



Smithsonian

SCIENCE
for Global Goals

BIODIVERSITY!

How can we balance the needs of people with the needs of other living things?



SUSTAINABLE DEVELOPMENT GOALS

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE**
HEALTH
POLICY
the interacademy partnership

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Biodiversity!

How can we balance the needs of people with the needs of other living things?
Community Research Guide

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Smithsonian Science Education Center

The Smithsonian Science Education Center (SSEC) is an education organization within the Smithsonian Institution. The SSEC's mission is to transform *K–12 Education Through Science™* in collaboration with communities across the globe. The SSEC promotes authentic, interactive, inquiry-based K–12 STEM teaching and learning; ensures diversity, equity, accessibility, and inclusion in K–12 STEM education; and advances STEM education for sustainable development. The SSEC achieves its goals by developing exemplary curriculum materials and digital resources; supporting the professional growth of K–12 teachers and school leaders; and conducting outreach programs through LASER (Leadership and Assistance for Science Education Reform) to help schools, school districts, state education agencies, and ministries of education throughout the world implement inquiry-based science education programs.

Smithsonian Institution

The Smithsonian Institution was created by an Act of Congress in 1846 “for the increase and diffusion of knowledge . . .” This independent federal establishment is the world’s largest museum, education, and research complex and is responsible for public and scholarly activities, exhibitions, and research projects nationwide and overseas. Among the objectives of the Smithsonian is the application of its unique resources to enhance elementary and secondary education.

Smithsonian Science for Global Goals (SSfGG) is a freely available curriculum developed by the Smithsonian Science Education Center (SSEC) in collaboration with the InterAcademy Partnership. It uses the United Nations Sustainable Development Goals (SDGs) as a framework to focus on sustainable actions that are student-defined and implemented.

Attempting to empower the next generation of decision-makers capable of making the right choices about the complex socio-scientific issues facing human society, **SSfGG** blends together previous practices in Inquiry-Based Science Education (IBSE), Social Studies Education (SSE), Global Citizenship Education (GCE), Social Emotional Learning (SEL), and Education for Sustainable Development (ESD).

Throughout the Smithsonian Science for Global Goals community research guides we have included quotes from many different individuals. These quotes represent the personal and professional perspectives of each individual and were not edited. We recognize that individuals have unique perspectives, experiences, ways of knowing, and expertise.



Thank You for Your Assistance



Thank You for Your Support

This project was supported by the **Gordon and Betty Moore Foundation** through Grant GBMF#9029 to the Smithsonian Science Education Center.



How can we balance the needs of people with the needs of other living things?

Part 1: What is a balanced community and how does it relate to me?

- Task 1: What is the problem?
- Task 2: How is the problem of balanced communities related to me?
- Task 3: What skills do we need to do our research?
- Task 4: Where do we notice the problem?
- Task 5: How will we achieve our goals?

Part 2: How can including people help create a balanced community?

- Task 1: Who is in our community?
- Task 2: How has our community changed over time?
- Task 3: Who makes decisions in our community?
- Task 4: How can including our community help us make better decisions?
- Task 5: How do we include the community in our actions?

Part 3: How can I balance the needs of people and other living things in my community?

- Task 1: What living things are in our research area?
- Task 2: What do the living things in our research area need to survive?
- Task 3: What do the people in our community need to survive?
- Task 4: What are the conflicts between people and other living things in my community?
- Task 5: How can I take action to balance needs in my community?



**Part 4:
How can I
balance the
needs of
people and
animals in my
community?**

- Task 1: What animals are in our research area?
- Task 2: What do the animals in our research area need to survive?
- Task 3: What are the conflicts between people and animals in my community?
- Task 4: What are people already doing to balance the needs of people and animals?
- Task 5: How can I take action to balance needs in my community?

**Part 5:
How can I
balance the
needs of
people and
plants in my
community?**

- Task 1: What plants are in our research area?
- Task 2: What do the plants in our research area need to survive?
- Task 3: What are the conflicts between people and plants in my community?
- Task 4: What are people already doing to balance the needs of people and plants?
- Task 5: How can I take action to balance needs in my community?

**Part 6:
How can I
balance the
needs of
people and soil
organisms of my
community?**

- Task 1: What soil organisms are in our research area?
- Task 2: What do the soil organisms in our research area need to survive?
- Task 3: What are the conflicts between people and soil organisms in my community?
- Task 4: What are people already doing to balance the needs of people and soil organisms?
- Task 5: How can I take action to balance needs in my community?

**Part 7:
How will we
act to help
create a
balanced
community?**

- Task 1: What is the problem we want to take action on in our community?
- Task 2: How will we try to solve our problem?
- Task 3: How will our team take action in our community?
- Task 4: Putting your plan into action
- Task 5: What did I learn?





Smithsonian

Science Education Center

Dear Parents, Caregivers, and Educators,

As a global community we face many challenges—biodiversity loss, climate change, pandemics. At times, these worldwide problems can seem overwhelming. We may ask ourselves questions about how to understand these complex problems and whether there's anything we can do to make them better. This community research guide encourages young people to discover, understand, and act on the answers to these questions.

In the years leading up to 2015, people around the world worked together to share their ideas about how our world should be. These ideas became a list of goals, the United Nations Sustainable Development Goals. The goals represent a plan for a sustainable world: a world where peaceful societies collaborate; a world where we live in balance with the environment of our planet; a world in which our economies fulfill our needs; a world that is fair to all.

As youth around the globe engage with the activities in this guide, they will gain an understanding of the science that underlies the Sustainable Development Goals—in particular, Goal 14: Life Below Water and Goal 15: Life on Land. They will be able to share their knowledge with their community, create tangible ways to help their community make informed decisions, and understand the best places to find additional information on the topics.

Throughout the guide, young people may find themselves asking many questions about the needs of people and other living things in their community and how they can play a role in helping balance those needs. You do not need to have the answers to any of these questions. The most important thing you can offer young people is the opportunity to question, investigate, think critically and systemically, synthesize, and act.

One of the best ways to ensure a sustainable planet is by arming yourself with knowledge and then using that knowledge to make a difference in the world. The same is true for young people. But young people may require support and guidance from you to put their new knowledge into context. Ask the young people around you how they are feeling and what they are thinking about as they learn this content. Validate the questions they ask you, even if they ask them repeatedly.

Throughout the world, everyone—even children—strive for healthy ecosystems, clean air and water, and a reduction in habitat loss, pollution, and overextraction of resources. Creating balance between the living things in communities can give us these things.

I am immensely grateful to the experts who helped to develop this guide—the InterAcademy Partnership (IAP), a collaboration of 140 national academies of sciences, engineering, and medicine; our colleagues across the Smithsonian Institution; and the external subject matter experts who contributed to this guide—for their perspectives and technical support in ensuring the science in this guide is accurate. I also want to say a special thank you to the author and developer of this guide, Logan Schmidt, for her tremendous expertise and understanding of science education and expertise in the life sciences, for her careful research and ability to translate complex ideas into meaningful content for youth, and for her thoughtful contributions to the *Smithsonian Science for Global Goals* project.



Working together—scientists, researchers, parents, caregivers, educators, youth—we can make a better world for all. This guide is a step toward that grand collaboration.

Thank you for partnering with us to inspire our youth to build a better world.

Best,



Dr. Carol O'Donnell, Director
Smithsonian Science Education Center



About this Community Research Guide

The goal of this guide is to prepare young people to take considered action on pressing global issues. Considered action means young people learn about a problem, connect it to the larger system, consider all the complexities of the problem, decide for themselves the best way to address it, and then execute a solution. Through this process young people are prepared not only to take considered action on a specific issue, but to build the skills to take action on all issues that affect them and their communities.

Learners use scientific and socio-scientific investigations to understand their local communities, scientific principles, and innovation possibilities. They then have a chance to immediately apply this information to make decisions that are informed by the results of their investigations. Along the way, young people are prompted to reflect, investigate, think critically, analyze, and build consensus. Engaging in these activities builds important skills of empowerment and agency, open-mindedness and reflection, equity and justice, and global-local interconnection. These sustainability mindsets prepare young people to take an active role in shaping the future of their communities and their world.



Figure 1: Sustainability Mindsets

A Framework to Discover, Understand, and Act

Throughout the guide, young people are prompted to Discover, Understand, and Act. The three parts of their learning journey are described here.

Discover

Young people already have a lot of information and opinions about the world around them. In this guide, they are prompted to use that knowledge as an entry point. They will discover what they already know and what questions they might have. They are encouraged to consider different perspectives and priorities. This both empowers young people and provides an immediate relevance and context for their investigations.

Understand

Gathering new information is a primary goal of science. Using a wide variety of methods to do so helps young people understand the problems related to balanced communities. They need to understand the problems both abstractly and within the context of their local community. Designing and conducting real-world investigations and interpreting results encourages young people to think like scientists.

Act

Finally, young people apply both their existing knowledge and their newly gathered information. First, they consider personal changes they could make to help make their communities more

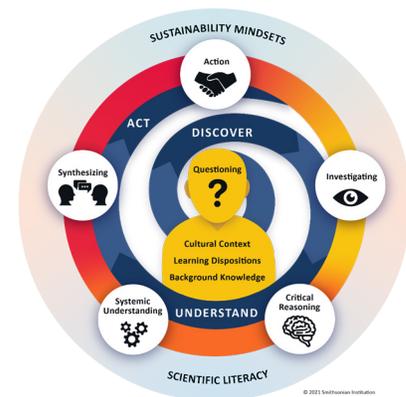


Figure 2: Global Goals Action Progression



balanced. Then, as a team, young people find consensus on what they *could* do, what they *should* do, and what they *will* do. Teams then take action and reflect on the consequences, both intended and unintended.

Pedagogy Shift

This guide may feel like a big shift from the standard method of teaching. The guide is:

Led by Young People

To make progress toward a better world, we need the ideas, enthusiasm, and energy of every young person. We need them to help design and build the world in which they want to live. This means throughout the guide young people make authentic decisions about what and how they will learn. Their goal is to understand issues in their own community and take sustainable actions to make their community and their world better.

Driven by Data Collected by Young People

In this guide, the young people you teach will become action researchers. They will gather information about what sustainable communities mean in their own local spaces. This includes scientific investigations and experiments to understand the problems better, and also using social science methods to understand their community better. Using science and social science helps young people arrive at a sustainable solution.

Focused on Action

The goal of the guide is to help young people not just learn but also do. Throughout the guide young people will conduct investigations and then use that knowledge to make decisions about the actions that would be best for their community. They will then put those decisions into practice and see the results of their actions.

Customized for Local Communities

Each community is unique. While the world has global problems, the solutions must work locally. Young people already have tremendous knowledge about their local community. This guide prompts them to use that knowledge and find out new information to drive actions toward local solutions that are sustainable in their community. This guide also helps young people understand that information is gained in many ways including formal science education, personal experience, and inter-generational conversations. Their local context determines what kind of information is available and valued. Young people are encouraged to consider multiple sources of knowledge or expertise while using the guide.

Structure of this Community Research Guide

Parts

This guide is made up of seven parts. Each part works with the others to help learners understand how to help create a balanced community and to put that knowledge to work by taking action.

However, we recognize that time is a limiting factor in many learning spaces. Therefore, the guide is designed flexibly so it can be shortened, if necessary. The learners are guided to do this shortening work themselves at the end of Part 1. The guide prompts learners to discuss with their teacher how much time is available and then make decisions about the best way to use that time.



Tasks

Within each part there are five tasks. Each task helps learners examine a different aspect of the topic they are exploring. Within each task, there are three activities, which correspond to the Discover, Understand, Act framework. Discover activities focus on existing learner knowledge. Understand activities focus on gathering new information. Act activities focus on analyzing and applying that new information to make decisions. Tasks also include perspectives and stories from experts around the globe, so students can connect with the work of real-world scientists.

Using this Guide

Roles

The Learner's Role

Learners are the decision-makers of the guide. They will decide what information they need and what the information they gather means. Then learners use that information to decide and implement actions.

The Teacher's Role

This guide may be challenging for learners, since they may be unfamiliar with their role. Learners may need assistance in deciding what to do. Support and help them, but do not decide for them. Be patient. There are no right answers to the big questions posed by the guide.

Adapting the Guide for Your Context

Different Ages

This guide is designed to be used with young people between the ages of 8 and 17. This large range is deliberate to give access to these ideas to as many young people as possible. If you teach learners who are on the younger end of the age range you may need to support them a little more. For example, you might need to:

- Explain more complex words or topics.
- Promote listening and tolerance in group discussions.
- Support group decision-making.
- Help them plan investigations in their community or accompany the teams on their investigations.
- Help learners think through the feasibility of the action they plan.
- Present alternate ways of capturing ideas. For example if the guide suggests that learners write, but that is too difficult or is inappropriate for your learners, they can always draw, act out, or just talk about their ideas.

If you teach learners who are on the older end of the age range the language of the guide might seem a little simple. However, older learners who can understand more complex ideas will be able to develop a more nuanced view of the problem and come up with more extensive solutions.

All young people should be able to engage with the guide in a way that is developmentally appropriate for them.



Different Resources

We have assumed that you have very basic classroom resources, such as a class board (blackboard or whiteboard), paper, and pens/pencils. If it is not possible to capture learner writing, you can always have learners act out or discuss their ideas. If you do not have the capacity to print out a Community Research Guide for each learner, you or learner leaders can read the guide out loud from a single print or digital copy.

Accessibility

This guide is designed to be widely accessible. The language, tone, and format attempt to be as inclusive as possible to reach learners with a wide variety of learning styles. However, learners with specific needs may need teacher support. As mentioned earlier, the guide activities can always be adapted to fit learner abilities, either by you or by the students themselves.

Extensions

For each part and many tasks there are additional activities, videos, and resources available digitally. They can all be found at the *Biodiversity!* storymap at <https://bit.ly/3zvJ2Qh>.

Teams

Much of the research, decision-making, and acting is designed to be done in teams. However, these teams can range in size from a group of two or three learners to the whole class. As a teacher, this is something to consider before beginning the Community Research Guide.

If you have motivated and responsible learners who need minimal teacher support, you may want to break your class into small teams. Smaller teams will allow individual learners to share their opinions and have more of an impact on team decision-making. With smaller teams, the experience can be more customized to the interests of the individual learner because there are fewer interests represented.

If you have learners who need more support, you may need to keep the class together in one team or have one team for each adult in the class. If you have only one team per adult, an adult can help support learners directly while they are engaging in activities such as conducting investigations and making decisions. However, because the team is larger, individual learners will have less of a voice in decision-making and less impact on group actions.

Alternately, if you have a group of learners with mixed abilities, you can design groups that bring together learners with different strengths. These types of groups can help learners support one another rather than immediately turning to an adult for support.

If you are uncertain whether a small or large group is most appropriate for your learners, you may want to wait and observe them during Task 1. In Task 1 in the Understand activity, learners break into groups and conduct investigations. If learners are able to complete this task independently with fairly limited teacher support, they would probably be successful in a small group. If learners need a great deal of help to complete this activity, you may want to structure group size so they can have more focused adult support throughout the Community Research Guide.



Getting Started

We recommend you give the young people you work with the Student Letter to read. You also may find it useful to read through each part of the Community Research Guide in its entirety before beginning that part. We suggest you encourage your learners to be excited about this new learning adventure. Be prepared to be enthusiastic about their ideas.



Student Letter

Dear Student,

This is the last time you will be called a student in this Community Research Guide. Instead, you will take on a new role as an action researcher. Action researchers are interested in figuring out what to do to make their communities better. They use scientific investigations to help understand the natural world around them. They use social science investigations to help understand the people, cultures, and history of their communities. Then they use the information they gather to help solve problems in their own communities. This guide will help you learn more about this process. The most important thing to know is that you will control your own research and make your own decisions.

Think back to a time when you solved a problem. You first needed to know what you wanted, your goal. Then you needed to figure out what you needed to do to achieve your goal. This guide is similar. You will think about goals you have for your local community, then figure out what you need to take action to help reach those goals.

