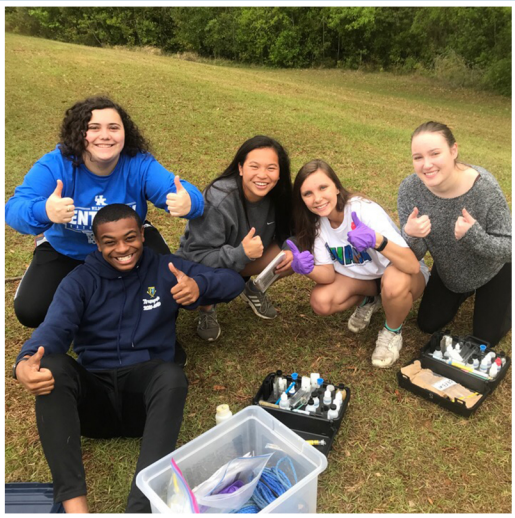
EPA
United States
Environmental
Protection Agency

June 2022 | www.epa.gov/research



Using Participatory Science at EPA: Vision and Principles

Office of Research and Development
Office of Science Advisor, Policy & Engagement

Using Participatory Science at EPA:

Vision and Principles

Preface

Public participation has long had a catalytic role in environmental protection. The principle that the public has a right to be informed of and engaged in decisions that affect them is integrated into our Nation's environmental laws and regulations. New tools and technologies such as smartphone apps, drones, digital photographs, and low-cost pollution sensors are becoming widely available, making public contributions to science more practical and commonplace. Greater involvement of the public in expanding scientific understanding and knowledge of environmental problems offers substantial opportunities, as well as challenges.

This document describes EPA's vision for the strategic use of participatory science approaches in EPA's work. Although public engagement in science is not a new concept, the term "participatory science" is relatively new. Others have used terms such as citizen science, community science, crowd-sourced science, community-based participatory monitoring, volunteer monitoring, public participation in the scientific process, public science, open science, civic science, and do-it-yourself science. There is current debate in the field about terminology, but scientists and practitioners agree on the larger goal of making these science approaches as broad and inclusive as possible. To that end, EPA is transitioning to the term "participatory science" to represent the most inclusive and accessible involvement of the public in the scientific process, especially for those who have been historically underrepresented in the field. EPA recognizes that changing terminology is a first step and commits to ensuring that everyone can influence the culture, values, and future of participatory science.

In this document, participatory science encompasses the use of scientific data generated by the public as covered by the Crowdsourcing and Citizen Science Act of 2016 and includes a broad and inclusive range of activities, from those originating in academic and government institutions that enlist the public in data collection to create knowledge, to community-led projects intended to develop data and information that address environmental justice issues and community concerns. EPA will work to advance community-based participatory science for all residents, focusing on local priorities and local perspectives, where communities are engaged in identifying concerns, project design and management, and follow-up actions.

This document will help guide EPA on the use of participatory science in its programs to increase public engagement and understanding and to take actions to investigate and mitigate environmental problems. This document also includes principles and actions needed to achieve this vision. Implementation details will be addressed in a companion document that will define roles and responsibilities for implementation steps and will identify resources to maintain and build upon current Agency expertise and programs.

The scope of EPA's vision for participatory science encompasses use in EPA programs; collaboration with state, tribal, and local governments, as well as other federal agencies; and support for participatory science work in academic and non-governmental organizations (NGOs) and directly with communities.

Introduction

Participatory science is the involvement of the public in the scientific process, often in collaboration with professional scientists and scientific institutions. In participatory science, the manner and level of public involvement exists on a spectrum based on the roles of scientists and project participants. Program leadership can range from scientist-driven to community-driven, which can result in differences in the role of government agencies, uses of data, and types of environmental issues addressed. Projects can have different starting points and intended outcomes. For example, projects that emphasize a science question may be designed specifically to expand scientific knowledge, whereas projects that are designed to address a local community concern may aim to influence environmental decisions to improve environmental quality. Increasingly, scientists and communities are learning to work together on co-created projects with shared management responsibilities that deliver benefits for both scientists and the community.

