community science to support vulnerable youth.

Impact

What will be different in 3 years if proposals are funded within this track?

If proposals are funded in this track in three years, there will be a network of YPAR for climate change hubs spread across five or six regions of the country, two cohorts of vulnerable youth

totaling 20 per cohort x 6 (120) who are YPAR science HUB fellows, at least 50% of engaged in school and college in community science oriented STEM education tracks, examples of positive youth contributions to climate change efforts in their local communities to post to the CSE HUB and to link with CitSci programming, a cadre of training teams that can provide technical assistance to other sites and an integrated Science/Social-Health Science YPAR curriculum that can be adapted in other locations around the country.

Equity

This approach even if implemented on a pilot basis in a single community will simultaneously address historical environmental discrimination affecting black, brown and otherwise marginalized communities, redress the traumas that marginalized high school youth have faced in formal schooling. By facilitating their useful and positive contributions to their local communities, the approach will reframe the views of community stakeholders that perceive them to be dangerous and detrimental to community welfare. By building on youth knowledge and perception the approach reinforces existing skills and capacities, enhancing resilience and mutual learning. The approach reframes and redistributes power by involving young learners in collaborating with scientists to approach climate change problems that impact directly on them in their own communities.

Challenges:

1. Funding;
2. 2 staffing;
3. Identifying community science experienced scientists for collaborations in communities with youth;
4. Providing continuing wrap around supports for marginalized youth to enable them to succeed.

Project Examples

A YPAR for climate change HUB in three plus locations each in three states with USDA UAIP funded sites promoting urban agricultural innovations. The HUB will involve urban Black, Hispanic and Indigenous youth and local scientists conducting interdisciplinary community research together with local allies to test, mitigate and evaluate the impact of traditional and new technology and practices to address water, soil and air quality toxicity and improve agricultural safety in urban farms.

## Time to Make Earth Sciences a Primary Science Subject

Author: Afroz Shah

Unfortunately, until now, the Earth sciences have not reached the status of science subjects like Chemistry, Biology, Mathematics, etc. Interestingly, Earth is the only home that connects the entire creatures on it, yet, we have not been able to communicate the science of how it functions and what it means to be a healthy and dynamic planet to our generations. We have somehow not realized the beauty of this planet. The climate change crisis is now surrounding us from all sides, and things are changing a little bit; people are trying to understand the Earth, but still, there is a considerable misunderstanding about which science is better. Ask me, and I will tell you that we humans have wrongly categorized knowledge into popular and not-so-popular science subjects, which is a problem. Wisdom is to learn and should not be graded by how much you earn. I may like to wonder about the vastness of the universe, and perhaps no one will pay me for that, but I am learning. So, I would want you to consider a proposal to communicate Earth science to the public at large and introduce it in schools. Perhaps, we have never had the urgency to understand the planet as we are having it now. We need to answer the rising global climate change issues, resource depletion, hazards turning into disasters, etc. We must discover our role on the planet and how we will teach and learn to be a good family.

## Metro Atlanta Urban Farm

Authors: Bobby Wilson and Phyllis Edwards Turner

Metro Atlanta Urban Farm (MAUF) will serve as the lead organization and fiscal agent in a co-created community science project that builds resilience in marginalized, underserved, and underrepresented communities.

MAUF will build a team that consists of twelve faith-based organizations across four different states—Georgia, Alabama, Mississippi, and Kentucky—and five HBCUs which are Alcorn State University, Clark Atlanta University, Alabama A & M University, and Fort Valley State University.

Faith-based organizations that agree to participate in the community science project will recruit students to participate in information technology classes that are designed to teach and enhance

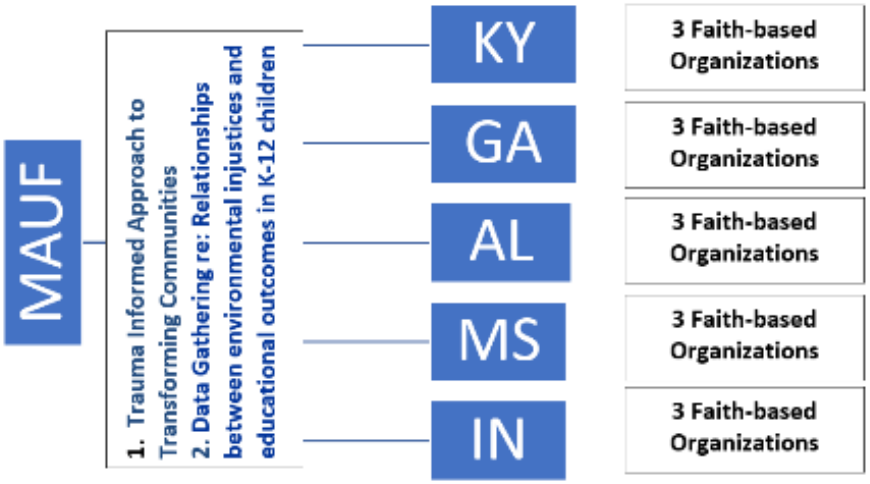
participants' technology, research, and community organizing skills for which an urban agriculture gardening program will be used to provide practice and research. The scientific research will include, but not be limited to, agricultural science

Each community will select a lead communicator and representative to report directly and exchange information with the lead organization, MAUF.

Because this will be a co-created process, individual communities will conduct needs assessments and surveys to define, within the first six months, the specific issues to address and skills that will be offered within their community's programming.