You and your classmates will work as a team to think about information you already have about the place where you live. Then you will investigate your local community and how things work. Finally, your team will decide how to make things better. Together you will put your decision into action. Sometimes, making decisions about what to do is difficult. Don't worry, this guide will give you lots of support.

How to Use this Guide

This guide is designed to help you explore and think about problems in your community. The guide is here to help you. That means you can always change it.

Adapting the Guide

You will notice that in this guide there are often suggestions of different ways of sharing your ideas or doing investigations. This is because different people think and work best in different ways. For example, some people like to draw, some people like to talk out loud, and some people prefer to write to express their ideas. This guide has suggestions, but you can always change the method suggested. You can share your ideas using discussions, acting, signing, telling stories, recording your voice, writing by



hand, typing on a computer, drawing, or another way you choose. Think about the way you and your team learn best together. Including everyone on the team is important.

Safety Tips

This guide asks you to do and think about things that may seem unfamiliar. You will notice physical and emotional safety tips in the guide. These will help you stay safe and supported during the activities. Make sure you follow your teacher's directions about staying safe.

Guide Structure

There are seven parts in this guide. Each part has five tasks. Each task has three activities. The activities are called **Discover**, **Understand**, and **Act**. In the **Discover** activities you will focus on thinking about information that you and your team already know. In the **Understand** activities you will investigate to find out new information. In the **Act** activities you will put your existing and new knowledge into action by applying it and making decisions. Words that may be unfamiliar will be in **bold** the first time they are used. Then at the end of each part a glossary lists the definitions of these words.

Investigations

You are the one doing the research in this guide. This means often you will develop your own questions and determine the best way to answer them. Developing and answering questions is how scientists find out new information about the world around them. As an action researcher, you need to think like a scientist to discover what you need to know, investigate to find out more information, and think about the meaning of what you found out.

Keeping Organized

In this guide you will have some papers you will need to keep so you can look at them later. You may want to have a folder, notebook, or scientific journal to help you stay organized.



Teams

You will be working with other classmates as part of a research team. Your team will conduct investigations and make decisions together. When conducting research, there may be many things to figure out as a team. You will need to be creative. There will not always be a clear right and wrong answer. Sometimes the team might not agree. This is okay. Just make sure to respect your teammates. There is no one right answer to the problems faced by your community. There is just the right answer for you and your team.

Getting Started

You will be thinking about complex problems. Sometimes this can feel difficult. Be patient. You will be guided to consider different parts of the problem. By the time you are making big decisions, you should have lots of information. Always remember, your work is important. Decisions you make can change your community. You are an important part of making your local and global communities better.

Thank you for working to make your community better.

The Smithsonian Science for Global Goals team

Smithsonian Science Education Center

Smithsonian Institution



Guide Planner

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What is the problem?					
Discover	Explore the concept of how you meet your needs using your class as an example.	<ul style="list-style-type: none"> Paper Pens or pencils 		10 minutes	7
Understand	Explore the living things in your community.	<ul style="list-style-type: none"> Paper Pens or pencils Class board or poster paper 		45 minutes + investigation time	8
Act	Imagine a perfect community.	<ul style="list-style-type: none"> Paper Pens or pencils 		10 minutes	11
Task 2: How is the problem of balanced communities related to me?					
Discover	Develop a personal identity map showing the different parts of who you are. Compare with teammates.	<ul style="list-style-type: none"> Paper Pens or pencils Objects that represent you (optional) 		25 minutes	13
Understand	Create a team identity map.	<ul style="list-style-type: none"> Paper Pens or pencils 		15 minutes	15
Act	Gather your team's knowledge about the living things in your community.	<ul style="list-style-type: none"> Paper Pens or pencils Class board or poster paper 		20 minutes	17
Task 3: What skills do we need to do our research?					
Discover	Interview teammates to find out about their ideas about a perfect community.	<ul style="list-style-type: none"> Pens or pencils Paper (optional) 	<u>My Perfect Community</u> (Task 1) <u>My Identity Map</u> (Task 2)	20 minutes	19
Understand	Explore different perspectives on what makes a perfect community.			25 minutes	21



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Act	Come to consensus on the most important goals for your local community.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Class board or poster paper 	<u>My Perfect Community</u> (Task 1)	25 minutes	22
Task 4: Where do we notice the problem?					
Discover	Consider connections between problems and knowledge in different places.			20 minutes	26
Understand	Investigate how the UN Sustainable Development Goals connect to the Balanced Community Goals you developed.	<ul style="list-style-type: none"> • Class board or poster paper • Sticky notes (optional) • Bag of small items (Option B: Activity) 	<u>Balanced Community Goals</u> (Task 3) * StoryMap extension available	30 minutes	28
Act	Decide where your research area will be.	<ul style="list-style-type: none"> • Paper • Pencils • Local map (optional) 		20 minutes	33
Task 5: How will we achieve our goals?					
Discover	Consider what you already know about your community and what you need to find out.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Class board or poster paper 	<u>Balanced Community Goals</u> (Task 3)	20 minutes	37
Understand	Decide which Parts of the guide you will use.			20 minutes	38
Act	Reflect on your thoughts and concerns about being an action researcher.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		15 minutes	41

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

<u>Activity</u>	<u>Description</u>	<u>Materials and Technology</u>	<u>Additional Materials</u>	<u>Approximate Timing</u>	<u>Page Number</u>
Task 1: Who is in our community?					
Discover	Consider the different identities in your community and why inclusion is important.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Identity Map</u> (Part 1, Task 2) <u>Team Identity Map</u> (Part 1, Task 2)	15 minutes	55
Understand	Use a survey or other investigation to find out more about the people in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 		35 minutes + investigation time	56
Act	Create an identity map of the people in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Community Identity Map</u>	20 minutes	65
Task 2: How has our community changed over time?					
Discover	Read a case study about changes in a community. Then, reflect on and record changes you and your team have noticed in your own community.	<ul style="list-style-type: none"> • Class board or poster paper • Audio or video recording device 		60 minutes	67
Understand	Record oral histories from community members.	<ul style="list-style-type: none"> • Audio or video recording device • Paper and Pen 		25 minutes + investigation time	72
Act	Create a representation of your community's history.	Optional: <ul style="list-style-type: none"> • Computer, paper, pen 		25 minutes	76



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: Who makes decisions in our community?					
Discover	Explore decision-making in your community. Then, read a case study about decision making in a community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Identity Map</u> (Part 1, Task 2)	30 minutes	79
Understand	Collect information about how decisions are made in your community.			25 minutes + investigation time	83
Act	Record how decisions are made in your community and how that could be more inclusive.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Perfect Community</u> (Part 1, Task 1)	20 minutes	84
Task 4: How can including our community help us make better decisions?					
Discover	Read a case study about inclusion and design a shared community space to fill your own needs.	<ul style="list-style-type: none"> • Paper • Colored pencils 	<u>My Identity Map</u> (Part 1, Task 2)	25 minutes	87
Understand	Experiment to find out whether including different people changes decision-making.	<ul style="list-style-type: none"> • Class board or poster paper • Paper • Pens or pencils 		45 minutes	89
Act	Analyze experiment results and decide how you want to make decisions	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	20 minutes	92



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How do we include the community in our actions?					
Discover	Consider what you now know, think, and wonder about your local community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Community Identity Map</u> (Task 1)	10 minutes	94
Understand	Investigate the best way to share information with your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes + investigation time	95
Act	Share and get feedback on your Balanced Community Goals.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	30 minutes	97

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



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Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What living things are in our research area?					
Discover	Consider the living things in your community and the senses you use to observe them.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 	<u>Living Things Identity Map</u> (Part 1, Task 2)	20 minutes	112
Understand	Use tools to investigate what living things are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 	<u>My Research Area map</u> (Part 1, Task 4) *StoryMap extension available	20 minutes + investigation time	115
Act	Classify living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 	*StoryMap extension available	30 minutes	119
Task 2: What do the living things in our research area need to survive?					
Discover	Discuss with your team what the living things in your research area might need to survive	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1)	15 minutes	123
Understand	Investigate the different needs of the living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • 3 plants • Soil • 3 plastic cups • Water 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Oral History Instructions</u> (Part 2, Task 2), optional	45 minutes	124
Act	Share the different needs of living things in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2) <u>Balanced Community Goals</u> (Part 1, Task 3)	25 minutes	127



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What do the people in our community need to survive?					
Discover	Identify what you need and how you meet those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	129
Understand	Investigate the needs and wants of the people living in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Photos of research area (optional, Investigation D) 	<u>Survey Instructions</u> (Part 2, Task 2), optional <u>My Research Area map</u> (Part 1, Task 4), optional	30 minutes + investigation time	130
Act	Share your communities needs and wants.	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	25 minutes	132
Task 4: What are the conflicts between people and other living things in my community?					
Discover	Examine conflicts from various perspectives.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 		25 minutes	134
Understand	Explore a case study about conflict between people and living things.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		30 minutes	136
Act	Identify some conflicts between people and other living things in your community.	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Part 3 Organizer</u> (Task 1)	30 minutes	140



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	143
Understand	Decide on individual actions you will take to help your community.		<u>Part 3 Organizer</u> (Task 1)	15 minutes	144
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	146

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



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<u>Activity</u>	<u>Description</u>	<u>Materials and Technology</u>	<u>Additional Materials</u>	<u>Approximate Timing</u>	<u>Page Number</u>
Task 1: What animals are in our research area?					
Discover	Consider the animals in your community and the senses you use to observe them.		<u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	158
Understand	Use tools to investigate what animals are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation tools 	<u>My Research Area</u> (Part 1, Task 4, Act) <u>Investigation Tips</u> (Part 3, Task 1) *StoryMap extension available	20 minutes + investigation time	161
Act	Classify the animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	167
Task 2: What do the animals in our research area need to survive?					
Discover	Discuss how you use space to meet your needs.			15 minutes	170
Understand	Investigate the different needs of the animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 4 Organizer</u> (Part 4, Task 1) <u>Oral History Instructions</u> (Part 2, Task 2, optional)	20 minutes + investigation time	172
Act	Share the different needs of animals in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	25 minutes	174



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and animals in my community?					
Discover	Explore conflicts between people and animals.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		30 minutes	176
Understand	Investigate conflicts between people and animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		15 minutes + investigation time	179
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	30 minutes	180
Task 4: What are people already doing to balance the needs of people and animals?					
Discover	Consider different perspectives on conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	20 minutes	182
Understand	Investigate one conflict from your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	25 minutes	184
Act	Begin to consider an action you could take to solve conflict in your community.			15 minutes	185
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	188
Understand	Decide on individual actions you will take to help your community.		<u>Part 4 Organizer</u> (Task 1)	15 minutes	189
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	191

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<u>Activity</u>	<u>Description</u>	<u>Materials and Technology</u>	<u>Additional Materials</u>	<u>Approximate Timing</u>	<u>Page Number</u>
Task 1: What plants are in our research area?					
Discover	Consider the plants in your community and the senses you use to observe them.		<u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	206
Understand	Use tools to investigate what plants are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation tools 	<u>My Research Area</u> (Part 1, Task 4, Act) <u>Investigation Tips</u> (Part 3, Task 1) *StoryMap extension available	20 minutes + investigation time	210
Act	Classify plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	217
Task 2: What do the plants in our research area need to survive?					
Discover	Reflect on how your identify and experiences relate to plants.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Identity Map</u> (Part 1, Task 2)	15 minutes	222
Understand	Investigate the different needs of the plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Books (optional) • Computer (optional) 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 5 Organizer</u> (Task 1)	20 minutes + investigation time	223
Act	Share the different needs of plants in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1)	20 minutes	226



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and plants in my community?					
Discover	Explore conflicts between people and plants.	<ul style="list-style-type: none"> • Paper • Pens or pencils • 3 Cups or containers of soil (optional) • Vegetable seeds (optional) • Water (optional) • Salt (optional) 		10 minutes + investigation time	228
Understand	Investigate conflicts between people and plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 5 Organizer</u> (Task 1)	10 minutes + Investigation time	232
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	235
Task 4: What are people already doing to balance the needs of people and plants?					
Discover	Consider different perspectives on conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1)	20 minutes	236
Understand	Investigate one conflict from your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2)	25 minutes	237
Act	Begin to consider an action you could take to solve conflict in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	239



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	241
Understand	Decide on individual actions you will take to help your community.		<u>Part 5 Organizer</u> (Task 1)	15 minutes	242
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	244

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Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

<u>Activity</u>	<u>Description</u>	<u>Materials and Technology</u>	<u>Additional Materials</u>	<u>Approximate Timing</u>	<u>Page Number</u>
Task 1: What soil organisms are in our research area?					
Discover	Consider the soil organisms in your community and the senses you use to observe them.		<u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	259
Understand	Use tools to investigate what soil organisms are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation tools 	<u>My Research Area</u> (Part 1, Task 4, Act) <u>Investigation Tips</u> (Part 3, Task 1) *StoryMap extension available	20 minutes + investigation time	262
Act	Classify the soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	272
Task 2: What do the soil organisms in our research area need to survive?					
Discover	Reflect on your experiences and how they relate to soil organisms.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		10 minutes	276
Understand	Investigate how the soil organisms in your research area meet their needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Books (optional) • Computer (optional) 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 6 Organizer</u> (Task 1)	25 minutes + investigation time	277
Act	Share how soil organisms in your community get what they need to survive and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1)	20 minutes	281



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and soil organisms in my community?					
Discover	Explore conflicts between people and soil organisms.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		10 minutes	282
Understand	Investigate conflicts between people and soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation materials 		20 minutes + investigation time	283
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1)	30 minutes	290
Task 4: What are people already doing to balance the needs of people and soil organisms?					
Discover	Reflect on your thoughts and feelings about conflicts between people and soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1) <u>My Identity Map</u> (Part 1, Task 2)	10 minutes	292
Understand	Explore what people in your community are doing about one conflict between people and living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2)	20 minutes + investigation time	294
Act	Prepare what you need to take action that will solve a conflict between people and plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	295



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	298
Understand	Decide on individual actions you will take to help your community.		<u>Part 6 Organizer</u> (Task 1)	15 minutes	299
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	301

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What is the problem we want to take action on in our community?					
Discover	Explore ways in which your community is doing well and ways in which it could be doing better.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 2, 3, 4, 5, 6 Organizers</u> (from Task 1 in each Part)	30 minutes	314
Understand	Report on problems in your community and consider the connections between the root causes of these problems.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Connected Problems</u> (Task 1)	25 minutes	316
Act	Come to a team consensus about which community problem you want to take action on.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3) <u>Connected Problems</u> (Task 1)	25 minutes	319
Task 2: How will we try to solve our problem?					
Discover	Imagine different actions you could take to help address your team problem.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 2, 3, 4, 5, 6 Organizers</u> (from Task 1 in each Part)	25 minutes	322
Understand	Explore ways your possible actions could be more sustainable.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Team Action Plan</u> (Task 2) <u>Community Identity Map</u> (Part 2, Task 1)	20 minutes + investigation time	324
Act	Come to a team consensus on which action you will take.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	20 minutes	326



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: How will our team take action in our community?					
Discover	List the steps needed for your action.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Community Communication</u> (Part 2, Task 5)	20 minutes	328
Understand	Organize the action steps.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	329
Act	Create an inclusive team action plan.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Team Action Plan</u> (Task 2)	25 minutes	330
Task 4: Putting your plan into action					
Task 4	Put your plan into action!	<ul style="list-style-type: none"> • Varies, depends on action plan 		Varies, depends on action plan	332
Task 5: What did I learn?					
Task 5	Reflect on your action and your feelings.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Feelings</u> (Part 1, Task 5) <u>Team Identity Map</u> (Part 1, Task 2)	15 minutes	333

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BIODIVERSITY!