[Participatory] science engages the public in efforts to advance scientific knowledge by formulating research questions, collecting data, and interpreting results. It also includes place-based and community controlled scientific efforts that advance social learning, empowerment, and collective action.

Built on a long history of public contributions to science, participatory science is a transformational approach emerging as a core tenet of environmental and human health protection. Through this approach, the public helps to improve understanding and scientific knowledge of environmental problems and protective actions. The scope of participatory science is broad and can span many scientific fields. Projects use the collective strength of the public to identify research questions, collect and analyze data, interpret results, make new discoveries, and develop technologies and applications to understand and solve problems.

The goal of this document is to provide a unified vision to guide EPA's participatory science efforts and investments. Given that technologies to enable these approaches are evolving, EPA considers this to be a living document and will update it as needed.

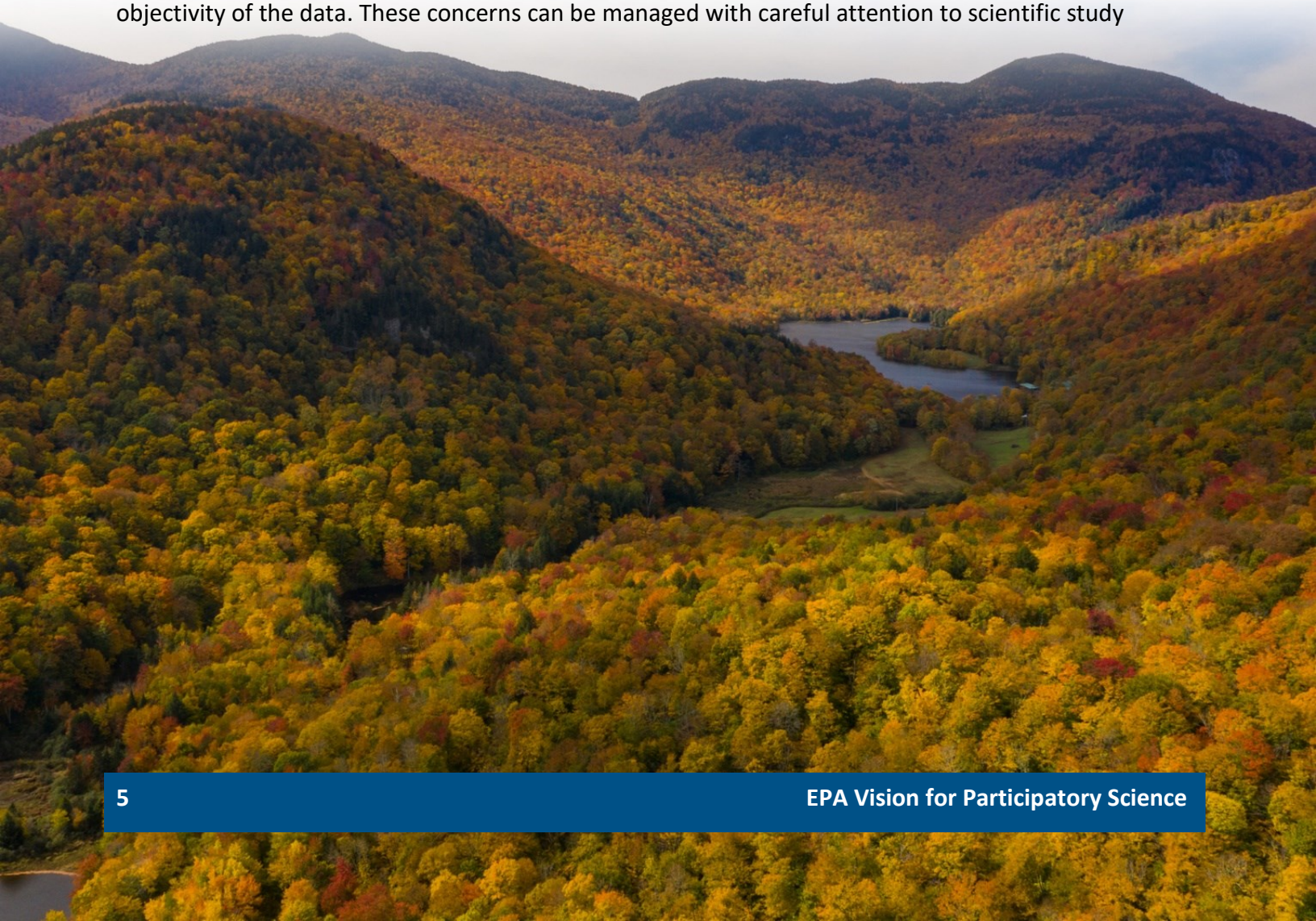
Vision Statement: EPA envisions a future where all parts of society are increasingly engaged and empowered to help advance scientific knowledge that informs environmental protection actions on local, regional, and national scales. In this vision, participatory science projects will provide accessible, actionable information that improves environmental awareness and decision making.

