CalEPA
California Environmental Protection Agency

Community Science Initiative

Practitioner's Guide

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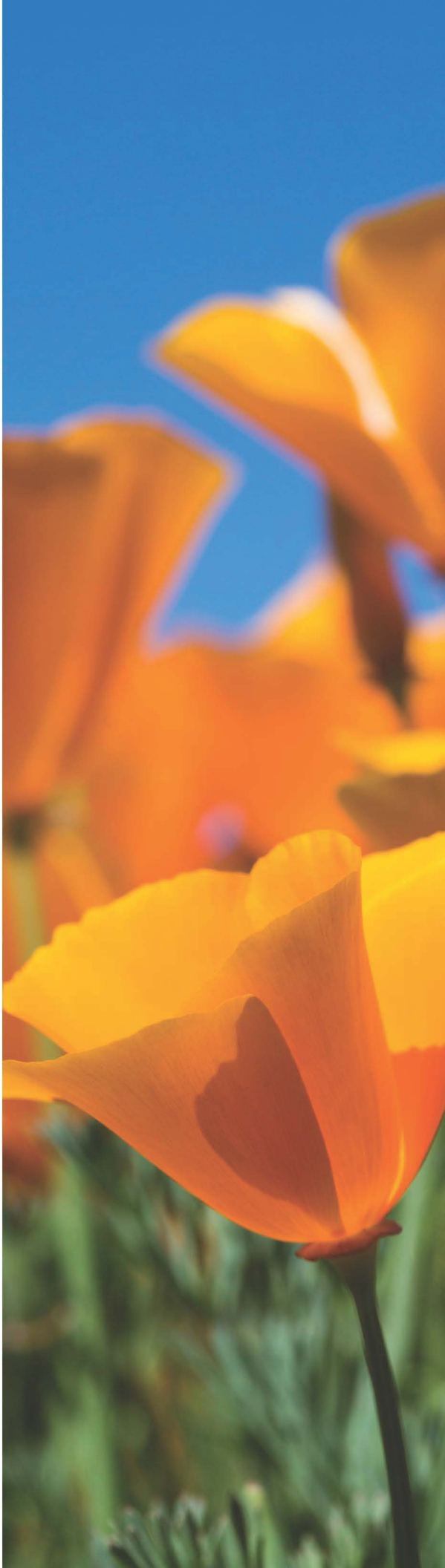

Partners

CCAC
Central California Asthma Collaborative

ALIANZA
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Promoviendo Acción Cívica

CAHTO TRIBE

Sierra Streams Institute

LAND TOGETHER

Comite Civico del Valle, Inc

The Great Seal of the Big Pine Paiute Tribe of the Owens Valley

Gabrieleno Band of Mission Indians
Kizh Nation

Orange County Environmental Justice

California Air Resources Board

CalRecycle

dpr
California Department of Pesticide Regulation

Department of Toxic Substances Control

OEHHA
Science for a Healthy California

California Water Boards
State Water Resources Control Board
Regional Water Quality Control Boards

Community Science Practitioner's Guide

Executive Summary

This Community Science Practitioner's Guide (Guide) provides detailed information for California Native American Tribes (Tribes), Community-based Organizations (CBOs), and other groups to conduct community science efforts. This Guide follows the scientific method and works towards actionable research. It assumes community science outcomes are more actionable when Tribes, CBOs, and others collaborate with agencies to design and implement projects. This Guide was produced in line with this assumption through a co-development process with community science experts from three Tribes, seven CBOs, and a staff working group from the California Environmental Protection Agency (CalEPA) and its Boards, Departments, and Office (BDO).

This document is intended as guidance only. This Guide should not be interpreted as legal advice. This Guide does not create any rights, obligations, or establish any new standards. It also does not establish, supersede, supplement, or revise any applicable statute, regulation, standard, or rule. Additionally, this Guide does not obligate CalEPA or its BDOs to commit funding, collaborate on projects, follow this Guide, or change existing approaches.

This Guide can be used independently or in preparing and carrying out a community science project with CalEPA or its BDOs. It has four major sections and several appendices. The Introduction orients Tribes, CBOs, and others to the Guide, vision, mission, principles, desired outcomes, and audience. The Background connects community science to environmental justice and raises considerations for community science projects with Tribes. The remaining three sections provide a comprehensive overview of major project phases and key actions to support a community science project from a community- or Tribe-generated idea through completion. Before You Start helps gather background information, identify project partners, and start building relationships. Carrying Out the Project guides Tribes and CBOs in co-developing and implementing a community science project with actionable research questions, methods, and data. After the Project provides practices for project partners to follow up on community science projects and actions while continuing collaborations and long-term relationships.

Three primary principles underlie this Guide. First, centering community and Tribal needs while ensuring inclusive partnerships. Second, addressing environmental disparities. Third, maintaining transparency and accountability. Ultimately, this Guide provides best practices for communities and Tribes wanting to develop collaborative, actionable, and policy-relevant research with the potential to reduce environmental harms.

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Section 1

Introduction

Section 1: Introduction

Overview

This Practitioner's Guide (Guide) provides practices for California Native American Tribes[1] (Tribes), Community-based Organizations (CBOs), and other groups to conduct community science efforts. It can be used independently or in preparing and carrying out a community science project with the California Environmental Protection Agency (CalEPA) or its Boards, Departments, and Office (BDO).

This non-binding Guide provides detailed information on developing community science projects that follow the scientific method and work towards actionable research. It can be used to develop a project proposal, implement a project, or carry out parts of a project. Tribes and CBOs may have projects focused on just one aspect of this Guide, like data collection, or may have educational goals instead of a desire for actionable research. Each Tribe and CBO can adapt this Guide to meet their needs.

CalEPA and BDO staff should follow the Community Science Staff Guide instead of the Practitioner's Guide. Work with CalEPA or its BDOs may start at different parts of the Practitioner's Guide after "Determining data gaps". Tribes, CBOs, CalEPA, and CalEPA BDOs can jointly determine when to formally collaborate.

This Guide was produced by community science experts from three Tribes and seven CBOs in partnership with a staff working group from CalEPA and its six BDOs, with advice from a CalEPA BDO Steering Committee. The Tribes include the Big Pine Paiute Tribe of the Owens Valley, the Cahto Tribe of the Laytonville Rancheria, and the Gabrieleño Band of Mission Indians – Kizh Nation. The CBOs include Alianza Coachella Valley, Central California Asthma Collaborative, Comité Cívico del Valle, Land Together, Orange County Environmental Justice, Sierra Streams Institute, and United Latinos. Through co-creating this Guide, the group aimed to elevate local knowledge and improve the science that can address California's most pressing environmental problems. Appendix I details the development process.

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Community Science Definition

At its simplest, community science is science by the community, for the community.[1] Community science can encompass activities from community monitoring to full research projects done with the public. This Guide frames community science as an effort where

[1] Tribes include federally-recognized and non-federally recognized Tribes.

community project partners co-design and implement research projects from start to finish following the scientific method. The scientific method includes co-developing a research question, collecting and analyzing data, and sharing results. Community science is action-oriented, meaning projects produce rigorous scientific outcomes that can support efforts to improve local problems, inform regulatory efforts, and provide educational opportunities. Appendix II provides terms and definitions used in this document.

Vision

This Guide envisions inclusive, transparent, and effective community science projects that promote environmental justice[2], racial equity[3], and community engagement.

Mission

Community science projects contribute to equitable and evidence-based decision-making that protects the environment, ensures public health, and supports economic vitality.

Principles

Three primary principles guide community science efforts.

1. **Centering communities and collaboration:** Community science projects prioritize community and Tribal needs while ensuring inclusive partnerships.
2. **Equity and justice:** Community science projects address environmental disparities and promote equity, especially racial equity, by ensuring that overburdened communities and Tribes' experiences and priorities are reflected in the project.
3. **Transparency and accountability:** Community science projects support openness in data collection and sharing, as well as decision-making processes.

Desired Outcomes

Community science projects work towards achieving the following desired outcomes.

1. **Alignment for action:** Community science projects integrate community and Tribal needs to support actionable research. If working with CalEPA or its BDOs, the projects need to align Tribe and CBO needs with CalEPA BDO priorities and requirements, as well as any applicable state and federal laws.
2. **Collaborative rigorous science:** Community science projects foster collaborations to co-develop rigorous scientific research questions and methods. Rigorous science includes quantitative methods, qualitative methods, and traditional ecological knowledge that is supplemented with community wisdom and observational knowledge.
3. **Strong and equitable partnerships:** Community science projects build collaborations with Tribes, CBOs, academia, agencies, and others to co-design and implement projects that jointly collect and analyze data while supporting relationship building.

Structure and Content

This Guide provides a comprehensive step-by-step process for designing and implementing a community science project. This Guide can be used in its entirety or by choosing sections aligned with project needs. Each section draws attention to environmental justice and community engagement while including real-world examples from the Tribes and CBOs who co-developed this Guide. Before starting a community science project, consider reading this Guide to understand the sequence, principles, and steps. The Guide has five sections that provide a high-level overview of community science practices that project partners can follow while maintaining flexibility.

Section 1: Introduction: Briefly introduces this Guide, its vision, mission, principles, and desired outcomes. This section identifies the audience, defines community science, and details how to use this Guide.

Section 2: Background: Connects community science to environmental justice and raises considerations for community science projects with Tribes.

Section 3: Before You Start: Sets a strong foundation of collaboration by providing steps for gathering background information, starting outreach, identifying project partners and roles, and developing engagement and communication strategies.

Section 4: Carrying Out the Project: Guides co-developing and implementing the project. It includes steps to develop an evaluation approach, co-create a research plan, and consider the application and communication of potential project outcomes.

Section 5: After the Project: Discusses options for following up on community science projects and evaluating the project to improve future efforts.

There are 14 steps in the Practitioner's Guide outlined below.

Figure 1: Community Science Practitioner's Guide Steps

Section 2

Background

Section 2: Background

The background section connects community science and environmental justice, raises important considerations for community science projects with Tribes, and notes community science benefits and challenges.

Centering Tribes, Communities, and Environmental Justice

Community science prioritizes deep, empowering, and iterative engagement, where Tribes, communities, academics, and agencies are equal partners throughout the research process. This represents a shift away from more common dynamics where Tribes and communities are research subjects instead of researchers themselves. Centering Tribes and communities as scientists can help ensure research questions reflect local needs and desires and can ideally be used to address those concerns. Tribal sovereignty is foundational to this approach. Tribal sovereignty means the right of Tribes to govern themselves, the ability to preserve their culture, and the right to control their economy. This approach also recognizes the inherent power that communities and Tribes possess and creates frameworks for power-sharing to increase access to resources and project decision-making.

Deep engagement implies that Tribes, CBOs, Tribal members, and community members are partners in the research project and are involved throughout. **Empowerment** signifies that community science is done with a community to support the co-defined research goals instead of a project done for a community. An **iterative** approach means the project is part of an ongoing conversation with continuous involvement and a capacity to change in response to new information.

This approach to research upholds the environmental justice principle[4] that those most affected by the research or decisions should be equal partners in the project. Tribes, communities, agencies, organizations, and researchers have varying definitions of environmental justice. Many groups draw from the Principles of Environmental Justice developed during the People of Color Environmental Leadership Summit in 1991. Generally, most definitions include the recognition that low-income communities and communities of color have been systemically exposed to environmental hazards, leading to adverse outcomes and inequalities.[5] This document draws on environmental justice and community engagement throughout but recognizes that the approaches suggested may not fully align with every group's work and that groups define environmental justice differently.

A Brief History of Tribes in California

Native Americans have lived within what has become modern-day California since time immemorial, which is defined as time in the distant past beyond memory or record. They continue to hold all lands and waters within modern-day California as sacred. Like all other

Tribes around the country, California's Tribes have a tragic and tumultuous history. Before the missionary, fur trapping, and gold rush era migrations, California's Native American population was estimated at about 200,000.[6] By 1870, the population had declined to 12,000 due to disease, death, and removal.[7]

Between 1851 and 1852, 18 treaties were signed between California Tribes and the United States. The treaties reserved 7.5 million acres for the Tribes but were rejected by the U.S. Senate in secret session at the request of the State of California.[8] The Tribes, believing that the treaties were valid, relinquished their territories and moved to the reserved areas, but were turned away. The Tribes were not officially notified about the reason for this until 1905.[9]

Simultaneously, California passed a series of laws in the 1850s pertaining to Native Americans.[10] These laws allowed:

- A white person to petition a justice of the peace to remove Native Americans from lands claimed by the white person.
- Any Native American could be declared vagrant, thrown in jail, and sold at auction to work for up to four months without pay.
- Native American children could be kidnapped, sold, and used as slaves.
- Native Americans could be forced into indentured servitude.
- Native Americans were prohibited from testifying in court against a white person.

In the 1950s, the federal government's continued attempts to force assimilation on Native Americans resulted in the termination (i.e., loss of federally recognized status) of over 109 Tribes throughout the United States. In California, this came about through the Rancheria Act of 1958, which resulted in the termination of the federal status of 44 Tribes.[11] Significant advocacy by Tribes in California and across the United States from the 1960s through the 1990s ended termination policies and led to multiple laws or policies that protect self-determination and self-governance. In California, Governor Brown issued Executive Order B-10-11, which directs the state to consult with Tribes as sovereign nations.[12] In 2019, Governor Newsom issued Executive Order N 15-19, which acknowledged and apologized for the "violence, maltreatment, and neglect California inflicted on Tribes" and established a Truth and Healing Council.[13]

Tribes and Community Science

This history means some Tribes do not have federal recognition or access to ancestral lands or ranges,[14] which is a continuing form of injustice and can complicate community science efforts. Additionally, there is a shorter record of co-creating mutually beneficial collaborations with equitable partnerships between Tribes, agencies, CBOs, academics, and others. Many Tribes are actively involved in their own community science programs tailored to their visions, knowledge systems, and relationship-building approaches. Given multiple competing demands, Tribal representatives may lack the time and resources for additional participation in external community science projects and may focus on conducting their own research within their Tribal lands and interests. This Guide may or may not align with a Tribe's approach to community science and can be adapted to best meet their needs.

Some Tribes engage in community science collaborations ranging from co-developing and leading projects to paid leadership advisory roles for Tribal members. This Guide assumes some form of partnership and therefore emphasizes understanding and respecting Tribal sovereignty, honoring traditional ecological knowledge, and protecting data sovereignty. It underscores the need for authentic and reciprocal partnerships that address the concerns and opportunities identified by Tribes.

This Guide may be more useful for Tribes interested in designing and implementing collaborative community science projects. Collaborative projects may be more successful if they align with existing Tribal interests rather than expecting Tribes to adapt their knowledge and expertise to partner goals. However, partnerships may not be desired or appropriate, and who participates may vary and have multiple considerations. It is critical to remember that Tribes are individual and diverse entities. One Tribe does not speak for any other Tribe. Tribes possess unique and deeply rooted knowledge of the land and decide when, how, and if they want to share that knowledge.