Part 1:

**What is
a balanced
community and
how does it
relate to me?**

**SUSTAINABLE
DEVELOPMENT GOALS**

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE
HEALTH
POLICY**
the interacademy partnership

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PART 1: WHAT IS A BALANCED COMMUNITY AND HOW DOES IT RELATE TO ME?

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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What is the problem?					
Discover	Explore the concept of how you meet your needs using your class as an example.	<ul style="list-style-type: none"> Paper Pens or pencils 		10 minutes	7
Understand	Explore the living things in your community.	<ul style="list-style-type: none"> Paper Pens or pencils Class board or poster paper 		45 minutes + investigation time	8
Act	Imagine a perfect community.	<ul style="list-style-type: none"> Paper Pens or pencils 		10 minutes	11
Task 2: How is the problem of balanced communities related to me?					
Discover	Develop a personal identity map showing the different parts of who you are. Compare with teammates.	<ul style="list-style-type: none"> Paper Pens or pencils Objects that represent you (optional) 		25 minutes	13
Understand	Create a team identity map.	<ul style="list-style-type: none"> Paper Pens or pencils 		15 minutes	15
Act	Gather your team's knowledge about the living things in your community.	<ul style="list-style-type: none"> Paper Pens or pencils Class board or poster paper 		20 minutes	17
Task 3: What skills do we need to do our research?					
Discover	Interview teammates to find out about their ideas about a perfect community.	<ul style="list-style-type: none"> Pens or pencils Paper (optional) 	<u>My Perfect Community</u> (Task 1) <u>My Identity Map</u> (Task 2)	20 minutes	19
Understand	Explore different perspectives on what makes a perfect community.			25 minutes	21
Act	Come to consensus on the most important goals for your local community.	<ul style="list-style-type: none"> Paper Pens or pencils Class board or poster paper 	<u>My Perfect Community</u> (Task 1)	25 minutes	22



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 4: Where do we notice the problem?					
Discover	Consider connections between problems and knowledge in different places.			20 minutes	26
Understand	Investigate how the UN Sustainable Development Goals connect to the Balanced Community Goals you developed.	<ul style="list-style-type: none"> • Class board or poster paper • Sticky notes (optional) • Bag of small items (Option B: Activity) 	<u>Balanced Community Goals</u> (Task 3) * StoryMap extension available	30 minutes	28
Act	Decide where your research area will be.	<ul style="list-style-type: none"> • Paper • Pencils • Local map (optional) 		20 minutes	33
Task 5: How will we achieve our goals?					
Discover	Consider what you already know about your community and what you need to find out.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Class board or poster paper 	<u>Balanced Community Goals</u> (Task 3)	20 minutes	37
Understand	Decide which Parts of the guide you will use.			20 minutes	38
Act	Reflect on your thoughts and concerns about being an action researcher.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		15 minutes	41

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



1

Part 1: What is a balanced community and how does it relate to me?

Remember: In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.

Task 1: What is the problem?

In this guide you will become an **action researcher** to identify and help solve problems in your **community**. The knowledge you have as a member of your community is an important place to start. First, you will **discover** what you already know in your community. Action researchers also use the tools of science and **social science** to understand the world around them. You will **investigate** to **understand** your community better. After thinking about all the information they know, action researchers **act** on what they have learned to improve their communities. In this guide you and your team are in charge. Your ideas and your investigations will help you decide the actions you will take in your community.

Ready? Let's get started.



Discover: *What do I need?*

We all are part of different groups. These groups are sometimes called communities. This guide will help you create a better community. As part of your action research in this guide you are going to explore how you use your community to meet your needs. You will also explore how the other living things in your community meet their needs. You will start by exploring the community in your classroom.

1. You are going to complete a quick activity. Think to yourself about what you need most in the classroom to help you learn. If you don't want to think about your classroom, you can go to another space that you and your classmates share such as a park, playground, or community center.



2. Action researchers also make careful **observations**. To **observe** means to use your senses to get information about something. This is an important step in science. Practice making observations. For example, you could look closely at the things and people around your classroom.
3. Gather together as a class. When your teacher says, “What do you need the most to learn?” move to, point to, write down, or say aloud the thing or part of the classroom that you need the most to help you learn.
4. Discuss the following questions as a class:
 - a. How does the thing or part that you picked help you learn?
 - b. Did anyone choose the same thing that you did?
 - c. What happens if two people need the same thing? How could you decide who gets to use it?
5. You may have noticed that more than one person picked the same thing. For example, two classmates might have picked the same art supplies or the same space to sit. Sometimes the people in a classroom need the same thing. They might be able to share it, like the art supplies. But sometimes it is much harder to share, like the space to sit. Only one classmate can sit there at the same time. Think about how easy or difficult it is to share things as you finish the rest of this Task.



Understand: *What do I think, notice, and wonder about living things in my community?*

You just explored your classroom community and found out what you and your classmates need. But you also live in a bigger community outside of your classroom. This community is made up of all the living things around you. This community includes living things you might be able to easily observe, like **plants, fungi,** and **animals**. It also includes living things that are harder to observe, such as **bacteria**. This collection of different living things is called **biodiversity**. “Bio” means “living.” “Diversity” means “different things.” As an action researcher, you will work with your class to find out more about what the living things in your community need.



1. Pick a place in your community where you can find out more about living things. You will need to go outside. You could explore your schoolyard, a garden, your street, or a park.
2. Bring something with you to record what you find out.

**Physical Safety Tip**

Always bring others when you go into your community. Talk to your teacher to make sure that your plan is safe and comfortable for everyone on your team. You can bring an adult with you if you would like.

3. As you move around outside, what living things do you see or notice? Pick one of those living things to find out more information about. It is okay if you don't know the name of the living thing. You can make up your own name for it or ask an adult for help naming it.
4. Do a "Notice, Think, Wonder" activity with the living thing you have picked.
5. First, you will "Notice."
 - a. Observe the living thing for several minutes if you can. To observe means to use your senses to get information about something. This is an important step in science. You can look, listen, or smell. It is best not to touch living things unless an adult says it is safe. Do not use your sense of taste to observe any living thing in your community.
 - b. Record what you notice.
6. Next, you will "Think." Use the following questions to help you and remember to record your answers:
 - a. What do you think this living thing needs to live? For example, what do you think it eats? Where does it live? How does it get water?
 - b. Do you notice any other living things near it that might need the same things?
 - c. Record your answers.
7. Now you will "Wonder."
 - a. What do you still want to know about this living thing?
 - b. Record your answers.



8. Gather with your classmates after everyone has finished finding out more about their living thing.
9. Place three large pieces of paper around the classroom. Write “Animals” on one piece of paper, “Plants” on another, and “Fungi and Bacteria” on the last one. Leave space for people to add their information.
 - a. The first paper says, “Animals.” Animals are living things that are able to move and eat other things for energy. Whales, insects, sea stars, people, and lizards are examples of animals.
 - b. The second paper says, “Plants.” Plants are living things that do not move on their own and make their own energy using water, carbon dioxide, and sunlight. Trees, seagrasses, and mosses are examples of plants.
 - c. The third paper says, “Fungi and Bacteria.” Fungi are living things that get energy by breaking down, or decomposing, living or dead things. Mushrooms, yeast, and mold are examples of fungi. Bacteria are living things that are very tiny and only have one cell. You cannot easily see a single bacterium without a microscope. You probably didn’t notice bacteria this time, but you will learn more about them later.
10. Read *Biodiversity on Earth* for more information about the kinds of living things you are going to observe in this guide.

Biodiversity on Earth

Your investigations in this guide are going to focus on animals, plants, fungi, and bacteria. These are not the only kinds of living things on Earth. There are some living things that do not fall into these groups. For example, a slime mold is an organism that hasn’t been grouped with animals, plants, fungi, or bacteria!

To keep things a little more simple for you, this guide is only going to focus on animals, plants, fungi, and bacteria. But if you find a living thing in your community that is not an animal, plant, fungus, or bacterium, you can still observe it!



11. Add your information to the matching piece of paper.
 - a. Write the name of the living thing you found out more information about.
 - b. Then add what you recorded in "Think."
12. Give everyone in the class time to record their own answers.
13. Read what they wrote.
14. Now think quietly to yourself.
 - a. Did you notice that some of the living things have the same needs? For example, do they share the same space or eat the same things?
 - b. What kinds of living things did your classmates observe most often?
 - c. Why do you think that some living things get noticed more than others? Does that mean they are more important?
15. Turn to a partner and answer the following questions. It is okay if you feel like you don't know the right answer. You are going to find out more in the rest of the guide.
 - a. What did you notice that living things needed? Do you also need some of those things?
 - b. How easy or hard do you think it is for people and living things to share what they need?



Act: *What is included in a balanced community?*

Action researchers apply what they learn to make their local communities better. Your community includes you and the other people that live there. It also includes other living things such as bacteria, fungi, plants, and other kinds of animals. All the living things in a community need things to help them live. Sometimes those needs overlap.

You will use this guide to explore what the people and other living things in your community need. Then you will take action to help balance the needs of everything in your community. Having a balanced community means the community can support many different kinds of living things.



1. Take out a piece of paper and title it *My Perfect Community*. In this guide you will be investigating how the needs of people and other living things are met in your community. This will help you find out information about what is going on in your local community right now. You will also need to think about what you believe *should* be happening in your local community. The difference between what *is* happening and what *should* be happening is where you can help when you take action.
2. Start to imagine how you think a community should be. Don't worry, we know life is not always perfect. Right now, it is time to dream.
3. Write or draw some ideas about your perfect community. If you would like to record this information in a different way, you can do that. Just make sure you can save it and use it later. You can use some or all of these questions to help you think.
 - a. What needs do you have that would be met in a perfect community?
 - b. What wants do you have that would be met in a perfect community?
 - c. What living things would be part of a perfect community?
 - d. What do you think you would see or notice in a perfect community?
 - e. What would you not see or notice in a perfect community?
 - f. How would you expect to feel in a perfect community?
4. Keep the *My Perfect Community* paper. You will be using it later.



Task 2: How is the problem of balanced communities related to me?

Action researchers need to **discover** their own **identities** and opinions. Then **understand** other people's identities and opinions. Finally, when you **act**, you can use that information to make decisions that are good for everyone. In this task you will think about how identities relate to goals for your community.



Discover: *Who am I?*

You may have noticed during Task 1 that some of your classmates had different ideas than you. Our different experiences, backgrounds, and ideas give each of us a unique identity. Your identity is what makes you you. Our different identities often lead to different **perspectives**. Perspectives are the way we think about the world around us. Understanding your own identity and perspective can help you understand other perspectives. This activity will help you think about your own identity.

1. Take out a piece of paper and title it *My Identity Map*. If you prefer you can make an identity map using objects or digital tools. There are more details on how to do that in step 6.
2. On the paper, write your name in the center of the page, or draw a small picture of yourself.
3. Draw a circle around your name or picture.
4. Answer the question "Who am I?" or "What describes me?" The following list can give you some ideas to consider. You can also include things that are not on the list. Record anything you can think of that is important to who you are.
 - a. Age
 - b. School or class
 - c. Race and/or ethnicity
 - d. Gender
 - e. Country or place where you live
 - f. Country or place that is important to you or your family
 - g. Topics or subjects that interest you



- h. Hobbies or things you like to do for fun
 - i. Physical traits (such as tall, black hair, blue eyes, wears glasses)
 - j. Personality traits (such as loud, funny, sad, kind)
 - k. Roles you have in your household (such as big sister, helper, cousin)
 - l. Groups you belong to
5. Write each answer on the page around your name. Draw a line between your name and each answer. Figure 1.1 is an example of a written identity map. You can put your answers at the end of each line.

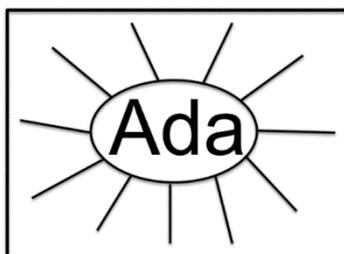


Figure 1.1: Example of a written identity map

6. If you don't prefer, you can use objects around your home to create your map. To keep your map, you can take a picture, or just remember it. Figure 1.2 is an example of an identity map using objects. You could also make a digital map using recordings or photos.



Figure 1.2: Example of an identity map using objects

7. Now form a team. You will be working with your team for the rest of this guide. You already know you are an action researcher while you are using this guide. You will also be part of a research team made up of your classmates. Using scientific tools,



you will work together to understand your community and make it better. Your team may be your whole class, or it may be a smaller group. Either is fine.

8. Find out what you have in common with your team. Try to find matching identities with your teammates. For example, if you like to read for fun, see if you can find someone else who likes to read for fun. Find a few matching identities. Then move on to the next step.

Emotional Safety Tip

Sharing your identity with someone else can help build trust between you and that person. But it can be hard to share your personal identity with someone else. Only share parts of your identity map that you feel comfortable talking about.

9. Now try to find teammates who have different identities than you. It is good to have different identities. Everyone is unique. This means you have different information to share. For example, if you were born in the place where you live, but your teammate was born somewhere else, you both may know different things. Find a few people who have different identities than you. Then return to your place.
10. As a team, discuss:
 - a. How did you feel when you found teammates with matching identities?
 - b. How did you feel when you found teammates with different identities?
 - c. What could you find out from your teammates who had different identities?



Understand: *Who is on my team?*

You just made an identity map that shows who you are personally. Your research team also has an identity that includes all the members of the team. In this activity, you will build a team identity map. Sometimes there are differences between your personal and team identities. These differences may affect the decisions you or the team make. For example, you may love listening to a certain kind of music. However, your



teammates might love another kind of music. Imagine you were deciding what kind of music to play. It would be important to have all the information when you make a decision. Your team may have many different perspectives. This is because you have many different identities. Different perspectives help you make better decisions.

1. Think about your identity map. What are some things that make you unique? Circle one item that may help you bring new information to your team.
2. You will have many discussions with your team as you work through this guide. Read through *Guidelines for Team Discussion*. Use these during your team discussions. You may notice *Guidelines for Team Discussion* is in a blue box. Blue boxes contain information or investigation instructions.

Guidelines for Team Discussion

- Remember, listening to many different perspectives and viewpoints is good.
- Open yourself to new ideas and perspectives.
- Actively listen by facing the person and show them you are paying attention.
- Collaborate with others to change things for the better.

3. Have the team leader take a piece of paper and title it *Team Identity Map*, or write it on the board. Write the word “Team” at the top and circle it. You can look at Figure 1.1 for an example.
4. The team leader will start by sharing the one item they circled about their identity from the Discover activity. They will also share why they circled this item.
5. The team leader will write their item on the *Team Identity Map*, just as you did on your *My Identity Map* in the last activity.
6. Then the team leader will ask another team member to share. The next team member should share their name and the item they circled from the Discover activity. They should also share why they circled this item. Write this item on the *Team Identity Map*.
7. Repeat until all members of the team have shared and added one item to the *Team Identity Map*.



8. Discuss the following questions with your team.
 - a. How is your personal identity map like the team map? How are these two maps different?
 - b. Does including everyone's identity on the Team Identity Map help everyone feel part of the team? What would it feel like if only some people were included?
 - c. Why should we care about the identity of other people on the team?
9. Save the Team Identity Map by keeping the paper in a safe place or taking a picture of the board.



Act: *What is the identity of my community?*

In the last activity, you completed an identity map for your research team. This map helped you find out what was important to your teammates. Thinking about the ideas and opinions of others helps you make good decisions. You are also part of a bigger team, the team of living things in your community. These living things include people, animals, plants, fungi, and bacteria. This community of living things shares space and resources. It is important to know what living things are in your community because that will help you make decisions as you finish the rest of this guide.

1. Pick one person on the team to lead the discussion. Remember to use the Guidelines for Team Discussion from the previous activity.
2. Have the team leader take a piece of paper and title it Living Things Identity Map, or write it on the board. Write "Living Things" at the top and circle it. You can look at Figure 1.1 for an example.
3. The team leader will start by sharing the name of the living thing they observed in Task 1. They can share what they found out about what that living thing needs. They can share what they think that living thing adds to the community.
4. The team leader will write the name of that living thing on the Living Things Identity Map, just like you did in the Team Identity Map in the last activity.
5. Then the team leader will ask another team member to share. The next team member should share the name of the living thing they observed in Task 1. They should also share what they found out about what that living thing needs.