EPA Vision for Using Participatory Science

Public engagement in science can improve environmental problem solving and result in better protection of human health and the environment. Together, EPA and the public will protect human health and the environment by using participatory science to inform environmental decision-making on an individual, neighborhood, state, national, and global scale. EPA will strive to achieve a balanced approach in support of the full spectrum of participatory science projects. EPA plans to provide additional scientific support for community projects, increase the diversity of project participants, and address equity in project design. Through these actions, EPA will encourage co-created projects where scientists and communities work together.

EPA aims to increase the appropriate and timely use of participatory science information in environmental decision-making at EPA. To achieve this goal, EPA intends to advance approaches that increase the objectivity, integrity, and utility of participatory science, such as data collection standards and data management practices.

EPA recognizes that potential concerns can arise with public contributions to scientific knowledge and understanding, particularly with respect to data quality and the use of participatory science data in environmental policy decisions and regulatory programs. Although the reliability of measurements is often the main concern, there may also be legal and ethical concerns regarding the generation and objectivity of the data. These concerns can be managed with careful attention to scientific study



design, data quality methods, involvement of human subjects, participant training, access to technical assistance and tools, and the trend of standardization of data collection methods. EPA's scientific integrity policy is one of several Agency policies that guides EPA's use of participatory science.

Over the last fifty years, the use of participatory science as a mechanism for collecting evidence of environmental justice issues has increased significantly. Projects that are initiated and managed at the community level are frequently used to define, research, and address environmental justice issues. Local community groups or NGOs often lead projects that collect monitoring data that they can use to document and draw attention to pollution in overburdened communities. Community-managed projects fill an important need in underserved and marginalized communities that lack trust in how government agencies respond to community concerns and needs. A crucial element of EPA's future vision is to strengthen the valuable role of community-driven projects that lead to effective responses to local environmental issues.

Background: Growth in Participatory Science

Public participation in environmental science, often through volunteer monitoring and observations, predates the creation of EPA in 1970 and has continued to evolve over time. EPA's early efforts to support volunteer water quality monitoring by providing tools, training, and technical assistance have expanded and diversified so that participatory science projects now span all EPA programs and the work of EPA regional offices.

Today, EPA uses participatory science to advance community engagement, research, monitoring, and environmental education goals. EPA and partner organizations have used participatory science to help with emergency response actions, evaluate new air-quality-sensor technologies, fill information gaps in non-regulatory programs, assess water quality, provide screening-level data for communities, and contribute to environmental education. Many other partner organizations – including other federal agencies, states, tribes, local governments, academic institutions, NGOs, community groups, and others – now engage in and use participatory science for environmental protection.