Community Science Benefits and Challenges

Community science offers several benefits, including but not limited to:

- Community science adds rigor to data collection, analysis, and conclusions.
- Community science can be impactful when Tribes and CBOs partner with agencies like CalEPA and its BDOs to gather data and apply methods that are appropriate to inform regulatory or policy actions.
- Community science can be a powerful tool to gather data on local community concerns and explore solutions. It can generate results that communities can use to confirm the effectiveness of current policy, advocate for policy changes and enforcement measures, or address unsolved concerns.
- Community science can improve transparency and accessibility. As part of a team, community members follow rigorous data collection and analysis standards but are deeply familiar with what data are being collected and what the results mean. Additionally, community science participants have real-time access to preliminary outcomes while waiting on long peer-review processes.
- Community science projects can more equitably distribute research funding and resources between Tribes, CBOs, community members, and academics.
- Community science can shift power dynamics by valuing Tribal and community members as equal project partners who co-design projects, shape partnership norms, and share in research project decision-making.
- Community science redefines the idea of who can be a scientist.
- Community science can offer an entry point for people to gain hands-on research experience or to be inspired, which can lead to further education or a new career.

Integrating community science into a project has several challenges, including but not limited to:

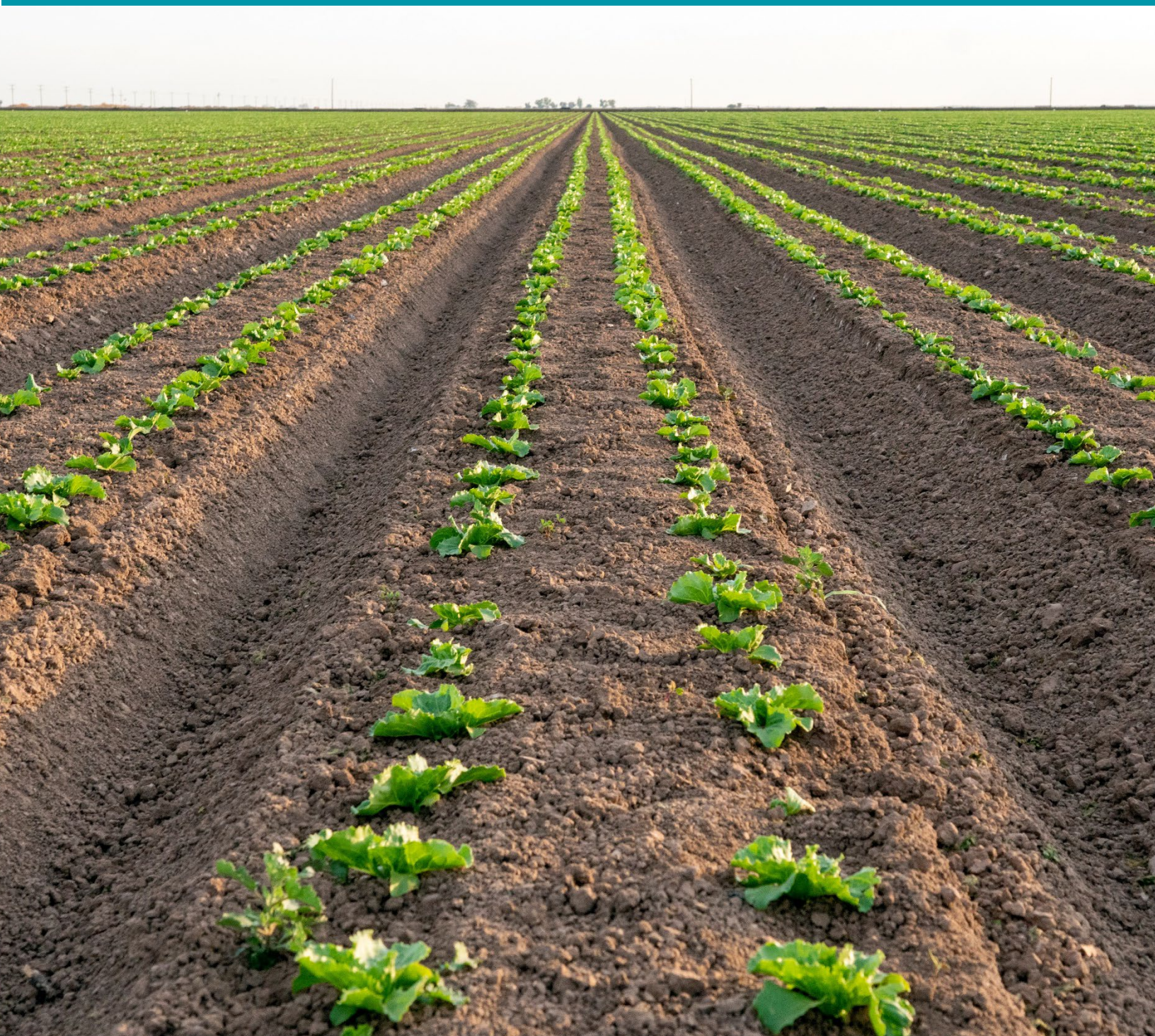
- Community science is one approach to research, but it does not include all the ways that knowledge is created or shared in a community. For example, youth art projects can

contribute to local knowledge and may be community science data, but they are not community science on their own.

- Community science is often site-specific, and findings from one location may not directly apply to other areas or scenarios.
- Community science projects may not generate significant results, or results can be unexpected.
- Community science partners may have different requirements or approaches to data transparency, sharing, and publication. Creating data agreements can be complex and time-intensive.
- Community science outcomes may not be enough to impact enforcement, policy change, or local conditions. Additionally, the response to outcomes may be slower than desired. Community science often needs sustained advocacy efforts or other approaches to improve local conditions.[15]
- Community science takes time and effort; quicker and simpler alternatives might exist.

Section 3

Before You Start



Section 3: Before You Start

Before You Start provides information on beginning initial engagement with potential project partners. It provides practices for gathering background information, understanding power dynamics, identifying project partners and roles, co-developing engagement and communication plans, and starting to brainstorm a research question. The three Tribes and seven CBOs who co-developed this Guide identified these steps as best practices that help set a strong foundation for a community science project that centers Tribal and community needs and commits to holistic engagement and effective coordination. The information gathered will also inform project planning and implementation.

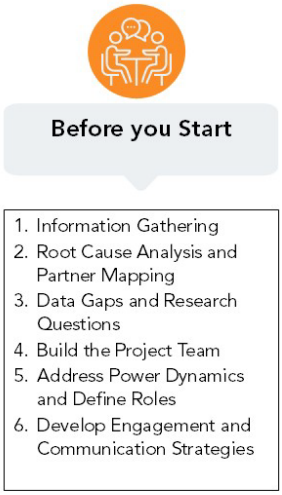


Figure 2: Before you Start

Three principles guide Before you Start:

1. **Centering communities and collaboration:** Community science projects prioritize community and Tribal needs while ensuring inclusive partnerships.
2. **Equity and justice:** Community science projects address environmental disparities and promote equity, especially racial equity, by ensuring that overburdened communities and Tribes' experiences and priorities are reflected in the project.
3. **Transparency and accountability:** Transparency throughout the project can help create and maintain trust and accountability as the project progresses. Accountability includes taking responsibility for actions and inactions, while transparency means being open and honest with project partners.

3.1. Information Gathering

Purpose and considerations

Communities possess the greatest insights about their neighborhoods, often recognizing local issues before others. Information gathering starts with local knowledge and experience to ensure a community science project addresses community concerns. Information gathering guides the group through questions to clarify concerns and understand community readiness. Through these processes, the group can develop a holistic understanding of the project's context and who might be good team members.

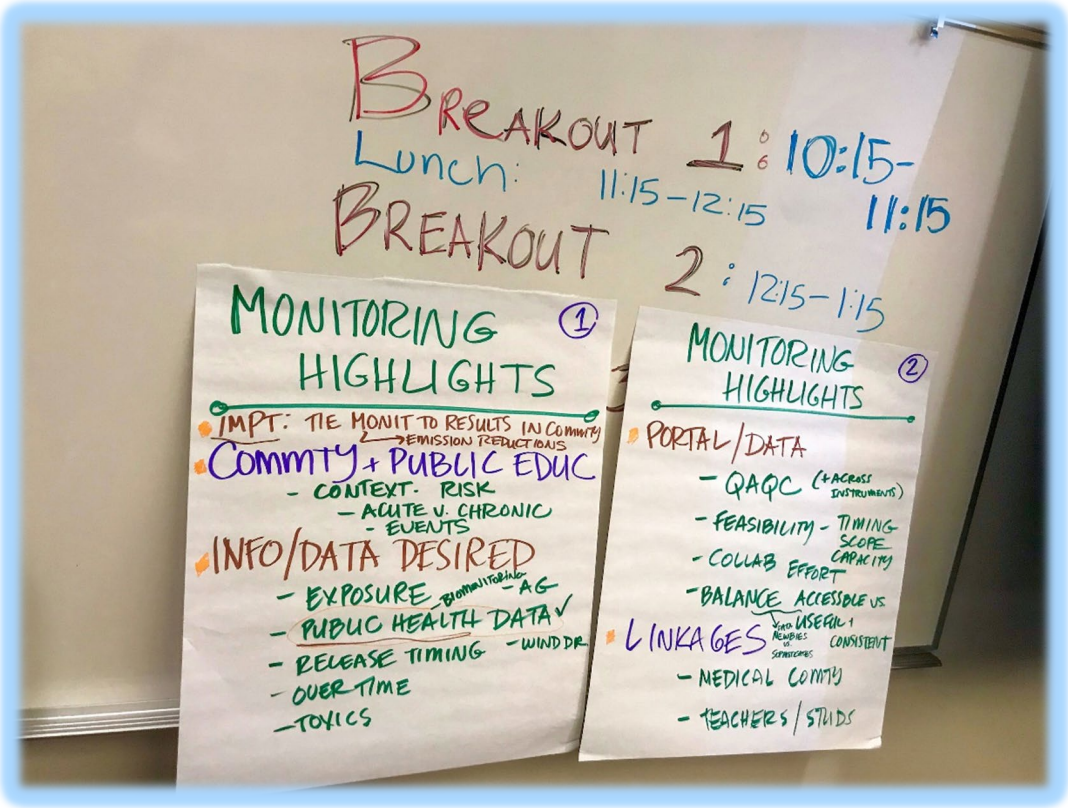
Practices for information gathering

1. **Understand the concern driving a potential project:** Hold Tribe and community group conversations, conduct a community survey, or work with existing Tribe or community partners to answer some of the following questions:

a. What environmental, health, or social issues concern you most? What are the main reasons you are concerned?
b. How familiar are you with the issue?
c. From one to five, with five being the most, how important is this issue to you?
d. Why is this issue important to the community?
e. Are there traditional ecological knowledge or cultural practices related to these community concerns? How has the community used these resources previously or historically compared to now? How are these practices important to the community?
f. What changes would address this concern? How do you define environmental justice related to these concerns?
g. What has happened/not happened here compared to other communities?
h. How involved would you like to be in addressing these concerns?
i. What projects are you aware of, or working on, related to this issue?
j. Has the community interacted with any decision-makers on this issue?

2. **Assess community norms and dynamics:** Ask some of the following questions in individual or small group conversations:
   a. How do you view yourself in the community?
   b. How does the community make decisions?
   c. Are there any formal or informal rules or decision-makers in the community?
   d. Who should be involved in a potential project?

3. **Start defining keywords and concepts:** List and define keywords and concepts that emerge during discussions and build a list of frequently asked questions as the project progresses. Co-developing shared definitions, especially for complex or contested terms, is important to building a shared understanding, increasing accessibility, and attending to language justice concerns. This is especially important when considering that many Latin-based names for plants, animals, and insects were introduced during colonization and are often different from the terms that Tribes, communities, or local groups may use. Having a shared understanding of terms makes science more accessible.



4. **Understand past efforts:** Review relevant past projects and initiatives by Tribes, CBOs, academics, agencies, or others. Assess the outcomes and impact. Use an internet search of keywords like location plus research, environmental justice, air quality, water, pesticides, etc. If intending to work with CalEPA or its BDOs, include the BDOs in the reviews by searching terms like "San Ysidro and Office of Environmental Health Hazard Assessment." Ask Tribes, CBOs, academics, agencies, or community members about the process and outcomes.
5. **Research the project location:** Explore the project location, including environmental and social issues. Consider the history, culture, relevant demographics, environmental, and climate characteristics. When possible, include information on how Tribes steward the land and waters where the project is based. Be mindful that Tribes may have limited

time or desire to engage more broadly with the questions or project. If intending to work with CalEPA or its BDOs, identify any data sources BDOs have for the location. Some examples of resources include internet keyword searches, CalEnviroScreen, Cal-Adapt, Pollution and Prejudice Story Map, Healthy Places Index, and the Digital Atlas of California Native Americans.

6. **Assess community readiness:** Apply the information gathered above to categorize potential project participants into one of the following community readiness stages and develop strategies to get to "initiation" (Figure 3).[16] Understanding community readiness will help you further develop your community communication and engagement strategies.

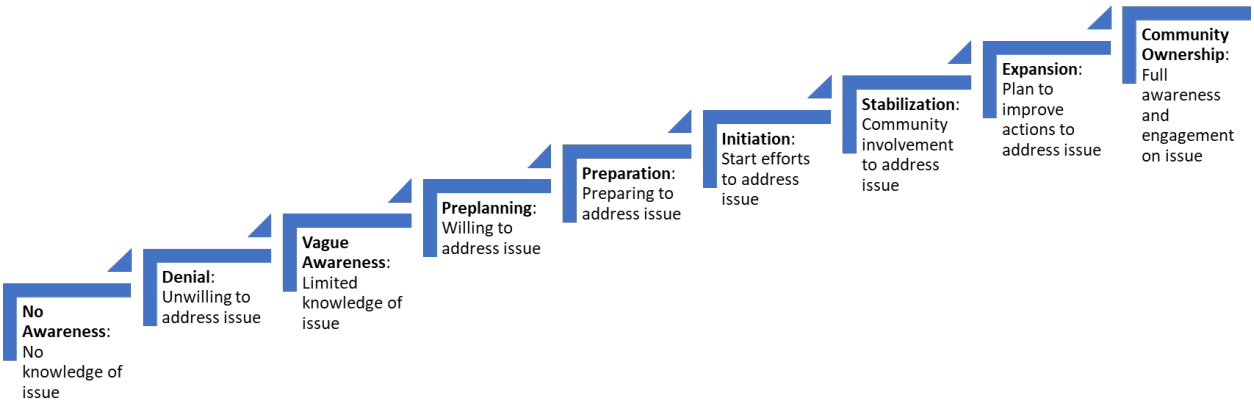


Figure 3: Community Readiness Model (Tri-Ethnic Center Community Readiness Handbook, 2014)

Examples of information gathering

- **Alianza Coachella Valley** builds a glossary of key terms and concepts by collecting Indigenous terms, everyday phrases, and other commonly used descriptions throughout the project. This includes defining terms during community engagement and refining those through ongoing work with a community steering committee.
- **The Cahto Tribe** conducts planning sessions in Tribal Council meetings, which are open to all Tribal members. Planning sessions help evaluate and understand concerns and assess community readiness.
- **Orange County Environmental Justice** starts each project with meetings in different neighborhoods. For example, to identify general environmental justice concerns, they used CalEnviroScreen to identify highly burdened neighborhoods and conducted door-to-door surveys to discuss household concerns.