6. Write this information on the Living Things Identity Map.
7. Repeat until all members of the team have shared and added one item to the Living Things Identity Map. Don't forget to add people to your Living Things Identity Map.
8. Notice that your community is made up of many living things. These living things have different needs and add different things to the community.
9. Keep this identity map in a safe place. You can add to it anytime you learn something new about the living things in your community. You can also use it to help you make decisions as you finish the rest of the guide.



Task 3: What skills do we need to do our research?

Action researchers use information to make decisions. In this task you find out information about different opinions in your community. This will help you understand how to help your community. You will **discover** the opinions of your team. Then you will **understand** different types of perspectives. Finally, you will **act** on this information to decide what is important to make a balanced community.



Discover: *What do I want for my community?*

Discovering what your teammates and other community members are thinking is important. This activity will help you discover how your teammates are thinking about a perfect community.

1. Remember the end of Task 1 when you thought about your perfect community? Take out your My Perfect Community paper.
2. If you are using paper, turn a piece of paper over and divide it into four sections.
3. You are now going to interview your teammates to discover their ideas about a perfect community.

Emotional Safety Tip

There are no wrong or right answers. Different people can have different opinions. Considering different opinions helps the group think better together. It may feel difficult to disagree with someone or have them disagree with you. Remember, disagree with ideas, not with people.

4. Interview four of your teammates about the ideas they wrote, drew, or thought about for their perfect community. Also, allow yourself to be interviewed by four different teammates.
5. During your interviews you can write or draw notes in the four sections of your paper to remind yourself about what your teammates said.



Interviewer Tips

- Face the person sharing their ideas.
- Show the person you are paying attention.
- Remember your teammates might have very different ideas from you. This is good. Learning about different ideas helps you understand your community and make better decisions.
- As an interviewer, do not share thoughts you might have. Your role is to pay attention to the other person's ideas.

6. When you have finished interviewing and being interviewed, return to your place. Look at your results. Consider:
 - a. Did anyone you interview have different ideas than you?
 - b. What did your interviews tell you about different ways of thinking about a perfect community?
7. As a team, discuss your results.
 - a. Did everyone have the same ideas?
 - b. Take out your *My Identity Map* from Task 2. Now think about when you had a different idea than someone you interviewed. Is there something about who you are or what you have done that makes you think the way you do? For example, you may think that a perfect community would have lots of sports fields because you love to play sports. However, your teammate may love to play music and so they would rather have a place they can perform or listen to music.
 - c. Remember communities are made up of lots of different people with lots of different ideas.
 - d. Why is it important to get ideas from many different people when trying to imagine what your community should be like?





Understand: How can we consider other perspectives when making decisions?

Action researchers must understand different points of view or perspectives. Thinking about different perspectives can help you understand why people might approach a problem differently. It can also help you understand what people value. In this activity you are going to explore different perspectives on what makes a perfect community. You will be talking more about how these perspectives work soon.

1. Break into four groups and move away from each other into four areas, such as the corners of a room. If your class would rather do this activity together, you can just go through all four perspectives one at a time.
2. Read *The Four Perspectives*. Each of the four groups is going to explore one perspective.

The Four Perspectives

The perspectives you will explore in this guide are social, environmental, economic, and ethical. People using different perspectives believe different parts of the community system are most important to consider.

- **Social** is about the interaction of people in a community. The health, education, and well-being of people are the most important thing.
- **Environmental** is about the natural world. Protecting the Earth and its natural systems is the most important thing.
- **Economic** is about money, income, and use of wealth. Economic growth, including making sure people have jobs and enough money, is the most important thing.
- **Ethical** means the fairness of something. Doing what is right and having a just community where everyone is treated fairly is the most important thing.

3. Decide or have your teacher assign you a perspective. Make sure one group is thinking about each perspective.
4. In your group, remember your ideas about a perfect community. This time you will think about what a perfect community would be like if everyone was only thinking



about your assigned perspective. For example, if you are considering an economic perspective, think about what a perfect community would look and feel like if the economy was the most important thing to people in the community. If people valued making money and having jobs above everything else, how would your community look and feel?

5. After you have discussed your perspective in your group, take turns sharing your ideas with the rest of the class.
6. Now you will take a different approach to understanding your perspective. Sometimes the easiest way to understand the importance of something is to remove it and see what happens. Back in your group, think about and discuss what life in your community would be like if no one valued your assigned perspective. For example, if your assigned perspective is “ethical” and no one thought about fairness, what would your community look and feel like?
7. As a group come up with a creative way to share your thoughts. For example, you could act out life without your perspective, tell a story about life without your perspective, or find another way to show the rest of the class.
8. Share your ideas with the rest of your class.
9. Then, as a class think about and discuss:
 - a. Were there any of the four perspectives that were not important?
 - b. What happened if one perspective was not valued?
 - c. Why is it important to balance all four perspectives?
10. When you can balance all four perspectives in a way that works for a long time, that is called **sustainable**. A sustainable solution balances the needs of living things and the resources available in a way that does not hurt future generations. Your goal while using this research guide is to understand how to help balance the needs of people and other living things in a sustainable way.



Act: *How can we come to consensus to help our community?*

Thinking about these different perspectives is the key to balanced communities. Your research team will make decisions about the best actions to take in your community. Making good decisions as a group can be hard. Not everyone in the group can always



get everything they want. Good teams try to come to **consensus**. Consensus is not competing to win or lose. Coming to consensus means working together to find a balanced decision that works for everyone. In this activity your team will come to consensus on the most important goals for your local community.

1. Get out your *My Perfect Community* paper. On one side, you will see your ideas about a perfect community. On the other side, you will see some of your teammates' ideas about a perfect community.
2. Read *Balanced Community Goals*.

Balanced Community Goals

Completely perfect communities do not exist. However, there are communities around the world that work to balance the needs of people with the needs of other living things. When things are generally working well for the living things in a community, it can be called balanced. As action researchers you need to figure out what you can do to help create a balanced community.

As action researchers you need to figure out what you can do to create a balanced community.

Right now you will set goals to help create a balanced community. If you were taking a journey this would be like knowing where you want to end up. Your goals are your destination.

Later you will find out what is happening in your community right now. This is like understanding where you are right now on your journey.

Then you can make decisions about the actions you need to take to reach your goals. This is like figuring out how to get from where you are in your journey now to where you want to end up.

1. As a team start building a list of team goals. Use a class board or a piece of paper and together make a list of possible goals. Team members can write their goal ideas on the board or paper.
2. Look again at the information you have on the *My Perfect Community* paper. Are there ideas on that paper that would be important goals? For example, maybe



you thought that in a perfect community all plants and fungi would have enough space to grow. Or all the animals would have enough to eat. Those are important ideas.

3. Next, remember the social, environmental, economic, and ethical perspectives? Are there goals that need to be added related to those perspectives? For example, maybe you remember the group with the environmental perspective sharing what life would be like if no one cared about the natural world. Do you want to include any goals about caring for or protecting the natural world?
4. Team members can add any new goal ideas on the board or paper.
5. Now, with your team, use those ideas to come to consensus on a team list of the main goals for your community.
6. Take a few minutes to look at the board or think about what you have heard. Are there goals listed that are very similar? Part of coming to consensus is noticing when different people share the same values but are talking about it in a different way.
7. If you see two or more goals that are similar, you can group them together. This will help you narrow down your list.
 - a. For example, maybe one person wrote a goal of wanting to stop cutting down trees in the community. Maybe another person wrote a goal of making sure birds had enough trees to live in. They both want to make sure living things have the space to live. They might be able to come up with one goal that describes both of those things.
8. Now that you have a list of the possible important goals for your community, look at the goals and decide which are the four you think are most important.
9. Turn to a partner and discuss your ideas. Listen closely to your partner's opinions and share your own thoughts about why the goals you chose are most important.
10. Together with your partner, pick the four goals that you two together think are most important. This is not about picking your ideas. It is about picking the best ideas. You can use these phrases to help you have a useful conversation:
 - a. I agree/disagree because . . .
 - b. I'd like to go back to what you said about . . .
 - c. I noticed that . . .



- d. Couldn't it also be that . . . ?
 - e. Can you explain why you think that?
11. As a pair, you should now have four goals. Write them down or remember them.
 12. Next, you will have a chance to eliminate less-important goals.
 - a. If you are using a board or paper, put a mark next to the four goals you and your partner think are most important.
 - b. If you are just talking as a team, have a teacher or team leader say the goals out loud. Raise your hand when someone says one of the goals you and your partner think are most important.
 13. Either look at the board or think about who raised their hand. Are there any goals listed that no one thought was the most important? If so, cross those goals off the list. They may still be important, but not the most important.
 14. For each goal, a team member who thinks the goal is very important should explain why to the team.
 15. When you have finished all the goals, discuss:
 - a. Have you changed your mind about whether specific goals should be included?
 - b. Are there goals that you think the team is ready to take off the list?
 16. As a team, see if you can narrow the number of goals down to between three and six. These are your balanced community goals.
 17. Title a piece of paper *Balanced Community Goals*. Then list these goals underneath. You will have a chance to talk about them again. Don't worry if they are not yet perfect. You will have a chance to think about these goals again later.



Task 4: Where do we notice the problem?

We are all a part of different communities. The people at your school are part of your school community. The people living near you are part of your local community. The people living in your country are part of your national community. All the people living around the world are part of the global community. Sometimes people in one community have problems that occur just in that place. However, you will **discover** that often problems that occur in one place are related to problems of the larger communities. During this task you will **understand** more about the relationship between problems of your local and global communities. Then you will **act** by deciding where you will do your research in your community.



Discover: *What connects problems in different communities?*

Communities may look different in different places, but many times they have problems that are similar. In this activity you will think about the connections between problems in different places.

1. Start off by thinking about a time when you had a problem and talked to a friend about it. Consider:
 - a. Was it helpful to talk to a friend?
 - b. If so, why?
 - c. If your friend had faced a similar problem, would that make talking to them more helpful?
 - d. If so, why?
2. As a class come up with some reasons why it might be useful to talk to a friend, especially a friend who had a similar problem. Just like people, communities have problems too. When they do, it can be useful to connect with other communities that have similar problems.
3. Communities around the world sometimes work together to solve their problems. They also work with scientists and other researchers to help understand their problems better. As action researchers, you can get ideas and advice from other researchers, just as you would from a friend.



4. In this research guide, you will find out information from researchers in other places. These researchers are also trying to understand problems in their local communities. They are trying to help their community balance the needs of people and the needs of other living things. The information from researchers can give you ideas about your research and actions.



Figure 1.3: A group of elephants stand in the clearing of a forest that is filled with trash.

5. Observe the photograph in Figure 1.3. It was taken in a community that is trying to balance the needs of people with the needs of other living things. Turn to a partner and discuss:
- What do you notice in the photo that makes you happy? Try to pay close attention and be specific.
 - What do you notice about the photo that makes you worried?
 - What do you wonder about this community?



 **Emotional Safety Tip**

It is okay to have strong feelings about this photo. But remember, you are an action researcher. You are learning how to take action so you can help with global problems just like the one you see in the photo. You are part of the solution!

6. Now come together as a team and share the ideas that you just discussed.
7. Problems in different places often have similar causes and solutions. Think about any connections between this photo and things you have noticed in your community. As a team, discuss:
 - a. Are there things you notice in this photo that you have also seen in your local community?
 - b. Are there problems you notice in this photo that are the same as problems in your community?
 - c. If you could talk to a researcher who works in this community, what advice or ideas do you think she could give you about your community research?
8. Asking advice or ideas from other researchers can be an important part of building a knowledge **network**. A network is a set of connections between people, communities, and ideas. Networks extend all over the world to help scientists and other researchers work together to create new knowledge and solutions.
9. As action researchers, you will use scientific and other tools to find out new information about your own community. This information can help you and your community. It can also help other communities by giving them new ideas, just as information from other communities can help you.



Understand: *How are global community goals related to my local community goals?*

Sometimes problems are so big that they really need the entire world to work together to make progress. As action researchers, you probably have thought of some of these problems already during your previous tasks.



1. By yourself or with your team, think about some problems that are so big that you think solving them requires people all around the world.
2. What do you know about organizations that help people around the world collaborate to solve problems? Read *The United Nations and the Sustainable Development Goals* to find out more.

The United Nations and the Sustainable Development Goals

Solving global community problems like the ones you just thought about is **complex**. It takes many people working together in many places to make these problems better. When many people are working together, it helps to have someone organizing. The United Nations, also called the UN, is a global organization designed to help governments and people around the world collaborate.

A few years ago, the UN asked countries and people around the world to imagine a better world. They worked together to determine a list of goals. Then the countries of the UN came to consensus on the most important goals needed to get to a better world. These goals for the global community are called the UN Sustainable Development Goals, or SDGs.

The process used by the UN is like the process you used to determine your *Balanced Community Goals*. You imagined a better community and thought about which goals were most important. Then you came to consensus on your *Balanced Community Goals*.

3. Now break into teams.
4. Examine the SDGs in Figure 1.4.
 - a. Do you see any of the big global problems you just talked about in step 1?
 - b. Are there any goals you would add to the SDGs?
 - c. Share your ideas with the rest of your team.



SUSTAINABLE DEVELOPMENT GOALS



Figure 1.4: UN Sustainable Development Goals

5. Next, list your balanced community goals on a board or other place where everyone can have access to them.
6. Think quietly to yourself:
 - a. How do any of the SDGs connect to your *Balanced Community Goals*?
 - b. Hint: Yes, Goal 14, Life Below Water, and Goal 15, Life on Land, probably connect, but also look at some of the other SDGs to see if they connect.
7. Each team member should go to the list of *Balanced Community Goals*. Then put the number of the SDGs that connect to each balanced community goal. You can write a number, add a sticky note, or use another way to record your ideas. Add as many SDG numbers as you think connect to your goals.
8. As a team, examine the list of *Balanced Community Goals* and then discuss:
 - a. Are there many connections between your balanced community goals and the SDGs?
 - b. What do you think those connections mean about the connection between goals in your local community and goals in the global community?
 - c. Why is it important to remember those connections when thinking about how to solve problems in your community?



9. Next, you can either have a discussion or do an activity. Choose either Option A: Discussion or Option B: Activity.

Option A: Discussion

If you want to have a discussion, talk about the following questions with your team:

- a. As action researchers you try to understand problems in your community and find the best way to solve them. How can your work in your local community help the global community make progress on the SDGs?
- b. Why is it important for everyone around the world to participate in achieving the global goals of the SDGs?

Option B: Activity

In this activity, your class will collaborate to solve a problem. Here are the steps:

1. A teacher or class leader should take a bag of dried rice, lentils, corn, stones, or other small items and spread them around on the floor. There should be enough items that it would take one person a long time to pick them up.
2. As a class or large team, divide up the floor area so each person is in charge of one area.
3. Pick up the items in your area. If necessary, cooperate with the team members next to you to make sure all the items between you are picked up.
4. When you have finished picking up the items in your area, notice if anyone else needs help.
5. Return the items to a container provided by your teacher.
6. Now come back together and discuss with a partner:
 - a. Why was it important to have many people working together to pick up the items?
 - b. What would it have been like if only some people in your team participated?



- c. How did you work together with the people near you to clean up the items together?
 - d. Did everyone pick up the items using the same technique? Why were there differences?
 - e. Did anything change while you were picking up the items? Did you learn new ideas from anyone else?
7. As a pair, share your thoughts with the team or class.
 8. Now, think about the items as problems that need to be solved. As a team discuss:
 - a. Could one person working alone solve all the problems (pick up all the items) easily?
 - b. How is this activity like people around the world working together in their local spaces to help solve a global problem?
 - c. In this activity, you worked with team members around you to make sure all the items were picked up. If you were trying to solve global problems, who do you think might be the most important people to work with?
 - d. Maybe some of your team members used different techniques to pick up their items. How is this like different people or communities solving global problems in different ways?