Each community will decide on the age groups of the initial participants to be served. After the first year, a new set of participants will be added. Using a concept that is similar to educational looping along with the "Each one, teach one" model, as participants move to the second and third year of participation, they will be asked to serve as mentors for newly-added participants.

The NOISE Project's model to engage and acknowledge the importance of youth participation titled them "Junior Community Science Collaborators".



# Appendix 3: Resilience-Related Topics Identified Before and During the Workshop

Resilience is the ability for communities to adapt, recover, or withstand adversity and challenges, especially adversity or challenges related to climate change, in a sustained manner. At its best, resiliency addresses the underlying causes of inequality, repairs past harms, and addresses future injustice.

Resilience topics of interest included the following:

1. Climate Change Impacts

    - Impacts that were mentioned multiple times included flooding, fires, water availability and water quality, urban heat, and air quality.

    - A key challenge identified multiple times was the sense that the information available from scientists isn't well connected to the questions community leaders have and the decisions they are making—the focus should be on making existing information and data more usable.

    - Questions about how to understand and respond to the cumulative impact of small events that are more likely or more severe due to climate change or how to respond to multiple climate impact stressors.

    - How can we support/enable nonscientists to easily access and share information about climate impacts they are experiencing?

    - Developing next-generation climate indicators that combine qualitative and quantitative data in order to provide an ecosystems and systems level assessment.

    - How do we inspire with visions of positive climate futures?

- How can climate action be a cobenefit of other community priorities (a step beyond asking what the cobenefits of climate action are)?

- Climate impacts are primarily local and so are ideally suited to community science. Local climate successes achieved through community science can fight a narrative of climate hopelessness.

2. Environmental Justice

    - Need for *structural change* to the way that funds are distributed and accessed.

        - Community-based organizations need technical training to go after big federal grants; they are competing with universities.

        - NSF funding should not be funneled through universities—they take approximately 50% of the money for overhead.

        - Need long-term strategies. Once the grant runs out, the problem may still be present.

        - Organizations not actually doing the work are getting the funds over the organizations on the ground, which creates another opportunity for trauma.

    - Justice40 principles should apply to *all* federal funding, so funding can go *directly* to the communities doing the work (minimum 40% of funding).

    - Solutions should be scalable, self-sustaining, and long-lasting.

    - Need a broad track to really target community issues because those issues are interrelated and need cross-cutting solutions, not single-focus solutions. Framing of problems needs to be broad enough to capture all the facets of the problem—allow for community inclusion in the framing of the problem and the solutions.

    - These problems are not single issues; they are interconnected because of long-standing structural issues, so these communities are not experiencing just one part of environmental justice, but interconnected ones.

    - Universities are benefiting from studying our communities, but our communities are not benefiting from that research. Money for research provided by NSF, but the

community didn't benefit or gain anything from that research. Communities have been excluded from the table in the discussion of what is researched and how it is used.

3. Equitable and Green Infrastructure

    - How can we better quantify the impact of and incentivize investment in green infrastructure at the neighborhood scale, especially in neighborhoods of color, given the long payoff and competing priorities?

4. Food Systems, Sovereignty, and Security

    - Need space for both longer-term research questions and community questions. For example, crop genetic diversity includes traditional varieties that have greater cultural and/or nutritional value as well as potential for adaptation and sustained resilience under increasing climate variability.

    - Need more investment in potentially disruptive approaches to food—not maintaining the status quo policies focused on improving the productivity of monoculture through investments in "big ag."

    - Prioritize food sovereignty, which recognizes that culturally appropriate foods, healthy waters/lands, and seeds are all human rights.

    - Focus not only on rural food-producing communities, but also on urban agriculture including community gardens that enhance food access and justice.

    - Need to carefully consider intellectual property rights when working with Indigenous communities.

    - Engage small farmers, urban farmers, women farmers, and support networks for farmers to facilitate exchange of grounded expertise.

    - Support Indigenous and other people who nurture and harvest foods and medicine from their homelands.

- Consider not just new technology, but also the restoration of ecosystems that contribute to food security through sovereignty.

5. Integrated Social and Technological Approaches for Transportation Justice

    - Better understanding of what supports transportation behaviors and transportation choices.

    - How can science shift the balance of power away from large developers? What kinds of data and tools equip communities to participate in and even drive transportation decisionmaking?

    - Intersections with affordable housing, food availability—how do we consider transportation in the context of access to services and resources?

    - What kinds of multimodal transportation options enable universal accessibility?

    - How can virtual participation in things (like access to medicine) complement physical participation, and how do we consider transportation and communications together in the context of access?

    - How can green infrastructure protect transportation during extreme events?

    - Data to better measure and quantify transportation need and inform transportation decisionmaking.

6. Mental Health and Well-Being

    - Young people, led by accredited Black researchers, to conduct environmental racism scans.

    - Better understand the intersectionality of mental health with racism, infrastructure, climate, etc.

    - What can NSF do to address people suffering from mental illness right now? People suffering right now—what are the immediate interventions for current problems?

- Is there a list of Black-led research?
- “NSF doesn’t trust nonwhite organizations to manage the money well.”
- Address the mental/emotional health of marginalized, nonwhite communities.

7. Other Environmental Hazards
    - Low-cost environmental sensors and tools for collecting data.
    - Cumulative impacts—over time and from multiple stressors/hazards.
    - More resources available to smaller organizations attempting to monitor large industrial operations.
    - Having some way to connect data to learn from different projects and learn from one another would be very powerful.
    - Need some help/work to develop comfort and facility at the interface of science and policy.