- **Sierra Streams Institute** hosts community science meetings or sets up informational tables in front of local stores to share findings from community studies to increase awareness, gauge interest in future projects, and identify next steps.

External resources

- California Strategic Growth Council Technical Assistance Toolkit
- CalEnviroScreen
- Cal-Adapt Climate Impacts Map
- Digital Atlas of California Native Americans
- EPA Glossary of Terms
- EPA EnviroAtlas
- EPA Report on the Environment
- Multi-State Guidance Affirming the Importance and Legality of Environmental Justice Initiatives
- PolicyLink Equity Atlas
- Public Environmental Data Partners Unofficial Federal Climate and Economic Justice Screening Tool
- The Public Health Alliance of Southern California's Health Place Index
- Othering and Belonging Segregation Maps

3.2. Conduct Root Cause Analysis and Partner Mapping

Purpose and considerations

Root cause analyses help uncover and understand the underlying drivers of the problem and identify potential research topics. It includes a historical survey, which helps develop a detailed timeline of events, policies, and decisions that contributed to the current problem. A root cause analysis also includes an environmental analysis, which accounts for community relationships with the environment and how environmental conditions are created and impact local people. Together, these approaches can raise awareness regarding the community's major environmental issues and strategies to keep the community healthy.

Partner mapping is a way to understand the key players, their roles, how much power they hold, their ability to create change, and their relationships with the community. Partner mapping can support strategizing for actionable change. Many environmental problems involve multiple parties and groups that can influence solutions. Partner mapping can also inform building a team and designing projects to try to influence an outcome.

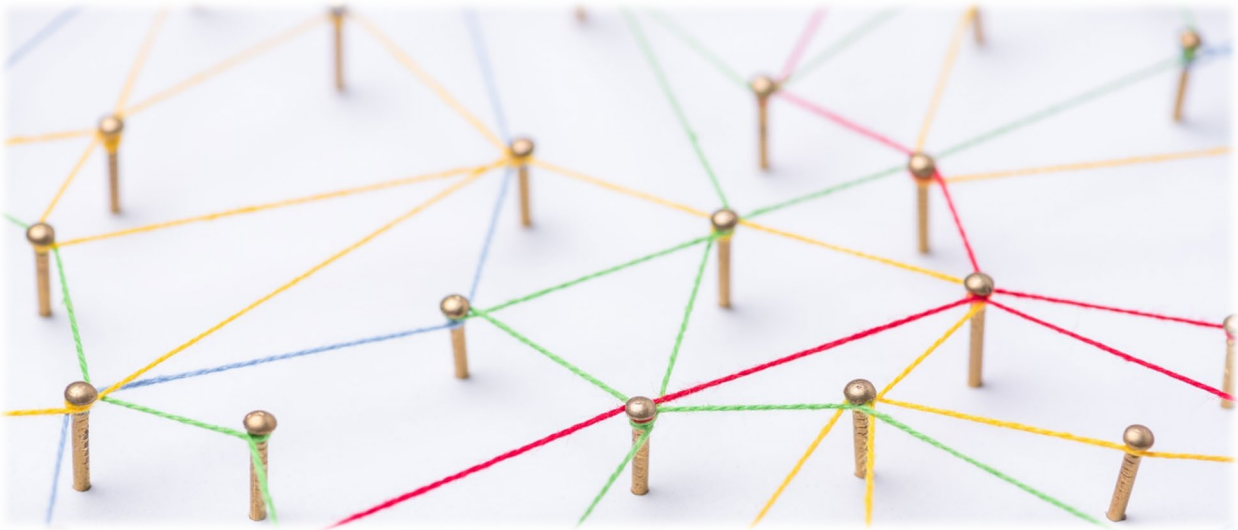
Practices for conducting a root cause analysis and partner mapping

1. **Develop a problem statement:** Work with local groups to list the problem identified above, what is happening, and why people are concerned. Then, ask "why" at least five times, going deeper with each iteration. Formulate a clear problem statement that draws from the list and answers.
2. **Conduct a historical survey:** Create a timeline of policies and practices related to your problem statement. Start by identifying the Tribes who live or lived on the land using the Digital Atlas of California Native Americans or Native Land Digital.[2] Work to understand the impacts of colonization on the people, land, culture, language, and practices. Consider how colonization practices evolved into laws, policies, and practices related to the communities' problems. Be mindful that Tribes may have limited time or desire to engage with the questions or project more broadly. Identify how other communities came to the area and the policies, practices, and actions that shaped the social and environmental landscape and the identified problem. Include Tribal or community action and efforts related to land acquisition, stewardship, advocacy, and research.
3. **Complete an environmental analysis:** Identify what is known about the environmental conditions related to the community's problem. Several mapping tools listed below provide information on environmental conditions, ecosystem services, watersheds, land use, air quality, water quality, toxins, hazardous waste, and climate impacts. You can also ask community members about environmental conditions related to the problem. Example questions could include:

[2] Native Land Digital is not an official resource and does not represent official or legal boundaries of any Indigenous nations. Native Land Digital is most applicable for educational purposes. Groups should use caution in using it for other purposes.

a. What is a pollution or environmental concern in the area? What do you notice about pollution? Smells, noises, tastes? Do you notice anything triggered by pollution, like coughs or runny noses?
b. Does your neighborhood flood, get hazy, or get hotter than other areas? If so, when and how bad?
c. Which times of day does pollution seem worse?
d. What are the known or likely pollution sources or other environmental problems?

4. **Understand who is most impacted by the problem:** Draw from community conversations and the root cause analysis to understand who is most impacted by the problem.



5. **List policies, local pollution sources, permits, and decision-makers:** Using the community concern, identify major policies or regulations related to the problem, suspected pollution sources, and the permit status as applicable. List the associated agencies, decision-makers, or groups with jurisdiction over the policies, regulations, or enforcement. As multiple groups may be involved, detail the specific jurisdictions (meaning the areas of responsibility), overlaps, and limitations. For known pollution sources, note the allowable level of pollutants and determine if permits are available. For community concerns with regulated pollution limits, identify the data to be collected and the quality needed for actionable change. Actionable change can include enforcement or advocacy for changes to allowable levels.
6. **Note potential avenues for change:** Discuss what decision-makers have done about the problem and whether there were positive, neutral, or negative impacts. Discuss when and how decision-makers should be engaged.
7. **Compile agency contacts and begin initial outreach:** Use the list of agencies to create a contact list for initial outreach. The CalEPA website provides mission overviews and initial contact options for CalEPA or its BDOs. Start initial agency outreach to confirm the agency's responsibilities align with the problem statement identified earlier. Request

additional contact information for people or groups to discuss a potential project and data requirements.

8. **Identify other major players:** List the allies, advocates, researchers, and other groups working on these issues generally or doing similar work in the same region. Clarify the existing relationships and potential contacts to discuss this work.
9. **Create and update a partner map:** Use the information gathered to develop a partner map. Revisit as the project evolves, adapting to new information and knowledge.

Examples of root cause analysis and partner mapping

- **Alianza Coachella Valley** conducted a root cause analysis to investigate the pervasive "rotten egg" smell from the Salton Sea. Working closely with academic partners, the team uncovered the intricate chemical cycle behind Hydrogen Sulfide formation in the lake's waters. Notably, agricultural runoff emerged as a significant source of nutrients, intensifying as the Salton Sea shrank. This decline in water levels, partly due to climate change and water diversion from the Colorado River, is regulated by water control agencies influenced by historical water rights. Unraveling these layers of historical information, legal nuances, and connections to distant water sources shed light on the complex root cause. Together, they created materials like this infographic and presentations to advocate for change. They also use this partner map template to plot major actors by their decision-making power and level of support.
- **Big Pine Paiute Tribe of the Owens Valley** identifies community members most impacted by climate change, especially related to water rights in the Owens Valley. They note major players, concerned parties, and how the different agencies, Tribes, and utilities approach the problem. The resulting partner map drives engagement and communication efforts.
- **Central California Asthma Collaborative (CCAC)** conducts neighborhood audits alongside community members. These audits highlight the nearby pollution hotspots and provide tangible experiences of the local landscape. CCAC and community members use the audit to map oil wells, incinerators, and other pollution sources. They then conduct a historical survey of district records and agencies to look up permits. Through partner mapping, they note the major decision-makers, which informs their research questions and methods.
- **Land Together** completes a land analysis of prison environments by visualizing how the prison was constructed, including land use changes. Participants consider which chemicals were used to remove the vegetation and ask why the prison was built that way. Then, they ask about the impacts of the construction and maintenance on soil, air, physical health, and mental health. Lastly, they ask how the construction and maintenance impact the soil and air. This approach informs the data gathered through soil testing and solutions around growing native edible plants.

External resources

Environmental Analysis

- Cal-Adapt Climate Impacts Map
- CalEnviroScreen
- CalEPA Pollution and Prejudice
- Digital Atlas of California Native Americans
- EPA EnviroAtlas
- EPA Report on the Environment
- Public Environmental Data Partners Unofficial Federal Climate and Economic Justice Screening Tool
- Othering and Belonging Segregation Maps

Permitting

- Air: US EPA Clean Air Act Permitting in California
- Water: California Water Boards National Pollutant Discharge Elimination System Facility and Permits Search and California Integrated Water Quality System.
- Pesticides: The Department of Pesticide Regulation Restricted Materials Permit system.

Partner mapping

- The Commons Library power map template

3.3. Determine Data Gaps and Brainstorm Research Questions

Purpose and considerations

Data gaps occur when potentially useful data are missing when a policy is made or implemented.[17] Data gaps may also occur for geographic regions where data is collected infrequently or not at all, or when previous research excluded diverse groups, cultural practices, or local community studies. Data gaps may also emerge when technology changes. For example, a pollutant can have health impacts, but only in small amounts, which are difficult to detect with available methods. New detection methods or technology may provide better information for policymaking. Identifying which data gaps exist for the project, why they exist, and if they can be filled are important in developing research questions.

Research questions define the problem to be solved and are the foundation of any science project. Defining a research question is an iterative process done with the Tribal members, community members, and the community science team. Starting to brainstorm the research questions at this stage informs who is approached to join the project team and other next steps.

Practices for determining data gaps and brainstorming research questions

1. **Compile existing data related to the community concern:** Develop a list of existing data related to the community concern. This can include peer-reviewed studies, government publications, NGO documents, community publications, and media stories. Be sure to list previous work done by and within the community or Tribe, survey results, social media, and workshops or meeting outcomes. Note any known traditional ecological knowledge or cultural practices related to the issues identified or in the project location.
2. **Review the existing data:** Develop a matrix for each data source that details:
    a. What data were collected and how they were measured
    b. Who collected the data
    c. Why the data were collected
    d. When and where were data collected
    e. What research questions the data do and do not answer
    f. What information is missing (for example, qualitative/quantitative/Tribal data)
    g. Who and what was left out of the collection process
    h. Any data gaps related to race, ethnicity, citizenship, gender, class, cultural practices, outdated metrics, old technology, new impacts (e.g., contaminants now known to be more toxic), changing environments (including land use or climate change), or cumulative effects.
3. **Understand decision-maker data requirements:** Consult agencies or other relevant decision-makers identified above to understand the method and data requirements related to the community's concern. This includes the standard or acceptable methods, data types, measurements, sample sizes, lab certification requirements, and quality control and testing requirements. Identify if data exists or if the team will need to gather

new data. Gathering this information now will help ensure research questions and plans can best align community needs with actionable science.

4. **Gather outcomes from previous steps:** Combine the outcomes from community readiness, root cause analysis, partner mapping, and data gaps to comprehensively draft a research question.

Subsection	Summary of results from the subsections	How does this feed into the research question?
Community readiness	Main environmental, health, and social issues of concern.	What is the main community concern?
Problem statement	A list of the major root causes impacting this issue, which may point to some potential long-term solutions.	What caused this issue, and what is needed to address it?
Historical survey	Historical impacts that still affect this community and issue today, policies that could change, and previous actions taken.	What historical events and actions contributed to the present issue?
Environmental analysis	Previous practices and ecological knowledge. The current environmental status of the land. The community's current understanding of environmental conditions.	How is the landscape affected by this issue?
Partner mapping	List of major agencies or groups that can influence the underlying concern. Includes allies, decision-makers, major polluters, permit status, etc.	Who regulates this issue? What information is needed for a solution?
Identify data gaps	Information on what is known and unknown, and what data may be outdated.	What new things do we need to know to create a solution?
Understand decision-maker data requirements	Information on the acceptable methods, data types, measurements, sample sizes, lab certification requirements, and quality control and testing requirements for relevant decision-makers.	What data is needed by relevant decision-makers?

5. **Generate draft research questions:** Collaboratively develop research questions that address the Tribe or community's concern, fill gaps in existing knowledge, and are feasible and actionable. You will refine the research questions in future steps.
6. **Discuss the research question with CalEPA or its BDOs:** Reach out to CalEPA or its BDOs if the topic is within their area of responsibility. Assess the alignment between the draft research question and CalEPA or BDO interest. CalEPA or its BDOs may be unable to provide detailed feedback, funding options, or participation commitments, but can note existing efforts, level of interest, and publicly available funding opportunities. Aligning research project questions and data requirements is one of the most important ways to implement community science projects that could be used by CalEPA or its BDOs. Responses from CalEPA or its BDOs do not obligate CalEPA or its BDOs to commit funding, collaborate on projects, or follow this Guide.

Examples of determining data gaps and brainstorming research questions

- **Central California Asthma Collaborative (CCAC)**, as part of a larger coalition, worked to identify data gaps related to California's oil and gas setback limits. Setback limits determine how far homes, schools, and playgrounds should be built from oil and gas wells. Existing studies showed that living, learning, and playing near oil and gas wells caused health issues such as poor pregnancy outcomes, respiratory issues, or cancer.[18] However, the research used to set policy did not include histories of discriminatory practices, race and ethnicity impacts, non-peer-reviewed literature, or subjective health impacts.[19] These data gaps led CCAC and others to conduct a community science project that demonstrated people in facilities or homes built 2,500 feet or closer to oil or gas wells were experiencing detrimental health effects.[20] This and other research and efforts[21] supported legislation banning new permits for oil and gas wells within 3,200 feet of homes, playgrounds, or schools.
- **The Gabrieleño Band of Mission Indians – Kizh Nation** brought the Los Angeles Regional Water Quality Control Board, the Barbareño/Ventureño Band of Mission Indians, the San Fernando Band of Mission Indians, and the university consortium, Mapping Los Angeles Landscape History, together to create a digitized map of water features. The map closed a data gap that the Los Angeles Regional Water Quality Control Board needed to implement a Tribal Beneficial Use project with the Tribes.
- **Orange County Environmental Justice** built on existing work by the Black Panther Party and investigative journalist Yvette Cabrera on soil lead in Santa Ana. These earlier efforts were motivated by community concerns about lead exposure and potential impacts on brain development and behavioral changes in children, especially youth of color. Orange County Environmental Justice built a project aligned with the same motivations and worked to close spatial data gaps by testing soil lead levels across all of Santa Ana. Closing these gaps generated new research questions on the relationships between exposure to soil lead and youth academic performance and behavioral issues.