10. Read *Local-Global Connection* and consider how you feel about the ideas.

Local-Global Connection

One of the most important parts of achieving global progress is people around the world taking action in local communities. You will act to help your local community work toward your *Balanced Community Goals*. Your local actions will also help the world make progress on the SDGs. If all local communities around the world acted to make their communities better, then the whole world would improve quickly.





Act: *Where will we act?*

As action researchers, you will be conducting investigations into your local community. Before you can do this, you need to decide as a team what local community area you will be using as your research area. In this activity, you will decide and map the boundaries of your research area.

1. Your research area will be the place where you will conduct investigations. Think about the following ideas when you consider which area to choose to be your research area.
 - a. Try to choose a space that is not too big, so you can get to know the area and its problems well.
 - b. Choose an area that has a variety of places in it. For example, it probably would be a good idea to choose an area with some spaces that help people meet their needs. You should also choose some places that help other living things meet their needs. And maybe choose some spaces that help both people and other living things meet their needs at the same time.
 - c. Think about a place in your community you would like to know more about.
 - d. Consider access. Make sure all your team members will be able to reach your research area. Be sure that they can all work there comfortably and safely. It may be best to have your research area near your school or near the places where team members live.
 - e. You can choose to have more than one research area if that works best for your team.
 - f. These decisions are all up to your team. It is also okay to change the size and number of research areas later as you collect more information.
2. By yourself, think about the area or areas that are best to do your community action research. Write or draw your ideas on a piece of paper. Or you can just think about the area you consider to be best.
3. With a partner or with your whole team, share your ideas about where it might be best to do your research.
4. Then decide with your team where you will do your research.



5. Now you and your team need to mark the edges or boundaries of your research area. You can do this using a map. Some boundaries you might want to consider include:
 - a. Team housing boundaries: set a boundary that includes all the homes of the team members, the meeting place of the team, and the surrounding area.
 - b. Natural boundaries: mountains, rivers, and different land features.
 - c. Political or administrative boundaries: city or county lines, school district lines, and neighborhood lines.
 - d. Physical infrastructure boundaries: roads and transportation networks.
 - e. Other boundaries: determine your own reasons for a boundary.
6. As a team you can either use an existing map or create your own to show your boundaries. You will continue to add details to this map throughout the guide, so make sure the map is big enough that you can add to it. Read *Using an Existing Map* and *Creating a New Map* to learn more.

Using an Existing Map

1. Obtain any maps of the community around where your team meets that may be useful to get you started.
 - a. Online: Use free online mapping programs, such as Google Maps, to download and/or print a map of the community.
 - b. Print: Good maps of the community are often published and available at local libraries, government planning offices, travel offices, road atlases, or tourist centers.
 - c. Local: Local community leaders or other local sources, such as elders, may have maps available to share.
 - d. Accessible maps: People who are blind or have low vision sometimes use tactile or Braille maps. These maps used raised surfaces to describe where things are.
2. Next, mark the edges of your research area on the map. Figure 1.5 shows an example.





Figure 1.5: Example of using an existing map to define the research area

Creating a New Map

You can use a map that already exists to help you save time. But you and your team can also create your own map. If you are going to create your own map, here are some instructions that can help:

1. Use a blank piece of paper or grid paper. If you can look at a print or online map to help you draw, that might be useful.
2. If you don't want to use paper you can make your map on a computer. Or you can draw your map outside in dirt, sand, or other material. You can also describe your map out loud with your team.
3. Start by marking on your map the location where your team meets. You will work outward from this location to determine your research site boundaries.
4. Your map should include:
 - a. Roads and other infrastructure
 - b. Businesses and other important buildings
 - c. Natural features (such as rivers or forests)
 - d. Parks or other shared spaces
5. Next, draw the edges of your research area on the map.
6. Your map does not need to be perfect; it just needs to make sense to you and your team. You can always add to it or fix it later.



7. When you have finished making and marking the boundaries on your *My Research Area* map, keep it in a safe place. You will use this map to help you decide where to do your research and to mark down important information.



Task 5: How will we achieve our goals?

As action researchers, you and your team will make choices about how to use this guide. You will **discover** which parts of your community you want to **understand** through further investigations. Then you can **act** and **reflect** on your role as an action researcher.



Discover: *What do we need to know more about?*

The problem of creating balanced communities is complex. As a team you have picked your starting goals for a balanced community. Now you need think about how to achieve those goals. This activity will help you discover what you already know about your goals and consider what you still need to explore.

1. As a team get out your Balanced Community Goals.
2. Write each goal across the top of a piece of paper or on the board. Then make three columns for each goal and label them “Notice,” “Think,” and “Wonder.” If you don’t have paper, you can just discuss these ideas.
3. If you want, you can move around your community to “notice” things related to your goals. If that is not possible, just try to remember what you have seen in the past.
4. Under the *Notice* column, write down everything you have noticed in your community related to your goal. For example, perhaps one of your Balanced Community Goals is to reduce pollution in your community so that it doesn’t hurt living things. Under *Notice* you might write down where you have noticed pollution coming from in your community.
5. Next, under *Think* write down what you think is happening in your community. For example, if the pollution is coming from people’s cars, write that down. If the pollution is worse in one area than another, write that down. Or if the pollution is in the form of oil, write that down.
6. Finally, under *Wonder*, consider what you don’t know.
 - a. What questions do you still have?
 - b. At the end of this guide, you will need to decide what to do to make your community better. What information about this goal do you need to help you make that decision?



- c. For example, thinking about reducing pollution, perhaps you wonder if people can find another way besides cars to get around? Or if there is a way to clean up the pollution so it doesn't hurt living things?
7. The things you listed under *Notice* are things you already know. You probably need to find out more information about the things you listed under *Think* and *Wonder*. For example, you might think the pollution is coming from cars, but you need to find out if that is true. Or you may wonder how people can do what they need without cars. Now you will think about how to get that information.
 8. As a team, look at things you listed under *Think* and *Wonder*. Write or say how those questions or ideas connect to making a balanced community. For example, under *Wonder* maybe you listed "How can I help keep living things safe from car pollution?" Think about what the living things need: a safe place to live. Think about what the people in that community need: a way to travel to work or to get food. How can you find out more about balancing these needs?
 9. Record these ideas by keeping your paper, taking a picture of the board, or recording your voices. You will have a chance to return to these ideas in the next activity when you will decide which parts you want to learn about.



Understand: What research will we do?

You will be leading the research for the rest of this Community Research Guide. You have already determined your starting goals. Then you thought about what you still need to know about those goals. In this activity you will decide how to spend the rest of your time as action researchers.

1. You need know how much time you have. Check with your teacher or leader. Are you able to do all seven parts of the Community Research Guide? If not, figure out how many parts you can do.
2. Read [Part Overview](#) to find out more about each part, to help you understand which parts are the most important for your team.



Part Overview

We suggest that you definitely plan to do Part 1, Part 2, Part 3, and Part 7.

- Part 1 introduced the problem and helped you understand how it relates to your community. You have almost finished Part 1.
- Part 2 will help you understand how to listen to different people in your community and make good decisions. Part 2 is a very important part.
- Part 3 will introduce you to the many kinds of living things in your community. It will help you practice how to find and observe the living things in your research area. It will introduce the idea of balancing the needs of living things with the needs of people. Part 3 is a very important part.
- Part 7 is when your team will decide which problem you want to help solve. Then you will act to solve it. Part 7 is also a very important part.

The rest of the Parts of this guide will allow your team to focus on exploring the animals, plants, fungi, and bacteria in your research area. Here is the list:

- Part 4: Animals
- Part 5: Plants
- Part 6: Soil Organisms (such as fungi, bacteria, and small animals)

3. As a team, you will find out information and take action. Think about which Parts of this Community Research Guide your team would like to investigate.
4. It would be easiest for your class to all do the same parts. Now you need to decide as a class which parts to do.
5. As a class, discuss the Parts you think are most important for your class.
6. If you will be able to do all of the Parts of the guide, you can stop this activity now.
7. If you can only do some of the Parts, discuss which are the most important for the largest number of goals. For example, maybe when you looked at the *Think* and *Wonder* columns there were questions for each goal that needed more information about fungi. As a class you probably want to make sure you do Part 6, which is about soil organisms such as fungi. If you can only do a smaller number of Parts, discuss which Parts will help you take action to meet your Balanced Community Goals.



8. Give everyone a chance to share their opinion, then spend some time coming to consensus. Think about:
 - a. Is there one Part that everyone thinks needs to be explored?
 - b. Is there one Part that no one thinks needs to be explored?
 - c. If you are having difficulty deciding, have team members talk about why they think one Part might be more important to explore.
9. After you have discussed all the ideas, you can try to come to consensus. Sometimes after a discussion, it is clear to everyone what the decision should be. If the decision is still not clear go on to step 11. If you think everyone agreed, then have a teacher or class leader list the Parts they think everyone has agreed on. You and other class members then have the option to:
 - a. Agree
 - b. Agree with reservations, like maybe you are a little uncertain or worried about the decision
 - c. Stand aside, meaning you don't agree, but you are willing to go along with the group
 - d. Block, meaning that you feel strongly the decision being made is the wrong one
10. If everyone agrees, then you can stop this activity now.
11. If there are a lot of class members who do not agree, especially if they are blocking the decision, it is best to go on and work more on finding consensus.
12. If people in your class are having trouble agreeing, you can try the following ideas:
 - a. List the good things and bad things about doing each Part. Discuss as a class.
 - b. Build a sense of group opinion. Each person can vote for as many parts as your class has time to do. For example, maybe you can only do two parts out of Parts 4, 5, and 6. In that case each person can vote for two parts. Look at the Parts that have the most votes, perhaps you can see if everyone can agree to do those Parts.
 - c. Find a slow consensus. Find a partner and as a pair find consensus on which part or parts are most important. Then in a group of two pairs (four class members) you can find consensus. Then in a group of four pairs (eight class members) you find consensus. Keep adding together groups until you have found a class consensus.



13. When you have decided on the parts you will do, you are ready to complete Part 1 by finishing the Act activity. Then you can move on to Part 2.



Act: *What are my feelings about taking action?*

As action researchers you will work as a team. Using scientific and other methods, you will try to understand your local community and its problems. Then you will compare the way your community is to the way you want it to be. This difference is where you will act to help make your community better. By the end of this guide, your team will have come to a consensus on what problem in your community you would like to address. Then you will put your plan into action.

1. The action researcher role may feel unfamiliar. Stop and think about how you are feeling before you go on to the rest of the guide.
2. Take a piece of paper and write “My Feelings” across the top. Then write down your answers to the questions in step 3 so you can look at them later.
3. Think about:
 - a. What worries me about being an action researcher?
 - b. What excites me about being an action researcher?
 - c. What do I hope I will learn about my community?
 - d. What do I hope I will learn about the topic of balanced communities?
 - e. How do I think my team will work together?
 - f. Do I feel ready to take action to make my community better?
 - g. How do I hope I will feel at the end?
4. Save these answers in a safe place. At the end of the guide, you can think about them again.



Congratulations!

You have finished Part 1.

Find Out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definitions, or anything else that will help. Add other words to the glossary if you would like.

Action researcher: People who use their own knowledge and information they find out from their community to make decisions and take action on important issues

Animal: Living thing that eats other things for energy and can move on its own

Bacterium: Very small living thing that only has one cell

Biodiversity: The many different living things on Earth; or a measurement of how many different living things are in an area

Community: A group of living things that have something in common and may share space

Complex: Made up of many parts

Consensus: A balanced decision that works for everyone in the group

Economic: About money, income, and use of wealth

Environmental: About the natural world

Ethical: The fairness of something

Fungus: Living thing that breaks down living or dead things for energy



Identity: Characteristics that make up each person or thing

Investigate: Find out more information

Network: A set of connections between people, communities, and ideas

Observation: Recording what you notice without adding your own opinion

Observe: Use your senses to get information about something

Perspective: A specific way of thinking about the world around us

Plant: Living thing that uses sunlight to make its own energy and does not move on its own

Reflect: Think carefully about something

Social: About the interaction of people in a community

Social science: Study of human communities and interactions

Sustainable: A balanced, long-term approach to social, environmental, economic, and ethical concerns

Other words:



BIODIVERSITY!



Part 2:

How can including people help create a balanced community?

SUSTAINABLE DEVELOPMENT GOALS

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE**
HEALTH
POLICY
the interacademy partnership

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Figure 2.1: Monique Avery Pipkin and Starr Audubon Sanctuary

Figure 2.2: Jon Cox and Andrew Bale

Figure 2.3: Courtesy of the Field Museum

Figure 2.4: Wesley Lickus

Figure 2.5: Therany Gonzales

Figure 2.6: Andy Bale

Figure 2.7: Jon Cox and Andrew Bale

Figure 2.8: Brian Griffiths: ACEER, OnePlanet

Figure 2.9: Logan Schmidt

Figure 2.10: Jon Cox

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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: Who is in our community?					
Discover	Consider the different identities in your community and why inclusion is important.	<ul style="list-style-type: none"> Paper Pens or pencils 	<u>My Identity Map</u> (Part 1, Task 2) <u>Team Identity Map</u> (Part 1, Task 2)	15 minutes	55
Understand	Use a survey or other investigation to find out more about the people in your community.	<ul style="list-style-type: none"> Paper Pens or pencils Computer (optional) 		35 minutes + investigation time	56
Act	Create an identity map of the people in your community.	<ul style="list-style-type: none"> Paper Pens or pencils 	<u>Community Identity Map</u>	20 minutes	65
Task 2: How has our community changed over time?					
Discover	Read a case study about changes in a community. Then, reflect on and record changes you and your team have noticed in your own community.	<ul style="list-style-type: none"> Class board or poster paper Audio or video recording device 		60 minutes	67
Understand	Record oral histories from community members.	<ul style="list-style-type: none"> Audio or video recording device Paper and Pen 		25 minutes + investigation time	72
Act	Create a representation of your community's history.	Optional: <ul style="list-style-type: none"> Computer, paper, pen 		25 minutes	76



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: Who makes decisions in our community?					
Discover	Explore decision-making in your community. Then, read a case study about decision making in a community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Identity Map</u> (Part 1, Task 2)	30 minutes	79
Understand	Collect information about how decisions are made in your community.			25 minutes + investigation time	83
Act	Record how decisions are made in your community and how that could be more inclusive.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Perfect Community</u> (Part 1, Task 1)	20 minutes	84
Task 4: How can including our community help us make better decisions?					
Discover	Read a case study about inclusion and design a shared community space to fill your own needs.	<ul style="list-style-type: none"> • Paper • Colored pencils 	<u>My Identity Map</u> (Part 1, Task 2)	25 minutes	87
Understand	Experiment to find out whether including different people changes decision-making.	<ul style="list-style-type: none"> • Class board or poster paper • Paper • Pens or pencils 		45 minutes	89
Act	Analyze experiment results and decide how you want to make decisions	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	20 minutes	92



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How do we include the community in our actions?					
Discover	Consider what you now know, think, and wonder about your local community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Community Identity Map</u> (Task 1)	10 minutes	94
Understand	Investigate the best way to share information with your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes + investigation time	95
Act	Share and get feedback on your Balanced Community Goals.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	30 minutes	97

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



Part 2: How can including people help create a balanced community?

Remember that as **action researchers** you investigate and act on problems in your **community**. You use science and other tools to find out more about your community. In Part 2 of this Community Research Guide, you will work with your team to get to know the people in your community better. You will explore who lives in your community, how it has changed over time, and who makes decisions. Understanding these things about your community will help you plan **sustainable** actions that are meaningful and long-lasting. Remember that a sustainable action is one that includes the **social, environmental, economic, and ethical perspectives**. When you can balance all four perspectives in a way that works for a long time, that is called sustainable. This can help your community now and in the future.