Examples of recent EPA participatory science (citizen science) topics

- ***Harmful algal***
- ***Drinking***
- ***Beach***
- ***Coastal***
- ***Invasive***
- ***Wildfire***

These approaches are expanding at EPA and other organizations, and public engagement in science is being used to solve a growing set of environmental issues. EPA and partner organizations now use participatory science to assess drinking water contamination, detect radon, support chemical safety, assist emergency responses, evaluate impacts of disasters, identify harmful algal blooms, monitor the distribution of contaminated soils, measure indoor air pollution, assess beach safety, track the distribution of invasive species, ground-truth wildfires, and more.

EPA plans to work with states, tribes, and other organizations to improve data management practices for all steps in the data life cycle – including data collection, sharing, access, storage, and information use and governance. EPA has provided resources to help communities define and document their data quality, a necessary step in increasing how and when participatory science can be used in decision-making. These resources include the EPA Handbook for Citizen Science Quality Assurance and Documentation, user-friendly quality assurance (QA) templates, and illustrative real-world examples. These resources can be applied to the collection and use of environmental data for three broad categories of participatory science projects: increasing public understanding; scientific studies and research; and legal and policy action. There are stringent quality assurance requirements for using data for enforcement actions; however, participatory science data may be useful in identifying areas for compliance evaluations.

Value of Participatory Science in Environmental Protection

Environmental problem solving in the 21st Century is strengthened when all parts of American society are engaged in the job of ensuring clean air, land, water, and chemical safety. EPA recognizes the value of participatory science as a catalyst for dialogue between EPA and the public about environmental issues. It connects government programs to the people and communities that EPA serves. Across the United States and around the world, people are collecting and using scientific data generated by the public to inform a wide range of environmental actions and decisions. These projects are driven by a growing interest in how people without formal scientific training can contribute to science and address community concerns.

> ***Participatory science is much more than collecting data. It provides a way to engage all parts of society in gaining a deeper understanding of human environments, build an informed population that can advocate successfully for environmental protection, and more effectively protect human health and the environment."*** *EPA's National Advisory Council for Environmental Policy and Technology Report*

Participatory science has untapped potential to improve environmental and public health protection and to contribute to equity, environmental justice, and more effective solutions for local, regional, and national challenges. Applications of participatory science offer new avenues of collaboration and information gathering among government agencies, scientific organizations, local communities, and the public. By incorporating enhanced accountability, transparency, and public participation, participatory science can produce valuable benefits to the American public and society.

Participatory science can:

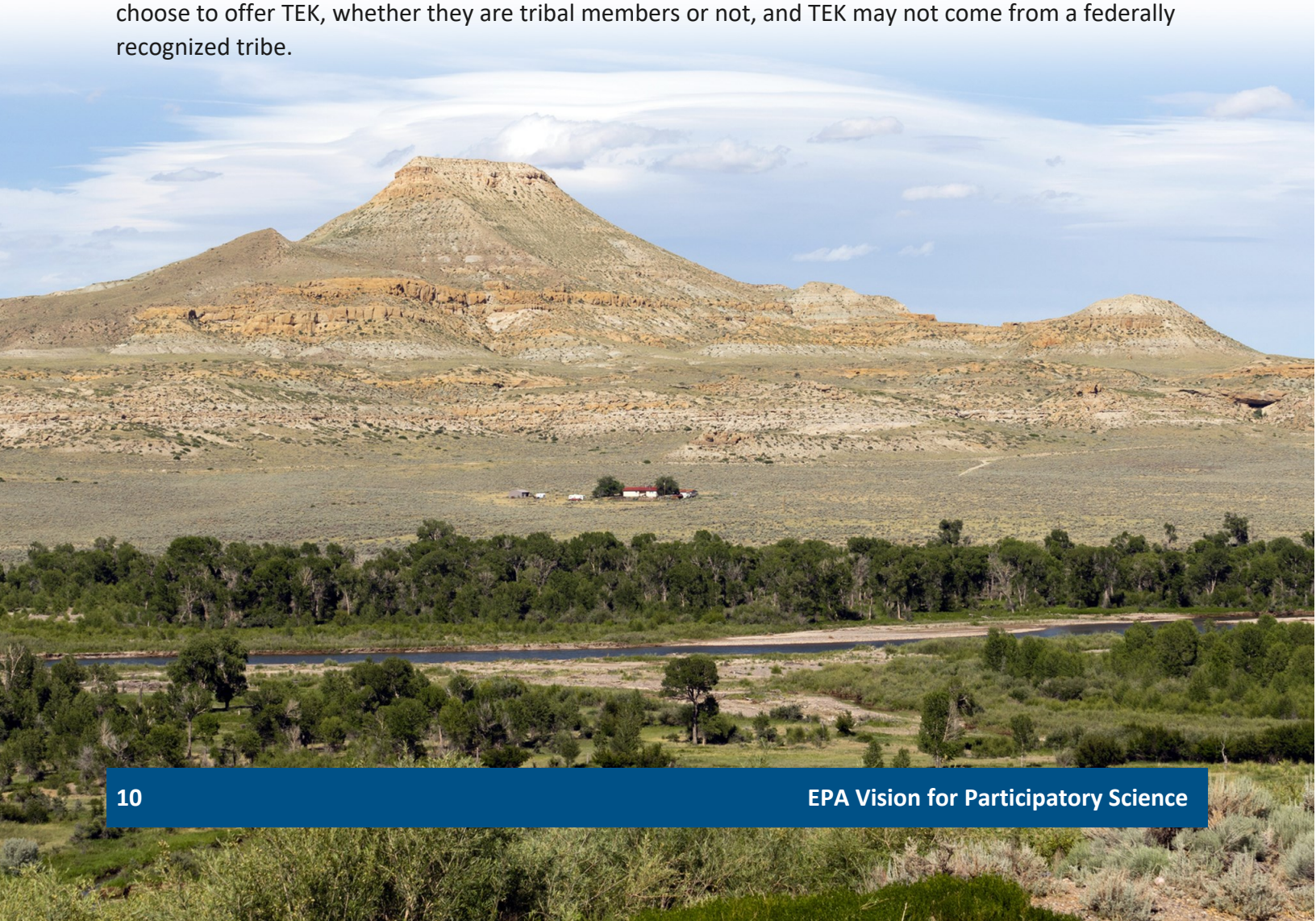
- **Fill information gaps** and provide other means of identifying potential environmental problems.
- **Improve public understanding** of environmental issues and actions that address them.
- **Create a stronger, more inclusive, and collaborative network** of individuals and organizations dedicated to environmental problem solving.
- **Yield cost-savings and efficiencies** in environmental monitoring and protection programs.

In summary, participatory science projects typically yield multiple benefits, including actionable information and engaged communities. Public involvement in science improves understanding and participation in environmental problem solving.

Tribes and Traditional Ecological Knowledge

Many tribes engage community members in environmental science activities and are motivated to find new ways to apply tribal-based participatory science. EPA commits to work with Tribal Nations and indigenous people to appropriately support their use of participatory science. EPA recognizes that tribal governments or individual traditional knowledge holders may wish to include Traditional Ecological Knowledge (TEK) in their projects. TEK is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems. It is applied to phenomena across biological, physical, cultural, and spiritual systems. TEK has evolved over millennia, continues to evolve, and includes insights based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation.

EPA intends to work with sovereign Tribal Nations to build capacity for addressing environmental and health issues throughout Indian Country. Tribal Nations have unique needs concerning data privacy, cultural information, and other issues that arise in participatory science activities, which may not be present in non-tribal projects. The scope of some tribal projects may include environmental, cultural, and spiritual perspectives and relationships. Additionally, individual indigenous TEK holders may choose to offer TEK, whether they are tribal members or not, and TEK may not come from a federally recognized tribe.



EPA Principles for Participatory Science

The design and management of future EPA participatory science projects can draw on the lessons learned and experiences from past efforts. Although each project may be unique and tailored to specific topics and circumstances, there are overarching principles that will create a more strategic Agency wide approach. With respect to community based projects, EPA and other science organizations need to expand their role of technical support and local capacity building, rather than one of project leadership and control.