- **Sierra Streams Institute** conducts community science stream monitoring surveys assessing water chemistry and other environmental indicators to flag changes, evaluate restoration efforts, and locate sources of potential problems. These monitoring efforts fill data gaps on the creek and watershed health and inform the community about water safety and conditions.

3.4. Build the Project Team

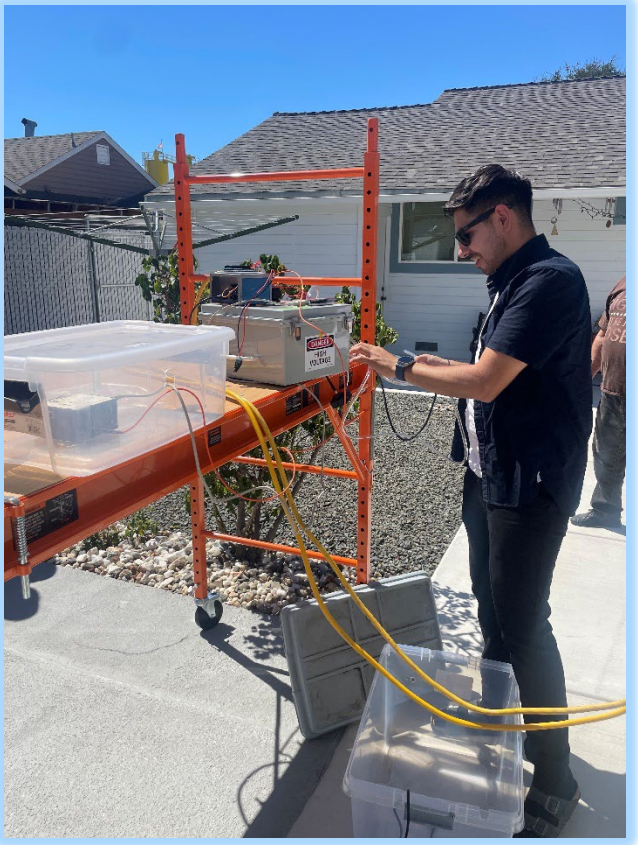
Purpose and considerations

Having the right project team helps community science projects leverage different areas of expertise, carry out key tasks, and connect community science to action. Community science project team members (called the project team or wider project team) often include the Tribe or CBO with the project idea, Tribe or community members, other Tribes, CBOs, or NGOs, technical experts, academics, and agency partners who will actively participate throughout the project. The core project team refers to people from those groups who are involved in managing the day-to-day aspects of the project. Other interested parties are part of the project but not in the project team or involved in the day-to-day aspects of the project. This group can attend relevant meetings, give direction and feedback, and help move the project results to action. Building an effective coalition of partners requires important up-front work. Each partner brings unique perspectives, expertise, and contributions. Having the right people at the table ensures community concerns drive the project, that the project can be carried out, and that the envisioned results are actionable. Intentionally building a project team that keeps the people most impacted at the center of the project goes a long way toward developing accountability, trust, and longer-term relationships.

Practices for building the team

1. **Identify potential partners:** Build on the list developed in the partner mapping exercise and clarify who the team should try to recruit or engage with throughout the project. Prioritize diverse partners with professional or lived expertise who support the project's core goals. Potential partners include but are not limited to representatives from CBOs, Tribes, community leaders, youth organizations, labor unions, farmworker groups, religious groups, artist cooperatives, academics, external technical experts, and agencies. It is important to identify current and potential compensation and time commitments for project partners before approaching people so they can understand if they have the time and desire to participate.
2. **Review potential partners:** Review the partner map completed earlier and draft research questions to ensure key partners are not missing or accidentally overlooked. Identify any conflicts, internal dynamics, or issues that may arise with people or groups on the list, and whether that should influence partnership invitations or require additional conversations.

3. **Contact agencies:** Consider how an agency aligns with the project topics and how agency partners can help guide data usability. Contact agency staff to discuss their capacity and desire to participate in the project. Specific considerations for CalEPA or its BDOs are below.
4. **Communicate with CalEPA or its BDOs:** Reach out to CalEPA or its BDOs to determine how and when to collaborate on the potential project. The Tribe or CBO may need to secure publicly available funding from CalEPA or its BDOs, or discuss if and how to collaborate when funding is limited or unavailable. Responses from CalEPA or its BDOs do not obligate CalEPA or its BDOs to commit funding, collaborate on projects, or follow this Guide. Coordinate with CalEPA or its BDOs to determine what is needed and timelines to agree on how to collaborate. Considerations like decision-making, review processes, data standards and quality assurance, and communication processes are detailed in this Guide and can be applied to work with CalEPA, its BDOs, or others. CalEPA or BDO staff should follow the Community Science Staff Guide to navigate these topics.



5. **Attend to Tribes individually:** Involving Tribes may require additional effort and care to see if needs and interests align. Tribes have long and deep inter-relationships to the land, despite facing displacement, assimilation, and mistreatment due to colonialism. Tribes may have many reasons to mistrust academic, local, state, and federal institutions, including the historical exclusion from scientific research and environmental management. Recent progress has been made, under the leadership of Tribal scientists, who have helped institutions recognize the importance of involving Tribes in processes that may affect their lands, cultures, and peoples. While this growing interest can be seen as a positive development, it also comes with challenges and potential pitfalls. It is important to note that Tribes have their own projects and goals that should not be overshadowed or overlooked by projects seeking collaboration. Projects should consider collaborating on existing Tribal efforts or envisioned projects due to potential limited Tribal capacity to engage in external projects. Additionally, if a Tribe is not leading the project, it is more appropriate to approach one Tribe first before involving additional Tribes.

Understanding a Tribe's interest early allows the team to co-develop project goals, roles, and funding, and may help the Tribe incorporate the partnership into its funding cycle. Before reaching out to a Tribe, note if the Tribe has an Environmental Office, funded programs, technical and legal support, and participation in grassroots or Tribal programs to help understand the existing capacity to participate in a project. If working with CalEPA or its BDOs, ask BDO staff to contact their Tribal Liaison before contacting a Tribe.

6. **Approach potential Tribal partners:** Reach out to appropriate contacts at a Tribe to gauge their interest and capacity for involvement in the project. If unsure of who to contact, start with the Environmental Director, as sending invitations to elected leadership can be viewed as inappropriate. Ensure Tribes are approached not just as project participants but as Principal Investigators or equal collaborators who can help align the project with Tribe goals and needs.
7. **Reach out:** Contact other potential team members to discuss their capacity and desire to participate in the project. The partners' time commitments will vary by project type but consider suggesting a minimum commitment of five hours per month, allowing time to meet and work between meetings. Reach out at least four weeks before the project kick-off. If you plan to work with youth, outreach could take longer unless relationships or participation frameworks exist.
8. **Develop partnership values and norms:** Clarify partners' values and goals. For example, do all partners agree to focus on community needs? Do partners share similar understandings of environmental justice and equity? Is everyone committed to transparency and accountability throughout the project? Some partnerships develop memorandums of understanding (MOUs) or partnership agreements to more formally document various aspects of the project.

Examples of building the team

- **Big Pine Paiute Tribe of the Owens Valley** collaborates with other Tribes facing similar water utility challenges who share a deep understanding of the area's history and land management practices. By respecting earlier Tribal or other cooperative agreements for water distribution and working together to develop climate mitigation plans, the Tribes are fostering strong relationships based on trust and common goals to address environmental challenges.
- **Land Together** partners with organizations like Rising Sun, which is a workforce development group in the Bay Area and San Joaquin County. Rising Sun brings in formerly incarcerated individuals to work with Land Together participants to construct garden beds. This develops skills, builds relationships between presently and formerly incarcerated individuals, and leverages resources both groups bring to the partnership.
- **The Gabrieleño Band of Mission Indians – Kizh Nation** is part of the "Mapping Los Angeles Landscape History: A Multi-Institutional Collaboration" with the Fernandeño Tatavium Band of Mission Indians, the Barbareño/Ventureño Band of Mission Indians, California State University (CSU) Long Beach, CSU Los Angeles, CSU Northridge, the

University of California Los Angeles, and the University of Southern California. The team is collectively reconstructing a 3-dimensional model of the historical ecology and landscapes of the Los Angeles Basin before Spanish colonization. The project synthesizes Tribal knowledge, historical topographic data, wildlife indicator species, cultural archives, and historical aerial photography into a model of the historical Indigenous landscape. A Kizh Nation member with academic training in biology is a co-principal investigator, which increases power, recognition, and decision-making.

External resources

- Community Research Collaborative Partnership Agreement Template

3.5. Addressing Power Dynamics and Defining Roles

Purpose and considerations

Before agreeing on roles and starting a community science project, it is important to understand and address the power dynamics that may surface during the project. Power is the capacity to get things done through either access to resources or influence. Power can be uneven between individuals, groups, and organizations, and can influence decisions, resource distribution, and social or environmental outcomes. Power dynamics are the patterns of behavior that occur between people when they interact and communicate with each other and how those shape interactions between two or more people and groups. Power dynamics can be influenced by culture, race, ethnicity, class, gender, sexuality, background, history, resources, education, language, and roles within the project. Power dynamics in a community science project can happen between the project manager, the project team, funders, Tribe or community members, and other interested parties. Understanding and addressing these dynamics can help foster collaboration, resolve conflict, and improve outcomes.

Project roles help people know what to do, who to work with, and how their efforts contribute to the larger project. They clarify how the team is organized, their responsibilities, and how different roles work together. Generally, there will be a primary project manager who can work with the core project team to identify and convene project partners.

Practices for understanding power dynamics and assigning roles

1. **Understand Tribal Sovereignty:** In reflecting on individual and group identities and power, it is critical to understand that Tribal Governments have inherent sovereignty with a government-to-government relationship with other government agencies that is unlike

relationships that community groups, CBOs, academics, or other parties may have with government agencies.

2. **Reflect on power:** Have individuals and groups consider their positionality, meaning individual and social identities related to race, ethnicity, culture, class, gender, sexuality, education, history, abilities, nationality, and others, and how those combine and influence how they see the world, how they may be perceived, what power they do and do not have, and what power they may be perceived to have. Inequitable access to power can cause resentment, mistrust, and complicated relationships. Discuss how identities and power may impact the project, the project partners, and other dynamics.

3. **Identify current and historical relationships:** Understand if there are current or historical relationships between different groups who may be interested in the project. Relationships can include contracts, projects, engagement activities, advocacy, treaties, historical events, or involvement in policies or practices. Consider how power influences current and historical relations, if any known mistrust exists, and the reasons for that mistrust. Mistrust may be present between Tribes, communities, academics, or agencies. In many cases, it may not be present between individuals but reflects historical relationships and the impacts, trauma, and skepticism from those relationships.
   For academics, reflect on relationships between Tribes, communities, and the University. When was the University established, on whose land, and was anyone displaced? What relationships does the University have with Tribes? Have remains and cultural artifacts

been returned? Have previous researchers involved communities as experts or only as objects of study? Have communities been compensated monetarily and acknowledged in previous work? Has research been driven by local needs and used by local communities or decision-makers?

4. **Identify and integrate opportunities to share power:** A community science goal is to share power in developing and implementing the project. This may include asking individuals and groups with less access to power to note what processes or resources can help those dynamics in the project. This often includes co-developing research questions, methods, and interpretation of results. Similarly, asking people or groups to share resources can help to address some of these dynamics. For example, academics can offer laboratory equipment or graduate student assistance. Non-profit organizations can help with fundraising or media outlet connections. Ask everyone to reflect on ways to keep community ownership of the project and how individuals and groups will be held accountable for this commitment. Discuss how community needs, transparency, and accountability will be built into the project. Starting to think intentionally now will lay a foundation as the project progresses.
5. **Agree on roles:** Collaboratively define roles, set expectations, detail responsibilities, and offer a tentative project timeline for each person who agreed to join the project team. Explore multiple mechanisms for determining roles, including but not limited to open self-nomination, nomination of others, voting, consensus, and rotating roles. The team should note who needs to attend which meetings to ensure informed and balanced representation. Key roles, expectations, and responsibilities for partners include but are not limited to:
    a. Project advisory group: Tribe or community members who provide high-level guidance and feedback and keep the project true to community needs.
    b. Project manager: Coordinates project direction, meetings, documents, etc.
    c. Agency project manager: Coordinates project direction with the agency. If working with CalEPA or its BDOs, the agency project manager may serve as the overall project manager.
    d. Technical advisor(s): Provides technical guidance.
    e. Academic advisor(s): Offers insights into the state of the field or research topic, relevant research, methodological considerations, potential data sources and requirements, and results interpretation.
    f. Communications lead and liaison: Helps design communication materials and coordinates with various communication teams as necessary.
    g. Tribe, community, and/or youth engagement coordinators: Work with various groups on overall engagement and incorporating engagement outcomes into the project.
    h. Other interested partners: Community members, advocates, allies, and decision-makers not involved in the day-to-day aspects of the project. This group attends project community meetings, gives direction and feedback, and helps move the project results to action.
    i. Other interested people: The general public, media, individuals, and groups interested in the project outcomes.

6. **Identify training or capacity-building needs:** While agreeing on roles, list any immediate capacity-building[3] needs and identify steps to fill those needs. Efforts to build capacity are multi-directional and can provide important co-learning opportunities. For example, do people need training or background knowledge on Traditional Ecological Knowledge or capacity building on water quality data collection methods?

Examples of understanding power dynamics and assigning roles

- **The Cahto Tribe** works with environmental consultants to support the Tribe's science efforts. The projects collaborate with established and trusted Tribal representatives, such as the Tribal Council, to ensure the project design, implementation, and interpretation represent the Tribe's priorities.
- **Land Together** operates as a transformative force within highly segregated prison spaces, where currently incarcerated people often face isolation and strict obedience requirements. Land Together creates a collaborative space by establishing gardens as no-conflict zones. Program participants gain agency by making decisions about gardening, discussions, data collection, and research questions. This shift disrupts the prevailing prison culture, emphasizing interconnection over isolation.
- **Sierra Streams Institute** collaborated with academic partners from the University of California, San Francisco, and the University of Arizona to evaluate the potential health impacts of living in a mining-impacted environment. The Community Health Impacts of Mining Exposure (CHIME) project was developed in response to overwhelming community concerns. Sierra Streams Institute formed a Community Advisory Board of representative members of the community for whom toxic metal exposure is a problem, including breast cancer survivors, Tribal members, teachers, and school administrators. The Community Advisory Board approved every project action before it happened, including study design, questionnaires, and results to make sure they would be accessible and meet the project goals.