Remember: *In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.*

Your Research Mentor

Sharing your experiences with others and learning from others' experiences is part of being a good action researcher. In Part 2, you will have a research **mentor** to help you understand some issues about making decisions in your community. A mentor is someone who has experience and can help guide you.

Meet Angela Mashford-Pringle, Your Part 2 Research Mentor



Meet Angela Mashford-Pringle. Angela (pronounced AN-juh-la) is one of the many researchers around the world trying to help make the communities around them more sustainable. As action researchers you are also trying to make your community more sustainable. Angela will be your research mentor to help you consider how making decisions in your community might be more **inclusive** and sustainable.



Since Angela is now working with you, it is important to understand who she is. To help you, Angela wanted to introduce herself.

“I’m going to situate myself. For my people that means introducing ourselves in our traditional way. My name is Angela Mashford-Pringle. I’m from Timiskaming First Nation in northern Quebec, but I was born and raised in Toronto so I’m an urban **Indigenous** person.”

“I’m from Bear Clan. I’m a mother of two. My mother grew up in our traditional territories, as did my grandmother. And if you and I were in the same community and you knew the names, I would say my mother is a Robinson, and my grandmother is a Hunter, and these would mean something.”

“And our traditional territories were stolen from us. We didn’t have reserves in Quebec as my mom was growing up. The federal government in Canada sits on our traditional territory on **unceded** land. Ottawa is on unceded Algonquin land that they have not returned to us or given us any kind of treaty for in more than 200 years. So it also changes how we can live in our traditional way.”

“I’m a **cis-gender** woman. I’m married; I’ve been married for almost 30 years, and I have two adult daughters.”

“So that’s how we would traditionally introduce ourselves. It’s about where we came from, who we come from, and where we are today. And as for the ‘where I am today,’ I’m an assistant professor and associate director of the Waakebiness-Bryce Institute for Indigenous Health at Dalla Lana School of Public Health at the University of Toronto. So all of those things make up me.”

“When you’re talking about **identity**, it’s a lot about what are the different labels and pieces that you consider part of you.”

Before you begin the rest of Part 2, think quietly to yourself about Angela’s introduction.

- What way do people in your community usually introduce themselves? What information about themselves do they include?
- How does Angela’s introduction show her connection to her community?
- Are there parts of your identity map that show your connection to your community?



- Would you need to add anything to your identity map to show where you came from, who you come from, and where you are today?
- Can you see anything about Angela's identity that would help her understand different perspectives on how to help a community thrive?

Throughout Part 2 you will notice Angela sharing ideas and experiences with you. She may help you understand better ways to conduct **investigations**, add an additional perspective, or share some of the work she has done.



Task 1: Who is in our community?

In this task you will **discover** what you already know about people living in your community. Then you will do investigations to **understand** the people in your community better. Finally, you will **act** to make an identity map of your community.



Discover: *Why is it important to understand the identity of people in my community?*

Imagine that two of your classmates made a new rule for your classroom. They didn't ask anyone else in the class before making the rule, but your entire class has to follow it. Your two classmates explain, "We think we know what's best for the class, so we made the decision alone."

1. As a class, share your answers to the following questions:
 - a. How do you feel about the way your classmates made this new rule?
 - b. What would you do differently?
2. Examine your *My Identity Map* from Part 1, Task 2. Consider:
 - a. What part of your identity was most important to you?
 - b. Would you want someone who shared that part of your identity to help make the new class rule? For example, you might say, "I am a girl, so I want to make sure there is at least one girl helping to make the new rule."
3. Now gather with your team. Examine your *Team Identity Map*. Discuss:
 - a. What were some of the parts of your team's identity?
 - b. Would you want someone who shared parts of your team's identity to help make the new class rule?
 - c. Think about the beginning of this activity. How did it feel to be left out of a decision that affected you?
 - d. How would it feel different to have someone who shared your identity making the new rule?
4. Read Angela's ideas about identity. As you think about what action to take in your research area, it's important to know who is in your community. Why? Remember that you and your team will plan and carry out an action to help balance the needs



of humans and other living things in your community. You need to know who is in your community so you can include their identities in the plan you make.

Angela Says . . .



We all carry labels or identities. Our identities inform our own values, beliefs, and worldview. And these things inform how we work. How we relate to and understand ourselves. How we relate to the world around us. If we don't consider identity, we cannot understand how others move through the world. We have to think about the unique knowledge and ways of being that each person and group carries.

5. Work with your team to answer the following questions. You will need these answers later. Remember that your team can decide the best way to record information. Writing is one way, but you can also draw, record your voices, make a video, or choose another way.
- Who do we think are the people living in our community?
 - What do we think the people in our community would put on their identity maps? If you need an example of what might be on an identity map, go back to Part 1, Task 2.



Understand: Who is living in my community?

You and your team have talked about who you think is living in your community. Do you think your ideas were right? You can find out by doing investigations in the community. Remember that you used investigations to find out more about your classroom community in Part 1. You can use the same kinds of investigations to understand your local community better. You and your team will need to decide what type of investigation will best help you understand who is living in your community. There are many different ways to do research.



1. Read Angela's ideas about research and then start to consider some of the different ways researchers gather information about others and the natural world.

Angela Says . . .



Often the way we think about scientific research is a Western **paradigm**. In Indigenous communities, we did research, but we didn't do all the academic pieces. There are different ways of knowing things about the world around us. We have to think about knowledge in many different ways. If you are researching a plant, a Western scientific researcher might understand it by pulling it apart and dissecting it. An Indigenous researcher might spend months watching it grow and trying to examine the surroundings. It's about different viewpoints. It is not that one researcher is better than the other, but rather we're doing research in different and unique ways.

2. Since you are trying to understand the identity of many different people in your community, a **survey** might be the best tool. You may have used a survey to understand your classmates better during your investigations in Part 1. A survey is a list of simple questions that you can give to a group of people. For example, you can ask, "What is your age?" Read *Survey Instructions* for more information about how to give a survey.

Survey Instructions

Choosing People to Survey:

- a. It is normal to want to survey only the people you know well and feel comfortable with. But try to include people you may not know as well or people who live in other parts of your community. This will help you get a more accurate picture of your community.



- b. Think about the categories on your identity map. Use those categories to try to pick a diverse group of people to survey. For example, ask people of all different ages or of more than one gender.

Ways to Give a Survey:

- a. Talk to people in person
- b. Talk to people over the phone or the Internet
- c. Write down your questions on paper and give to people
- d. **Design** a survey on the Internet and send it to people

Tips for Giving a Survey:

- a. Make sure your questions are easy to understand.
- b. Ask questions that have definite answers, such as “What things do you like to do for fun?” instead of, “What do you like?”
- c. Think back to Part 1, Task 2 when you made individual and team identity maps. Use these identity maps to help you think of what questions to ask.
- d. Some people may feel more comfortable answering surveys if their answers are **anonymous**. Anonymous means people do not list their name.
- e. Think about where you should give the survey. Is there a place in your community either in person or online, where people gather and might be willing to answer your questions? Could you go from home to home? Would that be safe at this time?
- f. Remember that you and your team members are part of your community. Think about what you already know about your community to help you choose the best way to get information. For example,
 - i. Will people in your community feel comfortable talking to a student?
 - ii. Does everyone have **access** to the Internet if you want to do an online survey?

Safety Tips for giving a Survey:

Talk to your teacher for guidelines. They will know what is safest in your community.



 **Physical Safety Tip**

Never go alone and always be aware of your surroundings. Pay attention to local guidance on whether it is safe to interact with people outside of your home.

 **Emotional Safety Tip**

It can be hard to talk to other people in the community. You may feel shy or nervous. Someone may tell you they don't want to talk. That's ok! It doesn't have anything to do with you. It just means they don't want to share. You can show them respect by thanking them and moving on to another community member.

3. If a survey doesn't sound like the right investigation for your team, that's okay! You can pick another way to collect information about your community.
 - a. You can investigate using books, lists, videos, maps, artwork, audio recordings, or other records of who lives in your community.
 - b. If your community has a **census**, it might include a lot of information about the community. Censuses often have information such as age, gender, family, religion, income (how much money a person or family makes per year), or race.
 - c. You can think of your own way to collect information. You could combine more than one way (for example, you could collect information from books and videos and give a survey) or create a new way to collect information.
4. Decide as a team how you will investigate.
5. Remember, including everyone is important. This is true when you take action in your community. It is also true when you investigate as a team. Try to pick a way to investigate that allows everyone on your team to participate. This is called making something inclusive. Here are some things to think about.
 - a. Time: If the investigation happens after school, does everyone in the team have time to do it?



- b. Comfort: If you decide to move around the community to do your investigation make sure everyone on your team feels safe and able to do this. If not, how could you improve that? Or what is another way that team members could help with the investigation?
 - c. Location: If the investigation is going to happen in a specific place, how easy is it for team members to get to that place?
 - d. Format: How are you collecting information? If you are reading books or other written records, can everyone on the team easily read? Can they understand the language the records are in? If the records are on video or are audio recordings, can everyone on the team see and hear easily?
6. Read about two additional research mentors for Part 2, Amelia-Juliette Demery and Monique Avery Pipkin. They are going to share important information about how to make investigations safe and comfortable in *Making Investigations Safer for All*.

Meet Amelia-Juliette Demery and Monique Avery Pipkin, Your Part 2 Research Mentors



Meet Amelia-Juliette Demery. Amelia-Juliette (pronounced Ah-MEE-lee-ah JOO-lee-eht) is a scientist in the United States who researches birds at the Cornell Lab of **Ornithology**. She studies how eye color and beak color varies in birds. Amelia-Juliette explains, “It’s really cool to look at traits that you may not think change, but actually change all the time, and investigate why and how that happens.” Amelia-Juliette is also studying how communities feel about the **emissions** that come from air travel. She wants to find sustainable solutions to reduce emissions.

Amelia-Juliette has knowledge and perspectives that come from her identity. Since Amelia-Juliette is now working with you, it is important to understand who she is. To help you, Amelia-Juliette filled out an identity map, just you like did in Part 1. Amelia-Juliette’s identity map includes the following things.



- I am 28 years old
- I am mixed race. I am African American and French (my mother immigrated over 30 years ago to America!)
- I identify as female
- I live in the United States of America
- America and France are very important to me and my family
- I am very passionate about using science to help us make decisions. We should make decisions that help many people. But we can't assume that one decision will work for everyone. There are so many different types of people and communities. Usually it takes a little extra effort to help different types of people in a fair way. So I love to combine science with decision-making to help come up with better ways to improve our lives and the lives of others.
- I have a lot of hobbies! I love Dungeons and Dragons, kickboxing, soccer, reading, knitting, cooking, hiking, and board games. No such thing as too many hobbies!
- I wear my hair buzzed short and wear glasses when I'm not playing sports
- I'm a big extrovert with introverted tendencies. My mother lovingly calls me a whirlwind.
- I am a proud younger sister to an awesome older brother
- I like participating in my community through professional and personal committees.
- I'm a first-generation college student



Meet Monique Avery Pipkin. Monique (pronounced Moh-NEEK) is a scientist in the United States who researches birds at the Cornell Lab of Ornithology. She studies **iridescent** feathers. Monique explains, "Iridescent feathers are feathers that change color depending on how you look at them! I like to think that my research studies the science of beauty." She studies how feathers work and how birds are affected by stress. Monique also studies how art can help people of all ages learn biology. She says, "I think using things people care about, like art, is a great way to teach people topics that can be difficult to explain."



Monique has knowledge and perspectives that come from her identity. Since Monique is now working with you, it is important to understand who she is. To help you Monique filled out an identity map, just you like did in Part 1. Monique's identity map includes the following things.

- I am 27
- I am Black
- I am female
- I live in New York, USA
- I love to bake, read, play trivia, watch musicals, and sing as much as I can!
- I have glasses, and wear my hair in braids and locs
- I am an extrovert who enjoys meeting new people and making friends laugh
- I am the youngest (but also the tallest) sibling of two
- I am a lifelong learner because there are always new things to discover!

Making Investigations Safer for All

You and your team will plan several investigations as you complete Part 2, Part 3, Part 4, Part 5, and Part 6. Many of those investigations will be outdoors in your community. Some members of your team may be unsafe or uncomfortable when doing investigations outdoors in the community. These team members may have that experience because of their identity. For example, if a person's gender identity, race, ethnicity, sexual orientation, religion, or disability is in the **minority** of their community, they may be unsafe or uncomfortable.

Amelia-Juliette and Monique each have experienced the feeling of being unsafe when working on their research. They decided to write an article about why people might feel unsafe or uncomfortable during investigations and what other people can do to help. They thought about their own experiences and interviewed many other researchers. Their article was published in the scientific journal *Nature Ecology and Evolution*.



Why might an investigation be unsafe or uncomfortable for some members of a team?

Monique says: We are all different but some people don't respect our differences. Those people might have said or done things that made team members feel bad or unsafe in the past. Even though it happened in the past, some team members may worry that they or their feelings will be hurt again.

Amelia-Juliette says: Some members of a team may not feel comfortable being themselves if someone made it clear that, because of who that person is, then they deserved to be treated badly or differently. That discomfort can make it hard for someone to keep focus, stay on track, and ultimately feel like they belong in that space.

What can young people do to support their teammates that are unsafe or uncomfortable?

Monique says: You should always have a buddy or find ways to check in with your teammates. If something happens, move away from the situation and tell someone. People can best help you if they know what happened. If someone is unable to stand up for themselves, stand up for them and show your support.

Amelia-Juliette says: I think young people can show their support in different ways. Asking if the teammate is alright after someone makes them feel excluded, or standing up for that person and saying, "Hey, I don't think there's anything wrong with who this teammate is." It's important to check in with them and see what type of **allyship** they are most comfortable with.

What inspired you to write an article about making investigations safer?

Monique says: We have been made to feel uncomfortable and unsafe in the past. Over the years, we have collected advice and stories from peers about what makes them feel safe and what to do when they don't. We wanted to write it down for those who don't know what questions to ask or have people to talk to.



Amelia-Juliette says: Monique and I have both experienced instances of discomfort while out enjoying our projects or just nature in general. We wanted to make something that anyone could use so that they can enjoy the outdoors as much and as safely as they want to.



Figure 2.1: Monique (left) and Amelia-Juliette (right) collecting data on the birds in their research areas.

7. As a team, discuss what you read in *Making Investigations Safer for All*. Include the answers in your plan for the investigation.
 - a. What can your team do to make investigations safer for all the members of your team?
 - b. What is your plan if a member of your team feels unsafe or uncomfortable during your investigation?
 - c. What kind of support do you want from your teacher or other adults?
8. Now that you have decided how you are going to get information from the community, your team needs to decide what information you would like to get.
9. Talk to your team about what you might want to find out about your community. Some examples are listed here:
 - a. How old are people in the community?
 - b. What genders are people in the community?
 - c. What roles do people have in their families?
 - d. What do people do for work and for fun?



- e. What do people say are the most important parts of their identity?
 - f. Are there ways in which the person feels the same as others in the community? Are there ways in which they feel different?
 - g. What groups do people in the community belong to?
 - h. Are there ways in which each person feels the same as others in the community? Are there ways in which they feel different?
10. Next, work with your team to plan how you will collect information. For example, if you decide to pass out a paper survey, decide who will type or write the survey, who will make copies, who will pass the survey out, who will collect the finished surveys, and who will keep track of the answers.
 11. Finally, conduct your investigation with your team.



Act: *How will I remember all the identities in my community?*

You and your team have found out information about the people who live in your community. You will need this information as you work through the rest of this guide. Use the steps in this task to help you make a record of what you found out.

1. Consider what you found out about your community.
 - a. Did you find identities different than the ones of people on your team?
 - b. Did any of the identities you found surprise you?
2. Use your results to make an identity map of your community with your team. This will help you remember all the different people living in your community. You can also include anything you already know about your community. Remember that you can make an identity map by writing, drawing, using objects, taking photos, or another way.
3. If you need help deciding what to put on your community identity map you can use the individual and team identity maps from Part 1, Task 2 as examples. You can also include the answers to these questions.
 - a. Who is living in your community?
 - b. What did people in the community say about their identity?