Incorporating participatory science in environmental protection programs can be challenging. EPA is moving toward a new era where this approach is an integral part of environmental protection. Three core principles for conducting and supporting participatory science–good science, community involvement, and informed decisions–will guide EPA's efforts and have broader utility for environmental protection efforts undertaken by other organizations. Given the networked nature of participatory science, which typically involves multiple organizations (government, NGOs, academia, etc.), alignment of shared goals should lead to more effective outcomes.

Good Science

Participatory science projects expand scientific knowledge and understanding. Public participation in all stages of the scientific process can be valuable, from identifying research questions, to collecting and analyzing data, to using information for improving public health and the environment.

- **Increase Scientific Understanding:** Every project should identify and define clear scientific questions and strive to answer those questions by making new discoveries, developing technologies and applications, collecting, and analyzing data and interpreting results
- **Plan and Document Data Quality:** The level of data quality assurance and documentation will correspond to intended data uses. Participatory science data used in regulatory programs should meet high standards of data quality, whereas other projects may produce valuable screening level data.

- **Use Innovation, Experimentation, and Evaluation:** Participatory science is a rapidly evolving field. Testing and demonstration of new ideas and approaches should lead to improved practices for future projects.

Community Involvement

Involving the public in environmental science can yield mutual benefits for communities, scientists, and environmental protection programs. Filling gaps in scientific knowledge supports local assessments and solutions to environmental concerns.

- **Support Equity in Community Projects**: Inclusive and equitable partnerships create meaningful collaboration around shared goals in participatory science projects. Projects should deliver tangible benefits to the community through meaningful involvement and a strong community voice in project design and management.
- **Build Capacity for Place Based Problem Solving**: Increasing local capacity for impactful participatory science requires support from EPA and other organizations, including funding opportunities, technical assistance, and training. Local environmental problem solving, from identifying problems to developing viable solutions, can benefit from public participation in science activities.
- **Create Collaborative Partnership Networks:** EPA recognizes the vital role of other organizations in environmental participatory science and will help build capacity and leverage expertise and resources in NGOs, educational institutions, and the private sector. Co created projects with shared roles and responsibilities often lead to the best results.

Informed Decisions

Public involvement in science can influence decisions about environmental protection in multiple ways, from addressing local community concerns to informing actions by state, tribal, and EPA programs. Some projects provide useful information at the neighborhood scale whereas others contribute to broader environmental problem solving.

- **Strengthen Shared Governance with States and Tribes:** States, tribal nations, and local governments are often at the front lines of environmental protection. EPA plans to work in partnership with states, tribes, and local government on approaches that effectively use participatory science in environmental protection, including sharing program information needs that can be filled through additional monitoring.
- **Maximize Transparency and Accessibility:** Project managers should strive to make project data publicly available, while protecting privacy. Where feasible, project data and analyses should be shared along with corresponding metadata (information about how the data were collected) as widely as possible, so participants and the public can be informed about project results.
- **Encourage a Variety of Project Approaches:** Different projects will influence different kinds of decisions, some at the community level and others at larger geographic scales. Participatory science approaches are used in protection of the environment and human health in diverse ways, including both regulatory and nonregulatory programs.
- **Incorporate into EPA's Environmental Programs:** EPA policies, incentives, and program guidance should be expanded in ways that allow useful participatory science contributions to environmental protection through community engagement, education, monitoring, and research, and ultimately contributions to policy, regulation, and enforcement.

Best Practices for Working with Communities

Increased support for community-based participatory science is a priority for EPA. EPA has historically supported projects addressing scientific questions that are typically organized by science organizations, but it has provided limited assistance to build capacity for projects addressing community concerns that are managed at the local level. EPA recognizes the value of community-based participatory science in improving local environmental protection activities and is committed to building new and better ways to support these projects.