3.6. Engagement and Communication Strategies

Purpose and considerations

Engagement is working with interested parties and impacted individuals to discuss a common issue. Engaging people from various backgrounds is vital to any community science project. It ensures that the project truly represents local needs and guides project design and

[3] Capacity-building refers to strengthening coordination, leadership, knowledge, skills, expertise, and resources so project partners are ready to plan and implement a community science project.

implementation. Additionally, engagement fosters a transparent and collaborative approach to making decisions, carrying out the project, and building relationships.

A communications strategy helps define how the project team will communicate internally, with external partners, and with the public. It sets standards for language justice, accessibility, and coordination. Language justice requires creating welcoming, fair, and inclusive environments where everyone can participate in their preferred language and prevents discrimination for speaking native languages. As part of a communication strategy, language justice encompasses making materials and meetings available in desired languages, accessible for people with disabilities, honoring cultural practices and non-verbal cues, and providing interpreters and translators as needed.

Practices for developing engagement and communication strategies

1. **Agree on engagement spectrum:** Discuss and agree on where the project falls on the engagement spectrum (Figure 4) and what impact engagement will have on decision-making. Different aspects of the engagement plan will likely touch on various points of the spectrum and vary throughout. The goal is to align engagement efforts to the spectrum. Community science projects should aim for "Defer To – Community Ownership" when possible.[22] Please note, some project partners may not be able to reach "Defer To." For example, if working with CalEPA or its BDOs, final decision-making authority rests with Executive Officers, Boards, Secretary, or the Governor. By clarifying these considerations and agreeing on the engagement spectrum, the project team can set and manage expectations.

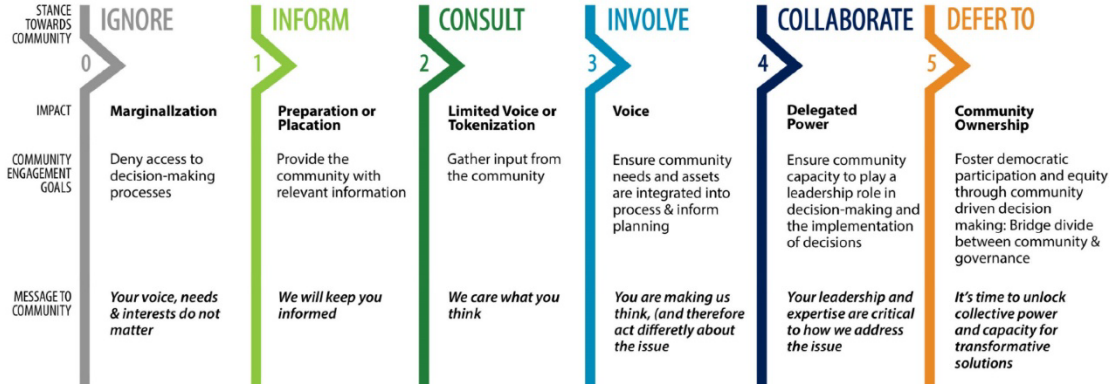


Figure 4: Community Engagement Spectrum (González, 2019)

2. **Discuss expectation setting:** Agree on what community members can expect during the community science project. It is important to communicate any process limitations and that research can produce unexpected or insignificant results. Unexpected or insignificant results may not lend themselves to insights or actions to address the original issues. Outcomes may still be relevant to communities, researchers, or agencies, but may not have a direct impact.

3. **Develop a Tribal engagement strategy:** If a Tribe is involved in the project, they should use their existing engagement strategies or develop a draft engagement plan. Tribes are best situated to design and implement their engagement strategies in a way that attends to their unique dynamics, outreach methods, and engagement approaches. The Tribal engagement strategy must involve actively listening to Tribes, learning from their experiences, and recognizing their unique contributions to community science. Ensure that Tribal collaboration acknowledges the wealth of Tribal knowledge, respects their expertise, sovereignty, government structures, and contributes to justice.
4. **Create a community engagement strategy:** Return to the partner map developed earlier and note those most impacted by the main concern, allies, advocates, and other interested parties. Collaboratively discuss engagement methods that best align with interested parties' needs, with special attention to those most impacted. Develop a draft engagement plan for feedback from the project team, community members, and trusted groups with local engagement experience. Some engagement approaches include:
    a. Community members: Door-to-door conversations, local community or neighborhood meetings, social media posts, or posting flyers at local gathering places.
    b. Youth and parents: After-school programs or clubs that involve youth in environmental science activities, parent-teacher associations, and environmental science or science, technology, engineering, art, and math (STEAM) charter schools.
    c. College students: Service-learning coordinators or faculty with students interested in volunteer efforts, internships, or service-learning courses.
    d. Seniors and elders: Storytelling sessions, workshops, or oral history projects.
    e. Health professionals and patients: Hosting or attending health fairs, community health clinics, or working with patient support groups.

5. **Ensure engagement outcomes are integrated:** Integrate Tribe or community decisions, knowledge, expertise, experiences, and contributions into all aspects of the project. One approach is to make time at each project team meeting to discuss engagement outcomes and how to respond.
6. **Set informal check-ins:** Include co-designed informal check-ins with Tribal members or community members to understand and address any issues with the engagement or project. Check-ins can be simple emails, comment boxes, or time set aside at engagement events.
7. **Gather communication needs:** Determine the general audiences for the project, why they should care, and when and how to communicate with them. Work with community members to understand language needs, desired accessibility aids and services, cultural communication practices, preferred communication methods, and communication frequency and timing. Ask about internet reliability and transportation options for attending meetings.

8. **Consider various outreach approaches and materials:** Discuss various approaches and materials that meet community needs and communication goals. Some outreach approaches include:
    a. Storytelling and narrative building: Storytelling is a powerful way to convey the importance of environmental justice. Encourage community members to share their stories and experiences if they feel comfortable doing so. Use these narratives to build awareness and advocate for change.
    b. Art and theater: Find creative ways to communicate scientific findings using artistic mediums. Examples include paintings, poems, theater, and comics. These forms of communication make understanding project results more accessible and understandable for people of all ages and backgrounds, and can better incorporate local cultures. Adding locally sourced art to flyers and reports can improve connections to the community.
    c. Traditional media (radio, newspapers, TV): Local radio broadcasts and newspaper articles can help disseminate project information widely. Build relationships with local

media so the community becomes the point person when media outlets report on an issue or location.

d. Social media and online platforms: Leverage social media and online platforms to share project updates, organize virtual meetings, and conduct online surveys. Make sure participating groups have announcements and reports that can be easily added to websites or social media.

9. **Design a communication strategy:** Create a communication plan for outreach (informing groups, inviting people to meetings, sharing outcomes), and engagement (what services are needed at meetings). Keep a commitment to language justice throughout, avoid acronyms or complex terms, and honor cultural practices. Be sure to budget time or funding for translation, interpretation, and following Americans with Disabilities Act (ADA) requirements and advice. Include ways to test materials before they are shared. For example, can an Advisory Committee, elders, or youth suggest improvements? Note if communication will need to be coordinated with multiple communication teams. For example, will the team need to coordinate with university or agency communication teams? If so, detail who leads the project communications, who should be consulted, and what level of review and approval is appropriate for various activities. Discuss and agree on how artificial intelligence (AI) can or cannot be used in developing communication materials.

Examples of developing engagement and communication strategies

- **Big Pine Paiute Tribe of the Owens Valley** surveyed Tribal members about air quality data and found that Tribal members wanted more information on poor air quality and actions they could take. They worked with the CARB Aqview: Community Air Quality Viewer and conducted community outreach to explain what the viewer shows and what the community should do if there is poor air quality. They also developed health advisory outreach strategies through Facebook, Instagram, low-power radio stations, texts, and a good neighbor policy. The good neighbor program organized neighborhood groups to check on elders, the housebound, or others with limited communication access.
- **The Cahto Tribe** runs three types of engagement events to share their community science projects:
  - A general public meeting, held after work hours and catered to community needs.
  - A decision-maker meeting, held during business hours to communicate results in the context of recommendations and needed policy changes.
  - A technical meeting, held during business hours with technical representatives from different parties (project staff, regulatory agencies, academia) to discuss the project's technical details and results.
- **The Gabrieleño Band of Mission Indians – Kizh Nation** installed a native plant garden with braille signage for the Inland Empire Lighthouse for the Blind. Audible bird surveys

with blind students accompany the braille signage to teach about birds and assess ecological diversity before and after the installation of the native plant garden.

- **Land Together** uses gardening and community science in prisons but cannot access translation services. As a solution, bilingual participants step in as untrained translators to find common terms and take on leadership roles in the projects.
- **Orange County Environmental Justice** created a comic book about the health impacts of lead in soil and how youth can take action, along with two award-winning videos for wider audiences.
- **Sierra Streams Institute** prioritized youth engagement through building partnerships with the school district and local educators to implement its science education programs. For example, Our Forests is a National Science Foundation-funded project that began in 2019 in partnership with the Center for Community and Citizen Science at UC Davis and the Nevada County Superintendent of Schools. This hands-on science curriculum for 3rd to 5th graders emphasizes community science in Western Nevada County. Students collect forest health and fire resilience data on plots within walking distance of their school, while UC Davis researchers study whether this method of teaching science is more effective than traditional in-class curriculum.
- **United Latinos** partnered with the Sacramento Metropolitan Air Quality Management District, the local lowrider community, and the Sacramento Academic and Vocational Academy public charter school to work with students to transform a classic lowrider car into an electric vehicle. This community science project engaged local youth and introduced important science concepts. They frequently partner with local artists to use art and theater to communicate about their projects.

External resources

- California Air Resources Board Community Engagement Model
- Changemakers Guide to Storytelling
- EPA Superfund Communication Toolkit
- Jemez Principles for Democratic Organizing
- The Movement to End Violence Language Justice Guide

Section 4

Carrying Out the Project

Section 4: Carrying Out the Project

Accurate, reliable, and actionable research relies on a well-thought-out research plan that is collaboratively developed and implemented. Research plans help project partners agree on a refined research question, appropriate methodologies, data needs, analysis approaches, results dissemination, and project evaluation. The project team should follow the research plan to carry out the project while remaining flexible to change.

Figure 5: Carrying Out the Project

Three principles guide the Carrying Out the Project phase:

1. **Centering communities and collaboration:** Community science projects prioritize community and Tribal needs while ensuring inclusive partnerships.
2. **Equity and justice:** Community science projects address environmental disparities and promote equity, especially racial equity, by ensuring that overburdened communities and Tribes' experiences and priorities are reflected in the project.
3. **Aligned actionable science:** Projects should co-develop research questions, methods, data needs, and analyses with Tribes, CBOs, community members, academics, agencies, and other relevant parties. The questions, methods, and data aim to support actionable and policy-relevant research.

4.1. Hold Kick-off and Subsequent Project Team Meetings

Purpose and considerations

Work with the project team to co-design a kick-off meeting and subsequent team meetings to ensure everyone understands the project and is making progress on implementation. Meetings are important opportunities for relationship-building and collaborative problem-solving. The kick-off meeting brings together representatives from the project partners to collaboratively refine the project goals, meeting agreements, processes for decision-making, timeline, and project evaluation. Subsequent team meetings track progress, solve problems, and help with wider collaboration.

The project team should create inclusive and welcoming meeting spaces by understanding and attending to power dynamics, assessing and addressing cultural practices, and considering other expressed needs from Tribes or CBO partners. All meeting materials should be in plain language, avoid or appropriately explain terminology and acronyms, and be translated as needed. Meeting materials and spaces, including virtual spaces, should comply with the Americans with Disabilities Act (ADA). The project team can identify other participation barriers and attempt to address as many as possible. For example, transportation barriers, child or eldercare concerns, and additional monetary and non-monetary participation costs are often cited as participation barriers. Lastly, if meetings will

be held on-line, the project team needs to consider how people without reliable internet access can attend and fully participate.

Practices for planning and holding meetings

Kick-off meeting

Co-design a kick-off meeting agenda and activities. Standard kick-off meeting actions and outcomes should include, but are not limited to:

1. **Spend time on team building:** Spend 15-30 minutes of the kick-off meeting with introductions and an icebreaker or team-building activity.
2. **Develop meeting agreements and decision-making processes:** Co-develop meeting agreements and decision-making processes. Meeting agreements are principles for how the team will treat each other. They can also include ways to honor cultural differences and create welcoming and inclusive spaces. Common meeting agreements are "to be respectful," "attack the problem, not the person," and "step up and step back." Creating welcoming and inclusive spaces can include practices like land acknowledgments or giving reflection time before people speak. Decision-making processes are agreed-upon ways to make decisions and resolve conflicts. For example, will the team use consensus, majority vote, or other methods to make complex decisions? Co-developing these helps set the tone of collaboration and shared responsibility. If working with a Tribe, begin with their established decision-making processes and meeting agreements. If changes are required, respectfully discuss the reasoning and possible solutions. In addition to meeting agreements, the project team should discuss conflict resolution methods before conflicts arise.
3. **Ensure a shared project vision:** Agree on the project's vision, desired outcomes, team members, roles, and budget. Share notes on any current grants or contracts and their requirements. Detail any plans to pursue funding. This step can take time and requires respect, especially when a project brings together different ways of knowing and multiple value systems. In reviewing the budget, agree on stipends for project participants or other monetary or non-monetary compensation for their time.
4. **Establish a project timeline:** Set a timeline that details long-term and immediate tasks, deadlines, and responsibilities for each task. Attend to any funding deadlines, review timelines, and other constraints. Identify opportunities to incorporate trust and relationship-building. Additionally, it is important to allow for at least three months of flexible time. Projects rarely go according to schedule, and having flex time can allow for changes based on new information and save time, money, and frustration later.
5. **Identify funding and resources:** Identify potential funding sources and resources that align with your project vision and draft a research question. Take advantage of technical assistance opportunities offered by funders. Community science projects may fit within existing funding programs or non-funded opportunities with CalEPA and its BDOs. CalEPA and BDO funding may become available periodically to perform community science projects, but it will vary annually and by BDO. If funding is secured, adjustments may be required to incorporate funders into the project or to ensure clear alignment with their objectives. This is further discussed in the research plan section.

6. **Plan for the project evaluation:** Collaboratively create an evaluation plan by refining the project goals, metrics, and measurement methods (See Create a Project Evaluation Plan for more details).