- c. Are there other important characteristics that might give someone a specific point of view?
4. Title this map Community Identity Map and keep it separate from your individual, team, and living things identity maps.
5. Leave extra space in the Community Identity Map in case you want to add to it as you find out more information later.
6. Think about the people you thought were living in your community before you did your investigation. You recorded this information in step 5 of the Discover activity. Compare your original ideas with the results of your investigation. Discuss with your team:
 - a. What did I learn about my community that I didn't know before?
 - b. What surprised me?
7. You have probably noticed that you didn't always guess correctly about your community. There may have been some information that was new to you. There may have been people in your community who you didn't know about before. Investigations about your community help your team learn more, make better decisions, and take sustainable action.



Task 2: How has our community changed over time?



Just like you, communities are always changing. In this task you will **discover** what you already know about those changes. You will **understand** what other community members might know. Then you will save this information so you can use it when you are ready to plan how you will **act**. You need to understand past actions before you develop or decide future actions.



Discover: *How have I noticed my community changing?*

Think back to the earliest time you can remember. Do you remember what you looked like when you were young? Do you remember what you liked to do? Think about how you are now. How have you changed?

Communities can change too. The people who live there can change. The way land is used can change. What people think is important can change. Scientists such as geologists can investigate physical changes in a community over time. Other researchers such as historians can investigate human actions of the past. Action researchers find out how a community has changed over time because it can help them plan actions for the future. Remember, you and your team are also members of your community. Your thoughts, feelings, and information about changes in the community are important. You are going to start this activity by thinking about what you already know.

1. Have someone in your class place four large pieces of paper around the classroom. Write each of the following questions on its own piece of paper. Leave space for the whole class to write their answers below the questions. You can also do this activity by sharing ideas online, recording your answers on video, or another way.
 - a. "What things in our community are new?" (For example: buildings, natural spaces, living things, or roads)
 - b. "What things are no longer found in our community?"
 - c. "How has who lives in our community changed?" (This question can mean people or other living things)
 - d. "How do we feel about the changes in our community?"
2. Write your answers to each question on the papers.



3. Move around and read other people's answers.
4. You might notice that another person in your class has different ideas about how the community has changed. They may have noticed something different than you.

 **Emotional Safety Tip**

Different people can have different opinions. Considering different opinions may help the group think better together. It may feel difficult to disagree with someone's ideas or have them disagree with yours. If someone shares an idea that makes you feel uncomfortable or upset, it is okay to say so or to stop the conversation. Remember, everyone should disagree with ideas, not with people.

5. Next, read this **case study** on your own. A case study is a record of something that happened. It gives details so that you can understand what happened and who was involved. This case study describes the Ese'Eja people and how they have been affected by changes that have happened over time.

Case Study

The people of the Ese'Eja Nation are an Indigenous people. Indigenous means people who lived in an area before anyone else arrived.

The Ese'Eja Nation is located in what is now southeastern Peru. The Ese'Eja used to own and live on a very large area of their ancestral lands. Ancestral lands are lands that generations and generations of Indigenous people have owned and lived on. The ancestral lands of the Ese'Eja include over 12,000 square kilometers of rainforest. The Ese'Eja carefully took care of the rivers, forests, and wildlife in their ancestral lands. Their actions kept the rainforest healthy.





Figure 2.2: The rainforest where the Ese'Eja live.

But the Ese'Eja people have had to survive **traumatic** changes. In the 1800s colonists invaded their ancestral lands. A colonist is someone who makes a home in a place that is not theirs. The colonists killed and enslaved the Ese'Eja people, separated Ese'Eja families, made new laws without involving the Ese'Eja people, and used the rainforest how they wanted.

As a result of this invasion and many years of **exclusion**, the Ese'Eja do not own or live on 96% of their ancestral lands.

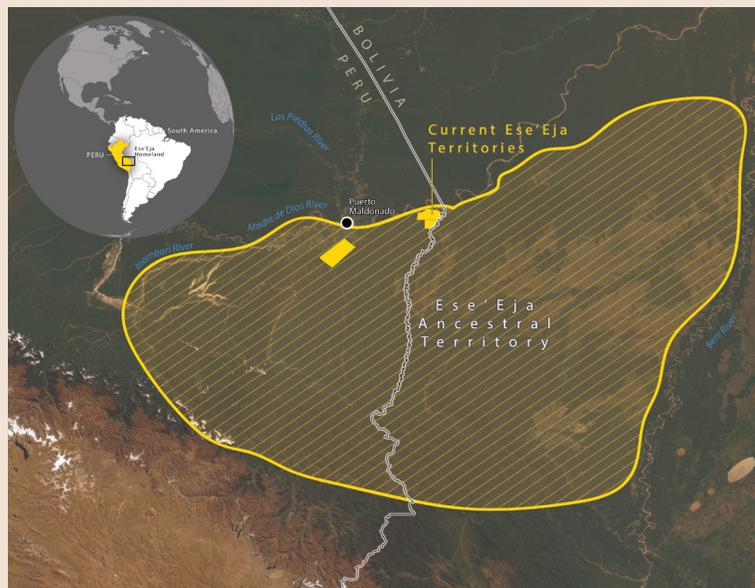


Figure 2.3: This map shows the Ese'Eja ancestral lands. Their current territory is the three small yellow blocks.



The people who currently live on Ese'Eja ancestral lands have made it difficult for the Ese'Eja to hunt, fish, and grow and gather food like they used to. Miners have polluted the rivers while looking for gold. Loggers have cut down many of the trees without permission. It is harder for the Ese'Eja people to stay healthy. The rainforest ecosystem that the Ese'Eja depend on and live in is threatened.



Figure 2.4: Logging on Ese'Eja ancestral lands



Figure 2.5: Mining has polluted these streams and rivers on Ese'Eja ancestral lands.

As a result of losing their ancestral lands, the Ese'Eja are also losing the knowledge that has been passed down from one generation to the next. "I worry most about



losing the Indigenous knowledge of our people,” explains Carlos Dejavisio Poje, a former president of the Ese'Eja Nation.



Figure 2.6: Carlos Dejavisio Poje, former president of the Ese'Eja Nation

6. Consider the following questions and share your answers with the team:
 - e. How do you feel about the changes in the Ese'Eja community?
 - f. Imagine your team was planning an action where the Ese'Eja live. What are the most important changes in the Ese'Eja community to know about before planning that action?
 - g. What do you think is important to know about your own community when making decisions?
7. Now each team member will create an **oral history** of their experience in your community. An oral history lets people share the story of their past. Oral histories can have a lot of information. They can be used to see how communities change over time. You will learn more about investigating using oral histories with other people in the next activity. But first you will record your own oral history.
8. Use an audio or video device to record your history. Or, if you prefer, you can make a record by writing or drawing.
9. Imagine you were telling the story of your time in your community to someone who did not know you or your community. These questions can get help you started. Share and record your answers.



- a. What is your earliest memory of your community?
 - b. What are some of the changes you have noticed?
 - c. What changes have affected you the most?
 - d. What are some things about your community that make you proud?
 - e. What are some things about your community you hope will change in the future?
10. Share your oral history with your teammates if you are comfortable doing so. Listen to your teammates' histories.
 11. Think about why it might be important to know the history of a community before making decisions about that community. Discuss with your team:
 - a. If we were making a decision about our community, what changes would it be important to know about?
 12. Ask yourself quietly:
 - a. Is everyone's history the same?
 - b. Why is it important to hear the histories of other people?



Understand: *How has my community changed over time?*

In Task 1, you and your team collected information about the people living in your community. Now you will investigate how your community has changed over time.

1. Decide the best way to investigate how your community has changed over time. One good way might be to talk to people who have lived in your community for a long time. Read the *Oral History Instructions* for more information.

Oral History Instructions

When you talk to people and record information about their past, it is called an oral history. Oral histories create a record of what people or communities were like in the past.



Choosing People to Talk to

- a. Think about who might know the most about how your community has changed. For example, it might be people who are part of Indigenous groups, older people who have lived in the community a long time, a local historian, people who build new things or tear things down, or leaders who make decisions. (Indigenous means a group of people or other living things that are native to a place and have not migrated from elsewhere.)
- b. It is important that all the people of your community are included and represented in this work. As a team, try to talk to people with a variety of ages, genders, jobs, incomes, religions, ethnicities, or other identities.
- c. Think about the many ways that people can share information and try not to leave people out. For example, someone in your community may be deaf or hard of hearing and use sign language to communicate. If you do not use sign language, ask your teacher if you can find an interpreter to help you collect an oral history from that person.
- d. Talk to people who live in different parts of the community so you can learn how many parts have changed over time. As a team, try to talk to people who live in all parts of your research area.
- e. Conducting oral histories can take a long time, so you may decide to talk to just one person. That is okay. If everyone on your team interviews at least one person, you will have enough information to complete the activity.

Ways to Record an Oral History:

- a. You can use audio or video to record an oral history.
- b. You can also write or draw to make a record of the ideas that are shared with you.
- c. You can talk to people in person, over the phone, or using the Internet.

Tips for Doing an Oral History:

- a. Make sure you ask permission to record a person's answers.
- b. Ask permission to share the oral history with the rest of your team, class, or other people in the community. People might be more willing to talk if their oral history is anonymous.



- c. A person may have photographs, drawings, or other objects that help them tell their oral history. Ask the person to describe the object and make sure you record their description.
- d. If it feels like someone didn't answer your question, don't be afraid to ask the question again in a different way.
- e. Let the person you are talking to answer the questions in the way they want. Be patient. Listen carefully. Understand that they might give answers that you didn't ask for.

Safety Tips for Talking to People

Talk to your teacher for guidelines. They will know what is safest in your community.



Physical Safety Tip

Never record an oral history alone and always be aware of your surroundings. You might want to suggest recording the oral history in a quiet public place.



Emotional Safety Tip

It can be hard to talk to other people in the community. You may feel shy or nervous. Someone may tell you they don't want to talk. That's ok! It doesn't have anything to do with you. It just means they don't want to share. You can show them respect by thanking them and moving on to another community member.



2. Read the additional ideas Angela has about collecting oral histories from others.

Angela Says . . .



Make sure that you're an active listener. While a person is talking to you just listen and wait until they're done, and **reflect** before you actually start talking. You need to make sure that the space is welcoming and inviting. And you need to be welcoming and inviting. Don't make faces when they say something you don't like. You need to actually pay attention and figure out what it is that they're telling you.

3. If an oral history doesn't sound like the right investigation for your team, you can pick another way to collect information about your community if an oral history doesn't sound like the right investigation for your team. For example, you can:
- Investigate using books, lists, videos, maps, artwork, audio recordings, or other records of the history of your community. If your community has maps or photos from different years they could show you what changed from year to year. If your community has a census it might include a lot of information about the community. Censuses often have information such as age, gender, family, religion, income (how much money a person or family makes per year), or race.
 - If you use books, videos, or other pieces of information remember to think about who made these records. What if people were living in your community before books were written or photos existed? It is important to try find out their history as well!
 - Investigate using census data. You can compare a recent census with one from the past to investigate how the community has changed. If your community has a census, it might include a lot of information about the community. Censuses often have information such as age, gender, family, religion, income (how much money a person or family makes per year), or race.
 - Think of your own way to collect information. You could combine more than one way (for example, you could collect information from books and videos and collect oral histories) or create a new way to collect information.



4. Now decide what information you want to get from your investigations. Your team can use these questions as suggestions or write your own.
 - d. How has the community changed over time?
 - e. What buildings, natural spaces, roads, or living things are new?
 - f. What things are no longer found in the community?
 - g. Have you noticed any changes in who lives in the community?
 - h. How do people feel about the changes in the community?

 **Emotional Safety Tip**

People may tell stories that are difficult for them to talk about. Some stories might be hard for you to hear. People you talk to may also have opinions that you disagree with or that make you uncomfortable. It is okay to pause or stop an interview if you are uncomfortable or upset.

5. Plan your investigation. Decide what needs to be done and who will do each part. For example, if you are recording an oral history you will need to decide who will find people to talk to, who will talk to each person, and who will help record the oral history.
6. Work with your team to conduct your investigation.



Act: *How will I remember how my community has changed?*

You and your team have investigated information about how your community has changed over time. You will need this information as you work through the rest of this guide. Use the steps in this activity to help make a record of what you found out.

1. Share what you learned from your investigations. Discuss with your team:
 - a. What surprised you?
 - b. What was something that you didn't know before?



2. Take out the four pieces of paper that the whole class worked on before in the Discover activity of this task.
 - a. How were your answers similar or different from the information you collected from others?
 - b. What information would you like to add?
3. Work with your team to understand the information you collected by answering these questions:
 - c. How has our community changed over time?
 - d. How have changes in the community affected the people who live here?
 - e. How do people in the community feel about these changes?
 - f. What do we need to remember about how our community has changed when we are making decisions?
 - g. What else do we want to learn about our community?

Angela Says . . .



One of our teachings is “seven generations back, seven generations forward.” You have to think about seven generations behind you and the seven generations about to come. By looking back, we can see what previous generations did to be sustainable and in balance with Mother Earth. It also gives us knowledge of how to move forward. What’s old is new again!

Many people in the world know three generations of their family. Think forward beyond that. What would you like to see in 2070? What do you want the world to be like at the end of your life cycle, looking at the next seven generations?

4. You and your team will need to keep a record of the information from this activity so you can plan actions that include and represent your community. Here are some suggestions:
 - a. Put all the oral histories you collected, plus your own, together in a single recording, such as a podcast. Your team could add their own voices to the recording and add explanations or other facts. You can find more information



about how to make a podcast at the Smithsonian Science Education Center's Don't Call Me Extinct Podcasting module, found at <https://ssec.si.edu/dont-call-me-extinct-podcasting-module>.

- b. Make a visual timeline of the community with drawings, symbols, words, photos, or objects.
- c. Look at your community records to see if any timelines already exist. What would you add to them? What would you take out or change?
- d. Add information to your *Research Area Map*. For example, you could add a note that a group of houses sit where there used to be a grass field.
- e. Add information from the oral histories to your *Community Identity Map*. For example, if a member of the community says that it used to be easier to find a job but now it is much harder, that is an important part of the community identity.



Task 3: Who makes decisions in our community?

Remember in Task 1 you thought about how you would feel if someone made a decision about your class without talking to everyone. People make decisions about your community, too. In this task you will **discover** how you are involved in making decisions. You will **understand** who makes decisions in your community. Then you will get ready to include what your new information in making decisions about how to **act**.



Discover: *Who makes the decisions that affect me?*

Knowing who makes decisions is important, especially when the decisions affect how you live your life, the place that you live, or the people you care about. Remember the goal of this guide is to take action. You might have to ask for help or permission to complete your action. If you know who makes decisions in your community you can ask them for permission if you need to. If you find out what people are usually left out of decision-making in your community you can include them in planning and taking action. In this activity, you will think about how you are included in the decisions in your life related to creating balanced communities.

1. Answer the questions in the *Who makes this decision?* chart about who makes decisions in your home and community. You can answer these questions by yourself or with the people who live in your home. For each question, record anyone who helps make that decision.
2. You can write this information as a list, record people’s spoken answers, type answers into a computer or other device, or choose another way. Read the following table for an example of a written version.

Who makes this decision?	Me	Other children in my home	Adults in my home	My local government
a. How we use outdoor space at our home				



Who makes this decision?	Me	Other children in my home	Adults in my home	My local government
b. What happens to rubbish or trash when we are finished with it				
c. What we do with living things we don't want in our home (for example, pests like mice or insects)				
d. Where we build new things in our community				

3. Think quietly to yourself. Do you wish you were included in more of these decisions? Why or why not?
4. Look at the identity map that you made in Part 1, Task 2.
 - a. Are there any parts of your identity that make it harder for you to be included? For example, if your community does not let people vote until they are 18 years old, your age may make it harder for you to affect local government decisions.
5. Think back to the Discover activity in Task 1 of this part. It described two of your classmates making a new rule in your classroom without asking you. Pause and remember how that made you feel. Could your classmates have made a good decision about you without including you?
6. Read the following case study. Notice who is making decisions that affect the Ese'Eja. Did these people include the Ese'Eja when they made decisions?