A well-executed community-based participatory science project yields benefits for both communities and scientists, including increased understanding of science by communities and clearer understanding of communities' concerns by scientists. Conducting a successful project begins with a commitment to developing a cooperative, mutually beneficial relationship with the community. Recognizing that community members are best suited to identify their needs, EPA scientists will work alongside communities to manage and implement projects that address community concerns and will strive to build a strong foundation of trust and understanding between communities and institutions.

Implementation: Turning Principles into Practice

EPA will convene a cross-agency group to prepare an internal action plan that defines specific implementation steps needed to realize the Agency-wide vision for participatory science. This plan will include roles and responsibilities for the different EPA offices, timelines, and resource requirements. The Office of Research and Development will serve as the EPA lead coordinator for implementing the vision for participatory science, working with EPA's national programs and regional offices. EPA will continue broad and inclusive community engagement as we move forward on implementation steps, including the following components:

1. **Implement an EPA data management strategy for participatory science** that improves data infrastructure, standards, and methods and promotes data accessibility and transparency.
2. **Increase staff skills and institutional capacity within EPA** to design and manage EPA-funded participatory science programs to include training, policy guidance, technical tools, and other capacity building and communication activities.
3. **Expand EPA cooperation with states and tribes** using an interactive process that characterizes state and tribal participatory science activities and defines how EPA can better support these programs. Continue building the E-Enterprise partnership for states, tribes, and EPA to share best practices and result
4. **Strengthen collaborative partnerships and multi-stakeholder networks** through dialogue with participatory science organizations about needs and opportunities, and sharing of technical tools, data expertise, and training resources. Work with academic institutions, NGOs, and other interested groups that can provide technical support.
5. **Enhance private sector understanding of and participation in participatory science** through outreach, dialogue, and expanded engagement.
6. **Support participatory science** through seed funding to community organizations and updating program guidance to explicitly include community-based participatory science in EPA programs.
7. **Incorporate participatory science results into EPA program strategies**, as appropriate, for addressing issues defined by local, state, national, and tribal environmental priorities (e.g., screening level data, identification of hotspots, addressing non-regulatory responsibilities, etc.).
8. **Develop metrics to measure and evaluate EPA participatory science projects**, and practical approaches for collecting information needed for evaluation.

Moving Forward

EPA's vision for the future – where participatory science data are abundant, increasingly accessible, and useful for environmental awareness and decision-making – is ambitious. Combining rigorous science and public participation is indeed a promising proposition, and EPA will need to address challenges, including legal and ethical issues, technical resources, and project management. Advancing participatory science approaches will require a cultural shift and a new mindset where public participation is viewed as a foundational asset for how environmental programs operate. EPA's future work will be energized by new and creative ways of mobilizing participatory science in support of environmental protection. This vision for participatory science can be realized only if EPA works collaboratively with other organizations with this shared goal.

References

Crowdsourcing and Citizen Science Act 15 U.S.C. § 3724. Retrieved from http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title15-section3724&num=0&edition=prelim

Cooper, Caren B., Hawn, Chris L., Larsan, Lincoln R., et al (2021). Inclusion in citizen science: The conundrum of rebranding. *Science Magazine, 372(6549),* 1386-1388. DOI: 10.1126/science.abi6487

National Advisory Committee on Environmental Policy and Technology (NACEPT). (2016). *Environmental Protection Belongs to the Public: A Vision for Citizen Science at EPA* (EPA 219-R-16-001). Retrieved from https://www.epa.gov/sites/production/files/2018-04/documents/nacept_citizen_science_publication_eng_022318_rf508_508.pdf

U.S. Environmental Protection Agency (USEPA). (2012). *Scientific Integrity Policy.* Retrieved from https://www.epa.gov/sites/production/files/2014-02/documents/scientific_integrity_policy_2012.pdf

U.S. Environmental Protection Agency (USEPA). (2019). *Handbook for Citizen Science Quality Assurance and Documentation*. Retrieved from https://www.epa.gov/citizen-science/quality-assurance-handbook-and-guidance-documents-citizen-science-projects