7. **Determine project team meeting and communication plans:** Detail how often the project team will meet, how, where, and who will coordinate. Distinguish between wider and core team meetings. Identify how the group will communicate and share information.
8. **Administer a meeting evaluation survey:** Provide a survey to all project team members that asks questions about meeting communication, accessibility, and an open question related to any issues that need to be discussed or addressed. The survey outcomes can be used to improve on-going collaboration. The survey can be refined to include questions supporting the overall project evaluation.
9. **Provide a meeting summary:** Share a meeting summary with the project team and other interested parties. Capture attendees, key agreements, action items, and next steps. Note any feedback from the meeting survey and plans to address any concerns or requests in the future.

Data and engagement meeting

Work with the project team to co-design a data and engagement meeting agenda and activities. Standard meeting actions should include, but are not limited to:

1. **Discuss data sovereignty:** If the project involves Tribes, discuss Tribal data sovereignty. Tribal data sovereignty emphasizes the rights of Tribes to determine the collection, ownership, and application of their data or data related to their Tribal members, lands, or

waters. For Tribes, there may be critical considerations related to sharing data that disclose locations of culturally significant sites, water resources, land management practices, or other sensitive data. Data sovereignty agreements often detail rules for collecting, analyzing, saving, archiving, and sharing data to protect the Tribe's interests. If working with an agency or using agency funding, work with their legal teams to clarify what information may be subject to Public Records Act disclosure or other legal requirements and detail this in the data management plan. The Design and Implement the Research Plan section will cover creating a data use agreement for all projects.

2. **Discuss community data:** If the project involves overburdened communities, discuss the guidelines for collecting, analyzing, saving, archiving, and sharing data to protect the community's interests. Include information about how to consult the community members on any sensitive data in the data management plan. Publishing data relevant to overburdened communities can have unforeseen consequences. If working with an agency or using agency funding, work with their legal teams to clarify what information may be subject to Public Records Act disclosure or other legal requirements and detail this in the data management plan. The Design and Implement the Research Plan section will cover creating a data use agreement for all projects.
3. **Detail agreements on artificial intelligence (AI):** Understand any guidelines or restrictions on using artificial intelligence (AI) to gather, manage, analyze, or share data. After noting any restrictions, discuss additional project agreements on artificial intelligence use and ensure alignment with previous data use discussions.
4. **Agree on project result review standards:** Clarify who needs to be involved in internal review before results are shared beyond the project team. The project team should also agree on what level of external review, if any, is required before results are made public. For example, will the project results need to undergo project team review or double anonymized external peer review? Agree on who from each group will sign off on releasing results, and if the team agrees to make data available with the publication. Conversations on releasing data should follow data use agreements. If working with an agency or using agency funding, work with their legal teams to detail what may get released under Public Records Act disclosure, other legal requirements related to publications or transparency, and other circumstances that may necessitate changes to the review process and how that will be communicated.
5. **Review wider communication and engagement strategies:** Share the engagement and communication strategies with the project team and confirm the plans provide an adequate level of meaningful collaboration and engagement, communication, cultural considerations, and language justice. Discuss when different team members should be involved in any engagement activities and associated expectations. Reaffirm how wider Tribal or community engagement will impact project decision-making and how engagement outcomes will be communicated.
6. **Administer a meeting evaluation survey:** See details in 'Kick-off meeting' above.
7. **Provide a meeting summary:** See details in 'Kick-off meeting' above.

Subsequent meetings

Co-design future meeting agendas and activities. Future meetings should provide adequate time for status updates on the timeline and associated tasks, information on the engagement processes and outcomes, troubleshooting, and identifying opportunities for additional collaboration. They should also include meeting evaluation surveys and meeting summaries shared with interested parties.

External resources

- California Climate Investments Funding Workbook for All California Tribes
- California Grants Portal
- California Strategic Growth Council Technical Assistance Toolkit Funding Sources
- California Water Board's Equity Data Handbook
- Community Data Playbook
- Community Data Playbook in Spanish
- Fielddoc

4.2. Create a Project Evaluation Plan

Purpose and considerations

Evaluation is a systematic method for collecting and using data to understand project impacts and inform changes within the project or in future efforts. Evaluation allows the project team to make any necessary adjustments, capture valuable lessons, and identify opportunities for improvement. Formally evaluating the project at the end provides an opportunity to measure success, identify emerging challenges and opportunities, report back to interested parties, and incorporate new strategies for future efforts. Plan for evaluation at the start of the project to have an adequate, efficient, and implementable approach.

Evaluation happens at the event and project scales. The event scale assesses how individual events went. The project scale evaluates the whole project against the defined project goals and metrics. Project scale evaluation works best when the team has defined the goals and metrics at the beginning and set up methods for tracking outcomes. The project team normally completes project evaluations, whereas independent third parties often do external evaluations and are more appropriate for large-scale or ongoing programs.

Practices for creating a project evaluation plan

1. **Define project evaluation metrics:** Co-develop the project metrics, which are measures or indicators that help track project progress over time. Metrics should be simple, measurable, and related to the communities' original concerns and goals identified in the kick-off meeting. After identifying metrics, consider including any additional metrics commonly used by project partners. Whenever possible, maintain continuity with previous metrics and assessment methodology. For example, a metric on the number of youth involved in data collection should have the same definition (i.e., youth are 12-24) and the same data collection method (i.e., sign-in sheets at data events). Example metrics include:
    a. Event scale: The percent of meeting attendees who agree the event materials were accessible and easy to understand.
    b. Project scale: The number of youth (age 12-24) participating in one or more project training events.
2. **Identify methods to measure and assess the metrics:** Decide if the project evaluation will be quantitative, qualitative, or mixed methods. Quantitative approaches often have measurable metrics with numbers and evaluate changes in those numbers. Qualitative approaches often assess how people feel or make meaning about a project. Mixed methods use both quantitative and qualitative methods together to get a fuller picture. Given the methodological approach, agree on the data and collection approaches for each metric. Common evaluation data collection strategies include sign-in sheets, self-reported demographics, surveys (paper or electronic), individual interviews, focus groups, polls, and pre- and post-counts. Examples include:

   a. Offer a 5-minute survey at the end of each project team meeting that asks questions about communication effectiveness, material accessibility, and suggestions for process improvement.
   b. Offer a 10-minute survey at the end of the project asking questions about perceived outcomes of the research and process, project management effectiveness, and budget adequacy.
3. **Decide how the team will share evaluation outcomes:** Collaboratively define how, when, and with whom the team will share the evaluation outcomes. For example, will the project evaluation be public? If the team includes agency partners or uses agency funding, note what information is subject to the Public Records Act or other legal requirements.
4. **Check with the Advisory Committee:** Share the draft metrics and methods for feedback and changes with the project advisory group (if present).
5. **Consider developing an evaluation framework:** The project team may create an evaluation framework that identifies goals, metrics, data, methods, analysis, and timeframe to help implement the evaluation. An example is provided in Appendix III.
6. **Identify team responsibilities:** Clarify who is responsible for intermediate and long-term project evaluation and who will develop evaluation materials like surveys.
7. **Assess progress:** Check-in on intermediate evaluation outcomes and progress at project team meetings.
8. **Conduct a final project evaluation:** Carry out the final evaluation at the end of the project and share the report with appropriate audiences. If previously agreed, share the outcomes publicly.

4.3. Design and Implement the Research Plan

Purpose and considerations

The research plan includes the research question and detailed data collection, analysis, and management methods. A research question identifies an unknown area of knowledge and focuses on understanding the relationship between two or more concepts or circumstances. The question is the nexus between a community concern and the research project. The research plan provides a framework for achieving project goals and focuses on research for action or other team goals. Research for action avoids projects that only generate new knowledge and implies research that generates knowledge with the potential to improve environmental conditions. As with all science, projects may not have conclusive outcomes, and research may not always be actionable. Consistent communication about findings and implications can help manage expectations.

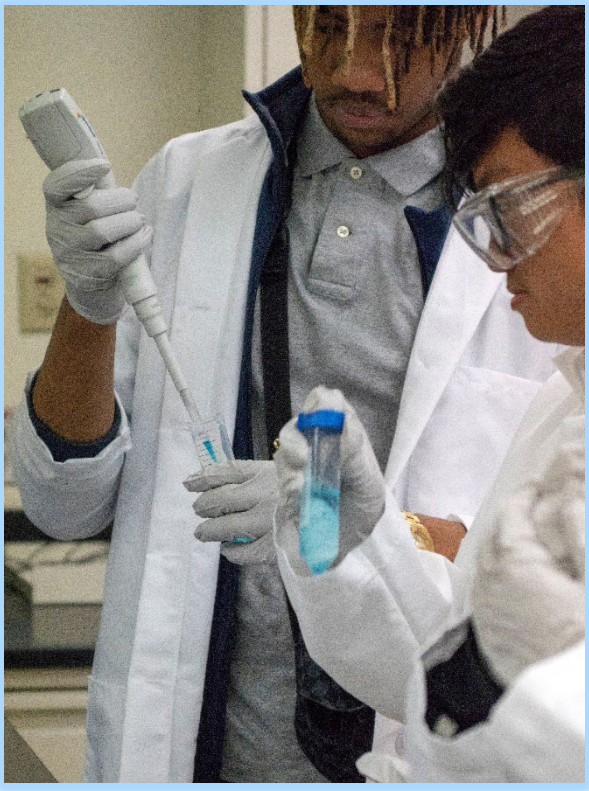
The research plan provides space to align partner priorities. Tribes and CBOs should continue to connect the project to their community's most pressing issues. Agency partners may note their priorities and regulatory authority. Academic partners help situate the project in existing academic knowledge and research gaps. The research plan should incorporate capacity building and integrate technical and professional skill-building opportunities, especially for youth. Successful projects incorporate qualitative and quantitative research methods and data. As the research project is developed, collecting traditional ecological knowledge and other qualitative data should be prioritized and guided by Tribe or community expertise. Combining different types of data—from quantitative water quality measures to community stories and traditional ecological knowledge—creates a fuller picture of Tribal and community concerns, improves data use, and identifies solutions.

Practices for the design and implementation of a research plan

1. **Develop a collaborative research plan:** Work as a project team to integrate information from the earlier steps into a draft research plan. The team should set aside one to two meetings to collaboratively develop and agree on a research plan that includes the following components:
    a. **Actionable research question:** If needed, the research questions should be refined. Questions should be clear, concise (1-2 sentences), specific, and feasible given the timeline and budget. Work with the wider project team to check that the question has not been answered and that everyone can understand it. Specificity means the questions should not yield yes or no answers but instead describe relationships. For example, "Is there lead in the soil?" versus "What is the distribution of soil lead concentrations in Santa Ana?" Feasibility means the question can be answered within the project timeline, data can be obtained, and methods are available. Typically, the first draft of a research question tends to be too broad or too ambitious. Identify how the research question will align with goals by understanding the program(s) or project(s) that can use the research outcomes to inform decision-making or for Tribes or communities to address their concerns.

b. **Actionable research methods and data:** Consult with the wider team, including any agency staff, academics, or technical experts, to understand the method and data requirements for the research to be actionable. This includes the standard or acceptable methods, data types, measurements, sample sizes, and quality control and testing requirements. This is likely the most important factor in connecting a community science project to potential action. Agency staff should verify acceptable data, methods, transparency, and quality control requirements with their legal, enforcement, or management teams. Identify if data exists or if the team will need to gather new data. Try identifying the simplest and most accessible methodology that will produce the most usable outcomes. If complex methodologies are selected, create a one-paragraph summary that clearly explains them. Understand which methods the team is comfortable with and which would require new skills or external assistance. Collectively agree on data quality objectives, or the methodology and data types that answer the research question and meet the team's needs. Mixing these needs may look like pairing a quantitative method that meets agency enforcement standards with qualitative methods and data or traditional ecological knowledge approaches that meet other Tribe or CBO goals. It is important to recognize that working in interdisciplinary teams that combine multiple ways of knowing, data sources, analysis approaches, and connecting outcomes to action is extremely challenging. Discussing and developing agreements about how various components will work together at this stage can prevent conflict later.

c. **Comprehensive data use agreement:** Delineate who has access to the data, how they access it, access timeframes, and any confidentiality or privacy requirements pertinent to the data. This should align with any Tribal or community data use agreements, agency, and academic data standards, and review standards established above. Other common sensitive data can include the presence of endangered or culturally significant species, health data, or property values. If the team includes agency partners or uses agency funding, note what information is subject to the Public Records Act or other legal requirements.



d. **Data collection and quality assurance plan:** Based on the data requirements, the team should develop a plan to ensure the accuracy and reliability of collected data. The plan should include:

i. Any existing standards for quality assurance, sampling, and analysis plans. For example, Tribes may have existing standards through United States Environmental Protection Agency projects. It is important to determine how to align existing plans with project needs.
ii. Data gathering approach and timeline that details the data and samples to be collected, data and sample collection methods and requirements, collection instruments, instrument calibration, data and sample handling and transmission, safety measures, regular audit plans to detect and correct errors, and training requirements. Safety measures include practices to keep people safe inside and outside of laboratory environments. For example, detail ways to keep data collectors from trespassing, create groups with enough representation and numbers to keep people safe, provide protective gear, have emergency plans if someone is harmed or injured, and create a reporting mechanism if someone feels harassed or unsafe.
iii. Data management plan detailing where the data will be stored and who will manage it.
iv. Data validation and verification protocol. This can involve cross-checking data entries, using control samples, and conducting peer reviews to identify discrepancies.
v. Standard operating procedures to ensure consistent and accurate data collection.
vi. Training plan for all individuals involved in data collection and analysis.

e. **Data analysis plan:** Create an initial data analysis and evaluation plan that aligns with the project goals and Tribe or CBO needs. Data analysis plans describe how data will be organized, analyzed, interpreted, and presented. Ensure the analysis plan is appropriate for the identified methodology and will meet data requirements for decision-makers to act. Discuss any software or technology needed for analysis and if access can be maintained after the project concludes.
f. **Revisit the project timeline:** Evaluate if the research plan fits the earlier project timeline. Review any administrative or financial deadlines and review timelines to align the research plan with the timeline constraints.

2. **Share the plan with the Advisory Committee, Tribal members, and community members:** Connect with the community to present the initial research plan and collaboratively adjust to address any missing or misunderstood needs. Discuss how community members would like to be involved in data collection or analysis and what skills they would like to build during those processes.
3. **Adjust the project based on new funding and resources:** If funding is secured, maintain transparency and accountability by incorporating financial updates in community meetings with information about how money is being spent. Modify the team roles and timeline to meet financial and project reporting requirements. Some funders may have greater involvement in the project or want to ensure clear alignment with their objectives. For example, if the team secures funding from CalEPA or its BDOs, additional steps should be taken to integrate staff into the project team and revisit the project research plan to align methods, data, and review processes.

4. **Build capacity:** Draw from the community readiness analysis and other conversations to develop a list of capacity-building needs, including safety training, based on when different groups will be involved in various project stages. For example, if students are involved in data collection, the team should identify the needed skills, how to develop the skills, and how students will be compensated for their involvement. If student groups transition with semesters, plan for repeated training or develop a train-the-trainer model. Training can be done through interactive webinars, in-person workshops, or one-on-one.

   Capacity building can nurture local leaders and change-makers so community members are ready to lead and actively participate in every project stage, thereby amplifying its overall impact and sustainability. Remember, trainings and capacity building offer important opportunities for multi-directional collaborations and relationship building. For example, Tribes may offer training on data sovereignty for the project team, an agency team member could train students on air monitoring sampling procedures, and students could offer social media training. Everyone should be recognized for their unique skill sets, and trainers should not be limited to technical professionals or academics.

5. **Carry out the research plan:** Conduct capacity-building activities, data collection, data analysis, and write up initial findings and outcomes. Tribal and community engagement is central to carrying out the project and should be woven into every step. This includes

engaging with people who are active project participants and wider engagement for those who are interested but not involved in the day-to-day. The team should continue to hold regular project meetings to track the deliverable timelines, troubleshoot any major issues, and begin discussing how to share the data and results. Keep transparency, accessibility, and language justice at the forefront of all efforts to carry out the research plan. It helps to build trust and supports a democratization of data and science. It also fosters a deeper understanding of what the data and analysis can and cannot tell us. Lastly, remain flexible as things may change as the project progresses.

Examples of designing and implementing the research plan

- **Alianza Coachella Valley** developed a quality assurance project plan in consultation with regional water boards and their academic partners. The quality assurance project plan was reviewed by project members and included in their data dashboard files.
- **Central California Asthma Collaborative** built air monitoring capacity with local communities to intentionally develop a powerful movement to address local concerns. In Lost Hills, the community created a network of low-cost air sensors to measure emissions from oil and gas sources. This led to the California Air Resources Board conducting their own monitoring under the Study of Neighborhood Air near Petroleum Sources (SNAPS) program and, ultimately supported wider efforts for legislation creating a 3,200-foot setback between oil and gas drilling sites and communities.
- **Comité Cívico del Valle** used a mixed methods approach to understand pesticides in Brawley. Community members conducted three years of soil sampling that followed the United States EPA standards. They combined this with oral histories of pesticide use and exposure in the area. Through that work, the community found that pesticides were impacting soils at a larger distance than currently modeled. Residents are now organizing around household preventative measures and larger advocacy efforts.
- **Orange County Environmental Justice** responded to community member concerns about delayed development in kids and other observed health impacts. As part of the ¡Plo-NO! Santa Ana! Lead-Free Santa Ana! (¡Plo-NO! Santa Ana!) coalition, they worked with academic researchers to identify existing studies showing health impacts from lead exposure on present-day youth, especially youth of color. They refined their questions and eventual methods to be usable by decision-makers. They settled on two research questions, "What is the distribution of soil lead concentrations in Santa Ana?" and "How are those concentrations related to social vulnerabilities across Census tracts?".
- **Sierra Streams Institute** works with community members to monitor the health of Deer Creek and the Bear River. They follow the Water Board's Surface Water Ambient Monitoring Program protocol to capture and analyze quarterly baseline monitoring data on water temperature, dissolved oxygen, conductivity, acidity, and turbidity, indicating the creek's state and what kinds of life can inhabit its waters. All volunteers receive

training on these data collection and sample analysis methods using calibrated instruments and approved analytical methods.

- **United Latinos** recruits Latinx students from Sacramento State University, majoring in relevant scientific fields, to participate in community science projects such as community air quality monitoring. Students develop leadership and science communication skills by using their educational training to collect data, write curricula, create website content, and share project results with their communities.

External resources

- California Water Board's Equity Data Handbook
- Center for Care Innovations Data Strategy Worksheet
- Community Data Playbook
- Community Data Playbook in Spanish
- EPA Quality Assurance Handbook
- Fielddoc
- Indigenous Guardians Toolkit Data Sharing
- Racial Equity Tools on Data Collection
- Racial Equity Tools on Data Analysis
- Surface Water Ambient Monitoring Program (SWAMP)
- USGS Data Sharing Agreements
- US Indigenous Data Sovereignty Network
- University of Washington Guide on Developing Research Questions
- Ventura County Behavioral Health Decolonizing Research Methods

4.4. Review Data and Results

Purpose and considerations

The preliminary review phase presents the initial analysis to the core project team and Tribal members, community members, and other interested groups. The preliminary review builds an understanding of project results and offers opportunities for feedback and iteration. This step democratizes the scientific process, fosters collaboration, compares the analysis with lived experiences, and addresses the research questions effectively. It promotes transparency, trust, and shared ownership of the results, allowing community insights to shape further research directions. Conducting a review with agency staff or decision-makers can help determine if the eventual results can be actionable and identify ways to address any unexpected or sensitive findings.

Practices for reviewing data and results

1. **Revisit the review process and data use agreements:** Revisit the comprehensive data use agreements and the review standards established earlier to confirm what can be released, to whom, and when. Pay attention to data sovereignty issues, agency requirements, and ensure proper protections are in place. The core project team can raise any new concerns about releasing information and collaboratively resolve any disagreements.
2. **Package initial key results and data for review:** Create materials communicating the initial project results with a focus on the outcomes that answer the research question and offer actionable insights. Revisit keywords and concepts to align word choices with the community's existing definitions. Employ visual summaries, such as infographics and graphs, to enhance understanding. Working with local artists or community art projects can be an important way to convey results and meaning. Working with artists early can help align art development with the final report. Discuss the limitations of the analysis, including what the results can and cannot explain, and any additional data needs or future studies. Ensure the data are available and understandable to all parties, utilizing online databases or data dashboards to facilitate easy access and comprehension. If needed, presentations can include both technical discussions and non-technical summaries. Note any data excluded for data sovereignty or privacy concerns. All materials should use plain language, avoid jargon, avoid acronyms, and be translated into needed languages.
3. **Facilitate open discussions with initial audiences:** Hold meetings and events to share project results and discuss the implications for Tribes, CBOs, and other partners. Project team members may need to share initial results with their wider teams, including communications and legal staff. Create opportunities for ongoing dialogue to foster new insights and develop further research questions. Questions or concerns may arise if the initial results are unexpected given existing research, lived experiences, or early-stage projects. Discussing potential explanations or additional tests to run can increase trust in the results.
4. **Incorporate feedback:** Integrate Tribal, community, academic, agency, and other partner feedback into the analysis. If necessary, complete additional analysis and repeat the sharing process to refine the findings.
5. **Prepare for any additional review:** Revisit the earlier agreements on what level of internal and external review, if any, is required before results are made public. External review may include academic or journal peer review. If changes are required, discuss those as a project team and resolve conflicts or concerns collaboratively. Send the revised report and results out for internal and external review as needed. Projects requiring extensive review or peer-review may need to be shared publicly after the project concludes. If the team has agreed to undergo a peer-review process, that may take 4-18 months and extend past funding dates. In those cases, agree with the project team beforehand on how and when results will be shared. Lab reports, field notes, and interview recordings should be preserved for future reference or review and follow data management and retention standards.
6. **Identify actions and strategies:** Work with the Tribe, CBO, academics, agencies, and other parties to translate findings into potential actions to address identified issues.

Research can produce unexpected or insignificant results. These may not lend themselves to insights or actions to address the original issues. Outcomes may still be relevant to communities, researchers, or agencies, but may not have a direct action. For relevant findings, formulate strategies to address the key findings, involving all appropriate partners to ensure effective and comprehensive action. Co-developing these before sharing them publicly provides for a more robust public report on project outcomes. How Tribes, CBOs, or academics envision using the results may differ from how an agency can use the results. Ultimately, the action may rest with the Tribe, CBO, or other project partners to identify and follow through on larger actions.

Examples of reviewing data and results

- **Big Pine Paiute Tribe of the Owens Valley** presents the results of their air quality monitoring project through a series of workshops with the Tribal Council. This allows the community and the Tribe to understand the data, why it was collected, what can be gained from it, if any health risks were identified, and if continuing is worthwhile.
- **Comité Cívico del Valle** first consults with their community advisory committee to guide the process of sharing results and ensure broader community outreach. In community review meetings, Comité Cívico del Valle staff or community members present the results to ensure that the data and results are accessible. Academic partners participate to answer any questions or provide clarification.
- **United Latinos** developed a partnership with a local neighborhood concerned about lead exposure from airplanes at a local Executive Airport. United Latinos met with the community to understand the concerns and desired solutions. United Latinos worked with the community to install air quality monitors, collect samples, and conduct analysis. Analysis showed elevated lead levels, but the levels were within Federal standards. Examining the data, results, and implications during a meeting helped the community understand their concerns and consider additional advocacy efforts outside of enforcement.

4.5. Sharing Project Results

Purpose and considerations

Sharing project data, results, and findings with broader audiences achieves community science goals of creating and sharing new knowledge and increasing transparency and accountability. By creating accessible ways to share project data, outcomes, and proposed actions, the project can continue to center Tribes and communities in inclusive approaches to connecting community science to action.

Practices for sharing data and results

1. **Connect with appropriate teams:** Coordinate between partner communication teams before final project outcomes are released.

2. **Identify target audiences:** Revisit the communications strategy and previously identified audiences, including Tribal or community members, Tribal councils, non-profit organizations, CBOs, local and state government entities, academic groups or journals, and media outlets. Decide on any new audiences like promotor/es, youth and youth groups, religious groups, educators, school districts, industry, and public health groups.
3. **Develop a project release plan:** Refer to the communication strategy developed at the start of the project to clarify and modify communication methods and outreach strategies. It is important to share project results through multiple outreach avenues like social media, email, traditional media, and release events. Assess the timeliness of the project, especially related to public health data that may need earlier communications. Assign roles and coordination responsibilities and include estimated timelines. The team should identify spokespeople for each major group in the project and an overall project spokesperson. When possible, Tribal or community members involved in the project should be the spokesperson for the overall project.
4. **Develop messaging for key results:** Identify the main results and craft messages that address the research question for the target audiences. Enhance communication with visuals like maps, graphics, photographs, and infographics to increase understanding and accessibility. Continue working with local artists or community art projects as appropriate

to convey outcomes and meanings. Choose methods for sharing data, such as spreadsheets, summary tables, web-based dashboards, art projects, and maps to address clarity and ease of access.

5. **Create inclusive materials:** Make all materials accessible, considering the language and format preferences of the targeted audiences. This may include translating documents and employing various media formats to reach and engage diverse groups. All materials should meet accessibility requirements and Americans with Disabilities Act (ADA) recommendations.
6. **Release study results and recommendations:** Work with the project team to identify the most appropriate ways to share results and recommendations. This could include a report, whitepaper, or peer-reviewed journal article. If working with an agency or using agency funding, identify any publication requirements, like ensuring publications are free and publicly accessible. In addition, consider sharing through various forums such as listening sessions, community meetings, public meetings, agency briefings, and media outreach to educate and inform a wide range of audiences. Consider the next steps, including any immediate and long-term potential actions and roles from the results or future studies. These may draw from work done in "Identify actions and strategies" Section 4.6 above.

Examples of sharing data and results

- **Central California Asthma Collaborative's** refinery emissions study collected data intending to advocate for more stringent enforcement or fenceline community air monitoring. To target these actions, they identified the regulatory agency with the jurisdiction to act on the air sampling results showing increased toxicity with increasing proximity to a refinery. CCAC shared results by blending technical presentations with personal stories during meetings. This format brought community voices into the conversation and personalized the issue.

External resources

- ESRI Nine Steps for Story Telling
- Racial Equity Tools on Data Collection

Section 5

After the Project

Section 5: After the Project

After the Project provides guidance for taking action, evaluating the project, and continuing relationships. A primary goal of community science is conducting research that informs action to address Tribal and community concerns. Taking action moves the team from sharing research outcomes to addressing the community's original concern. Community science projects should not stop with data analysis and publications, but use research outcomes to contribute to environmental and social justice for impacted communities. Additionally, evaluating the project can help further community science efforts or address identified issues in future projects.

Figure 6: After the Project

Three principles should guide the After the Project phase:

1. **Equity and justice:** Community science projects address environmental disparities and promote equity, especially racial equity, by ensuring that overburdened communities and Tribes' experiences and priorities are reflected in the project outcomes.
2. **Aligned actionable science:** Projects produce actionable, policy-relevant research that meets project partner needs.
3. **Collaborative rigorous science:** Project outcomes are co-created with the Tribe or CBO while maintaining inclusive partnerships with the project team, including academics, agencies, and others.

5.1. Taking Action Based on Results

Purpose and considerations

When appropriate, based on the results, the project team should develop recommendations for relevant actions to address the problem studied. These recommendations can be short- and long-term and identify how different team members can best use project data, tools, or outcomes for broader efforts. Recommendations may vary depending on the results, project partners, and targets.

Practices for taking action

1. **Understand the Tribe or community's desired actions:** Revisit the outcomes from "Identify actions and strategies" above and work with Tribal members or community members to prioritize possible actions related to project outcomes.
2. **Update project partner map:** Revisit the project partner map and consider what policies are relevant given the project data and results. If necessary, modify who has jurisdiction and decision-making power and what limitations exist. Document previous efforts to influence or change these policies and the outcomes. Identify existing public processes

for enforcing those policies or setting new ones. Note groups currently working on these issues that may be good allies or advocates.

3. **Identify policy changes or programmatic interventions:** Work with Tribes, CBOs, academic partners, and appropriate agency staff or management to understand how project outcomes can impact a program or inform policy changes. Agency staff and management can help strategize how project data, outcomes, and tools can be applied to address the Tribe or CBO concerns. This may include requesting support from other agencies or local partners. Partnering with CalEPA or its BDOs does not obligate them to use the data or act. When limited opportunities for agency actions or changes exist, ask agency staff to communicate about opportunities, limitations, and note any reasoning. The project team should write a short summary of potential next steps, key contacts, and a timeline for updates. The timeline should include envisioned short-, medium-, and long-term outcomes. Tribes, CBOs, and other groups may want to include a more comprehensive action plan detailing activities like coordinating with allies, attending meetings, submitting public comments, writing letters, social media campaigns, meeting with decision-makers, etc.

4. **Track and communicate actions and follow-ups:** Track how community science data and results were used, influenced policy or decision-making, and any additional outcomes. Tracking should come from all project partners, as different groups may have

different uses and applications. Celebrate small and big wins and report results to the project team, advisory committee, Tribal members, and community members annually or after major outcomes.

5. **Connect community science to wider social change goals:** Influencing policy and decision-making is important, but may not provide holistic solutions to the root causes communities identified. Interested project partners should work closely with impacted communities and Tribes to outline how to integrate past and future community science efforts into culturally adaptive, deliberate, and sustainable long-term approaches to undoing root causes and building a more just future.

Examples of taking action

- **The Gabrieleño Band of Mission Indians – Kizh Nation** is working with a pre-med college Tribal youth to co-design a land-to-medicine project with the City of West Covina. Kizh Nation contributes knowledge about native medicinal plants, the student evaluates the microbiology and how it relates to native plants and human health, and West Covina plans to hold Native Health clinics on medicinal plant use for all residents. This project aligns with the Kizh Nation's longer-term structural change goals related to ensuring reciprocal relationships with nature, promoting health and healing, and diversifying health systems.
- **Orange County Environmental Justice** participated in investigations with Santa Ana community members, youth, community organizations, and academic researchers as part of ¡Plo-NO! Santa Ana! (Lead-Free Santa Ana!) coalition. The goals were to understand soil lead exposure in Santa Ana and advocate for policy changes with the City of Santa Ana and the Orange County Health Care Agency. In 2017, journalist Yvette Cabrera and ThinkProgress responded to resident health concerns by collecting 1,000 soil samples across Santa Ana. They found hazardous lead levels in close to 25% of the samples. Lead is a toxin that can change how the brain and nervous system work and is especially harmful for children.

  Orange County Environmental Justice and ¡Plo-NO! Santa Ana! built on this work by training community members to collect over 1,500 soil samples across the city. External laboratory results showed that over 50% of the samples contained lead above California's standards and lower-income and Latinx communities lived in parts of the cities with the highest soil lead levels. The team then used radioisotope analysis and old city photographs, demonstrating that areas with high traffic when leaded gas was used matched areas with high soil lead now, and the soil lead isotopes matched those used in 20th-century gasoline. The team did a cumulative health risk assessment and found that lower-income Latinx residents had greater health risks related to lead and other heavy metal exposure.

The coalition used the outcomes from these community science efforts to advocate for remediation and larger policy changes. This included speaking at public meetings for years, call-ins, letter writing, and countless meetings. In 2022, the coalition succeeded in getting a series of policy changes passed, including free public blood testing and efforts to use bioremediation to clean up the soil. Several components of economic justice were achieved, including prioritizing local residents for training and bioremediation jobs, and renter protections to avoid eviction or rent increases once the soil is clean. New policies require more space between industrial sites and homes and require developers to say when lead is present so it can be cleaned up. The City of Santa Ana combined many of the city-level policies into their climate efforts to address climate and environmental injustice. They also created an environmental justice staff position to work with communities on these issues.

External resources

- Environmental Defense Fund Clean Air Action
- The University of Southern California Primer on Structural Change

5.2. Project Evaluation

Purpose and considerations

Evaluation is a systematic method for collecting and using data to understand project impacts and to make changes in future efforts. Formally evaluating the project at the end provides an opportunity to measure success, identify emerging challenges and opportunities, report back to interested parties, and incorporate new strategies for future efforts. The core project team should conduct the evaluation planned in Planning Evaluation Approach by gathering any final data from project partners, analyzing the data, and reporting the outcomes to interested parties.

Practices for project evaluation

1. **Revisit the evaluation plan:** Work with project partners to modify the previously developed project evaluation plan, metrics, and methods. The team should document any added or subtracted metrics or changed methods and the rationale. Review the previous agreements on how, when, and with whom the team will share the evaluation outcomes. Make any appropriate changes and document the rationale.
2. **Gather and analyze evaluation data:** Assess what data was compiled during project implementation and what additional data is needed. Compile, clean, and analyze the data related to the project goals, objectives, and metrics.
3. **Share initial evaluation results and recommendations:** Report out the initial results from the project evaluation to the project team and appropriate management. The team should identify strengths, weakness, and opportunities based on the initial analysis. Provide a set of recommendations for changes at the project and program levels. The project team should agree on these findings and recommendations and provide details of any divergent opinions.
4. **Distribute the final evaluation results:** Share the final evaluation results with the previously identified audiences.

Examples of project evaluations

- **Comité Cívico del Valle** creates a community-driven evaluation process with four components: Outcomes, Sharing, Program Evaluation, and Next Steps. During the project design phase, Comité Cívico del Valle engages and collaborates with the community and an advisory committee of residents to identify the outcomes they expect from the project and then works with the community as the project progresses to ensure the project addresses those outcomes.

External resources

- Centers for Disease Control and Prevention Approach to Evaluation

5.3. Ongoing Partnerships and Relationship Building

Purpose and considerations

Building long-term relationships is critical to solving environmental and public health issues. Relationship building requires sustained and on-going efforts to create and nurture connection over time. The networks, partnerships, and relationships that evolve from community science will ideally help everyone meet our shared objectives to improve environmental and public health in California.

Practices for ongoing partnerships and relationship building

1. **Close the project and discuss future communications:** Hold a final project meeting to officially close the project, openly reflect on project accomplishments and challenges, and agree on how individuals or groups will continue to communicate or collaborate moving forward.
2. **Follow-up and maintain relationships:** Address and complete any follow-up items from the community science projects. Work with the project partners to identify any specific follow-ups they would like outside of the annual updates.
3. **Identify opportunities for collaboration:** Identify opportunities for ongoing collaborations related to project outcomes, community science, youth engagement, environmental justice, or other shared objectives. Research is often an iterative process, and new project ideas may emerge, offering opportunities for new projects, additional learning, or continuing efforts.
4. **Engage youth:** Share opportunities for youth involved in community science projects to continue developing their technical skills, find internships, and apply for job openings.

Examples of ongoing partnerships and relationship building

- **Comité Cívico del Valle** developed a Youth Environmental Health Internship for a community air monitoring project in the Imperial Valley. High school students participated in a 10-week program that provided training on air quality, public health, air monitoring, and air quality policies. Students leveraged the internship to work with

academic institutions, engage in community-based air quality research, participate in research on tobacco effects, and be involved in other environmental health studies.

- **The Gabrieleño Band of Mission Indians – Kizh Nation** designed a project with the Boy Scout Camp in Monrovia to complete vegetation regeneration in areas burned during the 2020 Bobcat fire. The project focused on working with Tribal youth and Boy Scouts to create Hügelkultur mounds from burned vegetation to spur revegetation and regeneration, while monitoring the impacts of different revegetation practices. The relationship provided mutually beneficial opportunities to manage and restore land while teaching youth different vegetation regeneration practices.

External resources

- University of Kansas Community Tool Box: Maintaining a Coalition

Thank you for consulting this Guide to design and implement an equitable and evidence-based community science project.

Appendices

Appendix I: Community Science Development Process

The Community Science Practitioner's Guide, Staff Guide, Funding Guide, and Trainings were co-developed by three Tribes, seven CBOs, a staff working group from CalEPA and six BDOs, with advice from a CalEPA BDO Steering Committee. The Tribes and CBOs were selected through an open solicitation process and compensated for their expertise. Between March 2023 and August 2025, the workgroup, Tribes, and the CBOs met 30 times to develop these Guides and other resources. Additionally, the workgroup conducted three interviews with each Tribe and CBO to develop the examples and case studies detailed throughout the Practitioner's Guide. These Guides reflect various perspectives, emphasizing the importance of recognizing each Tribe and CBO participant as individuals rather than a representative of a monolithic group.

CalEPA Community Science Partners:

- Alianza Coachella Valley (Year 1)
- Big Pine Paiute Tribe of the Owens Valley
- Cahto Tribe of the Laytonville Rancheria
- Central California Asthma Collaborative
- Comité Cívico del Valle
- Gabrieleno Band of Mission Indians - Kizh Nation
- Land Together
- Orange County Environmental Justice
- Sierra Streams Institute
- United Latinos

The Community Science Practitioner's Guide was co-written by the workgroup, Tribes, and the CBOs. The staff workgroup adapted the Practitioner's Guide into the Staff Guide and received in-depth feedback from Tribes and CBOs. The Trainings were conceptualized

together with the workgroup drafting initial content by drawing from the Practitioner's and Staff Guides.

Tribes and CBOs provided written and verbal feedback on the Community Science Practitioner's Guide, Staff Guide, Funding Guide, and the Trainings. The CalEPA BDO Steering Committee provided direction and advice on all products. They reviewed and provided written feedback at least once for each document. Representatives from CalEPA BDO legal teams, environmental justice leads, and Executive Offices also reviewed and provided written feedback at least once for each document. The CalEPA legal team provided a final review of each document.

Appendix II: Terms in this Document

1. **Agencies**: State of California entities, including but not limited to CalEPA, CalEPA BDOs, other agencies like the California Natural Resources Agency, or committees like the Strategic Growth Council.
2. **Community**: An umbrella term for people living where a community science project occurs. It can include Tribal community members. When necessary, we distinguish between communities, overburdened communities, and Tribes.
3. **Overburdened communities:** Encompasses California communities that experience the highest pollution burdens and impacts of racism. Various terms are used to identify these communities. Common phrases include communities experiencing marginalization, frontline communities, disadvantaged communities, vulnerable communities, environmental justice communities, priority communities, impacted communities, low-income communities, people of color, or communities of color. We use overburdened communities here to capture those terms.
4. **Tribes:** Tribes are diverse, and various terms or names are used individually and collectively. In this document, we refer to specific names of Tribal Governments or Tribal Associations (e.g., Big Pine Paiute Tribe of the Owens Valley) whenever possible. For non-specific names, we often use the term Tribes, which includes federally-recognized California Tribal governments and non-federally recognized California Tribal governments, including those listed on the California Native American Heritage Commission Contact List. People usually prefer to be referred to by their specific Tribal name. There are other common terms, including Native American, Native, Indigenous Peoples, and American Indian, that individuals and groups may prefer. Always defer to how Tribes and individual Tribal members self-identify.

Appendix III: Example Evaluation Matrix

Project goal	Question	Metric	Data	Method	Timeframe	Audience
Increase youth scientific capacity	How many youth completed technical training workshops?	# of youth at each technical training	Count youth sign-in at technical trainings	Quant - Descriptive statistics. Track in excel doc	Quarterly reporting up to 12 months after the project	Project team and final report
Increase youth scientific capacity	How do youth describe changes in their technical skills?	Youth reports of changes in technical skills	Youth interviews	Qual – Analysis of interviews and coding for shifts in knowledge and skills. Track in qualitative software or word document	Quarterly reporting up to 12 months after the project	Project team and final report

Appendix IV: References

[1] Charles, A., Loucks, L., Berkes, F., & Armitage, D. (2020). Community science: A typology and its implications for governance of social-ecological systems. *Environmental Science & Policy*, *106*, 77-86.
[2] Individuals and groups often have their own definition and application of environmental justice. Many groups draw from the Principles of Environmental Justice, which include the recognition that low-income communities and communities of color have been systemically exposed to environmental hazards, leading to adverse outcomes and inequalities. The State of California defines environmental justice as "the fair treatment and meaningful involvement of people of all races, cultures, incomes, and national origins, with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies."
[3] CalEPA defines racial equity as when "race is not a determinant of exposure or proximity to hazardous chemicals, and exposure to hazardous chemicals is minimized across all racial and ethnic groups and all California communities have access to the information needed to meaningfully participate in the decision-making processes that impact their lives." Individuals and groups may have their own definitions or applications.
[4] https://www.ejnet.org/ej/principles.html
[5] Casey, J. A., Cushing, L., Depsky, N., & Morello-Frosch, R. (2021). Climate justice and California's methane superemitters: Environmental equity assessment of community proximity and exposure intensity. *Environmental science & technology*, *55*(21), 14746-14757. Cushing, L., Faust, J., August, L. M., Cendak, R., Wieland, W., & Alexeeff, G. (2015). Racial/ethnic disparities in cumulative environmental health impacts in California: evidence from a statewide environmental justice screening tool (CalEnviroScreen 1.1). *American journal of public health*, *105*(11), 2341-2348. Pastor Jr, M., Morello-Frosch, R., & Sadd, J. L. (2006). Breathless: schools, air toxics, and environmental justice in California. *Policy Studies Journal*, *34*(3), 337-362.
[6] California Tribal Court-State Court Forum. (nd). Frequently Asked Questions: Indian Tribes and Tribal Communities in California. Retrieved from: https://courts.ca.gov/sites/default/files/courts/default/2024-08/tribalfaqs.pdf
[7] California Tribal Court-State Court Forum. (nd). Frequently Asked Questions: Indian Tribes and Tribal Communities in California. Retrieved from: https://courts.ca.gov/sites/default/files/courts/default/2024-08/tribalfaqs.pdf
[8] Johnston-Dodds, K. (2002). Early California Laws and Policies Related to California Indians. California Research Bureau Report. Retrieved from: https://digitalcommons.csumb.edu/hornbeck_usa_3_d/34/
[9] California Tribal Court-State Court Forum. (nd). Frequently Asked Questions: Indian Tribes and Tribal Communities in California. Retrieved from: https://courts.ca.gov/sites/default/files/courts/default/2024-08/tribalfaqs.pdf
[10] Johnston-Dodds, K. (2002). Early California Laws and Policies Related to California Indians. California Research Bureau Report. Retrieved from: https://digitalcommons.csumb.edu/hornbeck_usa_3_d/34/
[11] California Tribal Court-State Court Forum. (nd). Frequently Asked Questions: Indian Tribes and Tribal Communities in California. Retrieved from: https://courts.ca.gov/sites/default/files/courts/default/2024-08/tribalfaqs.pdf
[12] California Executive Order B-10-11 (2011). Retrieved from: https://archive.gov.ca.gov/archive/gov39/2011/09/19/news17223/index.html
[13] California Executive Order N-15-19 (2019). Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2019/06/6.18.19-Executive-Order.pdf
[14] Penchanga Band of Indians. (nd). California Treaties. Retrieved from: https://www.pechanga-nsn.gov/index.php/history/facts-or-myths/pechanga-history-fact-or-myth/california-treaties
[15] Davis, L. F., & Ramírez-Andreotta, M. D. (2021). Participatory research for environmental justice: a critical interpretive synthesis. *Environmental health perspectives*, *129*(2), 026001.
[16] Tri-Ethnic Center. (2014). Community Readiness Handbook.

[17] Giest, S., & Samuels, A. (2020). 'For good measure': data gaps in a big data world. *Policy Sciences*, *53*(3), 559-569.
[18] Garcia-Gonzales, D. A., Shonkoff, S. B., Hays, J., & Jerrett, M. (2019). Hazardous air pollutants associated with upstream oil and natural gas development: a critical synthesis of current peer-reviewed literature. *Annual review of public health*, *40*(1), 283-304.
[19] Garcia-Gonzales, D. A., Shonkoff, S. B., Hays, J., & Jerrett, M. (2019). Hazardous air pollutants associated with upstream oil and natural gas development: a critical synthesis of current peer-reviewed literature. *Annual review of public health*, *40*(1), 283-304.
[20] Ferrar, K. (2019). *Impact of a 2,500' Oil and Gas Well Setback in California [Press release]*.
[21] Shonkoff, S. B., Maddalena, R. L., Hays, J., Stringfellow, W., Wettstein, Z. S., Harrison, R., ... & Energy, P. H. (2015). Potential impacts of well stimulation on human health in California. *An Independent Scientific Assessment of Well Stimulation in California. California Council on Science and Technology, Sacramento, CA. Available at: http://ccst. us/publications*, *2*.
[22] González, R. (2019). The Spectrum of Community Engagement to Ownership.