Case Study

Remember that at one time, the Ese'Eja owned and lived on 12,000 square kilometers of rainforest. Much of that land was taken away by colonists. The Ese'Eja were not allowed to own their ancestral lands.

In 1974, the government of Peru changed the law so Indigenous people had the right to own land. But the government only gave the Ese'Eja people 200 square kilometers of land. That is less than 1.25% of their ancestral lands. Those 200 square kilometers were divided into three separate territories.

The Ese'Eja used to move around their ancestral lands to fish, hunt, and gather their food. When they needed food or materials, they would go to the part of the forest that had that resource. Because they owned all the land it was easy to move from one place to another.



Figure 2.7: The rainforest on Ese'Eja ancestral lands.

When the government of Peru divided the Ese'Eja lands into three separate territories, it made it difficult for the Ese'Eja to move around to hunt, fish, or gather food like they used to. It also made it hard to stay connected to their culture, history, and parts of their lands that were sacred. "With limited or no access to our ancestral lands and sacred historical sites," members of the Ese'Eja Nation explain, "...many members of the younger generations...haven't been able to experience the sacred sites from which our oral stories originated."



What has happened to the land that was taken from the Ese'Eja? The government has given some of the land to private companies, such as logging companies. The logging companies cut down trees, sell the wood, and keep the money. Other parts of the Ese'Eja lands have been made into national parks or reserves. These national parks and reserves help to protect plants, animals, and other living things inside their borders from loggers. But they also keep the Ese'Eja out. The Ese'Eja are not allowed to use the forest as a place to live, gather food, or grow food. They cannot visit their sacred sites.



Figure 2.8: Some of these logs were cut down illegally from Indigenous lands.

7. Discuss with your team:

- How did the decisions from the government affect the Ese'Eja people?
- If you were making these decisions, what would you have done differently? Why?
- What do you think about the decision to make national parks and reserves on Ese'Eja land?

8. Now think about your local community. Answer the following questions with your team.

- Who do you think makes the decisions in your community?
- Who do you think you should include when you plan to take action in your community?





Understand: *Who makes decisions in my community?*

You and your team talked about who you think makes decisions in your community, but now you need to collect more information about how those decisions are made. You can do this with another investigation. In Tasks 1 and 2, you might have collected information using surveys, oral histories, or documents.

1. With your team decide the best way to find out who makes decisions in your community. You could:
 - a. Use documents to find out who is leading your community and how they were chosen. Are there people who are appointed instead of being chosen?
 - b. Attend a meeting where the community makes decisions and record who gets to speak. Think back to what you learned in Task 1 in this part about who lives in your community. Notice who in the community is at the meeting and who is missing.
 - c. Ask people in the community about who makes decisions.
 - d. Come up with your own ideas. Use Angela's thoughts to get you started.

Angela Says . . .



We often take for granted who is a leader or in charge of a space. Our assumptions may not be true. In some communities it may not be just one person. Depending on the community, there may be a more consensus-building approach. To make decisions it may be that you need to talk to a number of people. For example, I've worked with communities where you make decisions by going to a town hall meeting and talking to everybody at once. There's not one person in charge. Knowing who makes the decisions is really important. You can find out by going to the community. Talk to organizations or talk to people in the community. Ask them who represents them.



2. Now that you have decided how you will investigate your team needs to decide what information you would like to get. You can use these questions as suggestions or write your own:
 - a. Is everyone allowed to help with making decisions?
 - b. Is there one person or many people in charge?
 - c. Does our community vote on decisions?
 - d. Who is allowed to vote?
 - e. Are people able to talk about decisions before they are made?
3. Plan your investigation. Decide what needs to be done and who will do each part. For example, if you are attending a community meeting, you will need to find out the time of the meeting, decide who will attend the meeting, and who will record the information.
4. Work with your team to conduct your investigation.



Act: *How will I use what I know about decision-making in my community to help me take action?*

The information you collected about who makes decisions in your community will help you decide how to take action. In this activity you will create a record of how decisions are made in your community. You will need this information as you work through the rest of this guide. You will also discuss how you think decisions should be made in your community.

1. Work as a team to record the information you collected in the Understand activity. Here are some suggestions for how to record who makes decisions in your community:
 - a. Write a list, table, or a chart
 - b. Make an audio recording of your team's description
 - c. Draw a visual. You can use words, symbols, lines, shapes, or other drawings that help you show this information.



- You could make a **concept map**. A concept map is a visual that helps you show information.
- Figure 2.9 is an example of a concept map. For example, imagine your community has one person in charge. This one person talks to a group of five community members before making decisions. You could show this with a concept map like the one in the figure. It might include one, large purple square to show the one person in charge. Five, small blue triangles show the five community members. The purple square is on top because it is in charge. The blue triangles all share the same row because they have equal power:

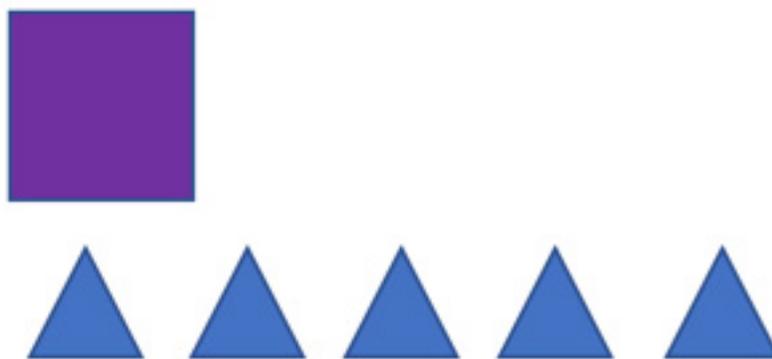


Figure 2.9: A concept map showing how decisions are made.

2. Work with your team to answer the following questions:
 - a. Who makes the decisions in your community?
 - b. Who does not get to make decisions?
 - c. Do you like how decisions are made in your community or would you like it to be different in the future?
3. Remember that in Part 1 your team imagined your perfect community. Get out your *My Perfect Community* paper. Think about the goals that you made for your community.
 - a. If you want to reach your goals who do you need to talk to in your community who makes decisions?
 - b. Are there people who don't make decisions but could help you take action?



4. Think about how decisions are made in your community. Is there anything you wish were different? What would make it easier for you to take action in your own community? Just as you did in Part 1, dream a little bit.
 - a. For example, maybe your community has only one person in charge. Your team may wish more people could make decisions.
 - b. Or perhaps decisions in your community do not include the ideas of young people, people without much money, or people who were born outside of the community. Your team may wish those people could help make decisions.
5. Record any ideas about how you think decisions should be made on your *My Perfect Community* paper.

Angela Says . . .



Three Ps: power, privilege, positionality. Youth have to remember those three. They need to think about how they have a position. People can say the kids and teens don't get a voice, but they actually have more power than we give them credit for. Youth can make decisions that can put them at the table.

Almost every organization I work with has some kind of youth component to it. I think young people don't understand how their voice will be heard. They need to say, "This is what I want you to hear for me, and this is why I want to sit at your table."



Task 4: How can including our community help us make better decisions?

In this task you will **discover** how it feels to be in charge. Then you will **understand** the differences between including everyone or just a few people in making decisions. Finally, you will find out how important it is to include others when making decisions about how to **act**.



Discover: *What are my ideas?*

You and your team talked about who makes decisions in your community. Now you will think about decisions you would make if you were in charge.

1. Read this case study on your own. It describes how the Ese'Eja community was involved in a decision that affected their lives.

Case Study

Infierno is a community located on Ese'Eja lands in Peru. The community has a mix of people, including Ese'Eja and some colonists. In the 1990s, a company called Rainforest Expeditions Peru asked the community of Infierno if they could build a lodge. The lodge would be on Ese'Eja lands. The company would make money by charging tourists to stay in the lodge.

Over the next six months, a staff member from the company talked to each family in the Infierno community about the lodge. They created relationships with the families, asked what the community wanted, and answered their questions. After the conversations, 96% of the community members voted to approve the lodge. The Infierno community signed a written agreement with the company. The community would keep 60% of the profits, and the company would keep 40%. The community also formed a ten-person committee. This committee would have the power to **approve** or **deny** decisions made about the lodge.

The partnership between Rainforest Expeditions Peru and the Infierno community is not easy. The community and company do not always agree. To help encourage



trust, the company and the Infierno community share all the information about the business. The Infierno community is able to see every single payment, file, report, or piece of information about the lodge.



Figure 2.10: The lodge.

Twenty years after the first agreement the community agreed to work with the company for another 11 years. The Infierno community wrote the new agreement. The company and the community both signed it. Now, the community keeps 75% of the profits. The company hopes that someday the lodge will be run entirely by the community.

2. Next, think about these questions as you read through the case study again:
 - a. Who made decisions in this case study?
 - b. Why do you think the Infierno community decided to keep working with the company?
 - c. What could your team do to make sure your actions work for a long time in your community?
2. Take out the *My Identity Map* paper from Part 1. Remember things you like or hobbies you have. You can use these ideas to get you started in this activity.
3. First you need to do a little imagining by yourself. Imagine there is a shared community space, maybe like the one shown in Figure 2.11. You are in charge. So, you can decide how the space will be designed.





Figure 2.11: A shared community space waiting to be designed.

4. Think about:

- a. What kinds of things would like to be able to do in this community space? For example, maybe you really like to ride your bike. Would you want the space to have a fun place to bike?
- b. How would your senses feel when you are in the space? For example, maybe you like the color red or the smell of roses or the sound of running water. How could those things be part of the space?
- c. How would you like to interact with other people in the space? For example, maybe you like playing games outdoors with a big group of other people. Is there a way the space could help you do that? Or maybe you like spending time alone. Is there a way to design the space to help you do that?

5. Write or draw your ideas on a piece of paper. Be as specific as possible. If that is not possible, record your voice or a video explaining your ideas.

6. Do not share these ideas with anyone else. You need to keep them secret for the next activity.

7. Fold up your paper or give another record of your ideas to your teacher.



Understand: *How can working together help us make better decisions?*

A community is not just one person. It is many people. Working together with many people can take time and patience. But usually it helps a community make better



decisions. In this activity you will investigate to see if this is true in your community. This investigation will help you understand why it is important to include people when making decisions.

1. You are going to do two experiments. You will need a large group. If you have a large team (12 people or more) you can work as a team. If you have a smaller team (2 to 11 people) you may want to work together with another team or even your whole class.
2. Start with Experiment 1. You can do this experiment two ways. Option A is a little easier. Option B is a little more difficult. You and your teacher can decide which option is best.

Option A: Easier

Remember in Task 1 when you thought about how you would feel if two of your classmates made a rule for the whole class without talking to you. Now you will experiment to notice what happens if only two classmates make decisions for your whole class. Will they be able to make decisions that work for everyone?

- a. Have a teacher pick two of your classmates.
- b. The two classmates will design a shared community space that they think is best for everyone. The two classmates can use their ideas from the Discover activity.
- c. No one else should talk or give ideas.
- d. As the two classmates design the space, they should write, draw, or otherwise record their design so everyone can remember it later.

Option B: More Difficult

Remember at the end of Task 3 when you thought about how decisions were made in your community? Now you will experiment to understand how the process of making decisions can affect those decisions.

- a. Think about how decisions are made in your community. There might be one or more than one leader making decisions. There might also be advisors or other people involved.



- b. You and your classmates will take on decision-making roles that are similar to the ones in your community. For example, if your community has one person in charge with five advisors, then pick one classmate to be in charge. Pick five other classmates to be advisors.
- c. Either your group or your teacher can pick the people who will play each role.
- d. Now the decision-makers need to design a shared community space that they think is best for everyone. The decision-makers can use their ideas from the Discover activity.
- e. No one else should talk or give ideas.
- f. As the decision-makers design the space, they should write, draw, or otherwise record their design so everyone can see it later.

3. After you have finished either Option A or Option B, come back together as a class or team. This is the end of Experiment 1. You will discuss the results later.
4. Now start Experiment 2. In this experiment you will try to make decisions in a different way.
5. In Experiment 2, your whole group will design a shared community space together. Everyone should share their ideas. Share your ideas with as many people as you want. Think about the ideas you wrote, drew, or recorded when you were in charge of the design in the Discover activity. These are the ideas you should share.
6. Design a shared community space together in a way that works best for your group. For example, you could:
 - a. Use the board and have different group members draw on it.
 - b. Have group members move around and talk to each other to share ideas.
 - c. Use another way to record everyone's ideas.
7. As a group, write, draw, or record your design for a shared community space. You have now finished Experiment 2. You will discuss the results in the next activity.





Act: *Why is it important to include others when making decisions about my community?*

Now you will compare the results from your experiments. You will think about how the way you made decisions affected the decisions you made. This will help you decide how you want to make decisions about taking action in your community.

1. Pull out the designs from Experiments 1 and 2 and display them next to each other.
2. Silently notice any differences and similarities between the two designs.
3. Now have your teacher take out the folded pieces of paper or recordings that show each person's ideas for your imagined shared community space. Either:
 - a. Unfold these pieces of pieces of paper and display them for everyone to see. Move around the room by yourself and notice all the things that the people in your class want.
 - b. Or, if you recorded your voices, play those recordings for everyone to hear. Listen to the ideas of everyone in your group.
4. Compare the ideas from your classmates with the designs from Experiments 1 and 2. Discuss as a whole group:
 - a. Did the design from Experiment 1 or the design from Experiment 2 match more of the things people in your class wanted in their shared community space?
 - b. When you have a shared community space, why is it important to think about what everyone wants?
 - c. Which design do you think would be better?
5. Now think about how decisions were made in Experiment 1. Only some of the people in your group were able to share their ideas.
6. Ask one of the decision-makers to share how it felt to make decisions for everyone.
7. Ask one of the classmates who was not a decision-maker to share how it felt to have someone else make decisions for them.
8. As a whole group, discuss:
 - a. Were there ideas that were missed in Experiment 1 because everyone did not get a chance to talk?



- b. Would it have made a difference if the decision-makers had talked to the others before making a decision?
 - c. What else would have helped the decision-makers make better decisions?
9. Now think about how decisions were made in Experiment 2. As a whole group discuss:
 - a. How did it feel to make decisions as a big group?
 - b. What did you like about making decisions this way?
 - c. What did you not like about making decisions this way?
 - d. Did everyone's ideas make it into the final design or were there some ideas that got left out?
 - e. If some people's ideas got left out, why was that?
 - f. What else would have helped your group make better decisions?
10. Gather as a team. Remember what you learned in Task 3 about decision-making in your local community. Discuss:
 - a. Are there people in your community who do not get to share their ideas?
 - b. How do you think that makes them feel?
 - c. How could your community decision-makers get ideas from more people?
 - d. How would decisions in your community change if more people were involved in the decision-making process?
11. Think about the way you make decisions as a team. As a team you can choose to make decisions in a way that includes everyone. Discuss with your teammates whether you think you need to change the way you are making decisions.
12. Take out your *Balanced Community Goals*. As a team, you have the chance to choose how you think decisions *should* be made in your community. Do you want or need to add a goal to your *Balanced Community Goals* related to the way decisions are made in your community? If so, add that goal now.



Task 5: How do we include the community in our actions?

Learning from and working with your local community is a process that does not end. As action researchers you continue to **discover** what you know and what you still need to find out. To take action you need to partner with your community. So, you need to **understand** the best way to communicate with your community. Finally, you will use this information to **act** and get feedback on your community goals.



Discover: *How do we want to make community decisions?*

You have discovered information about your local community. Now you will think about what you already know and what you still need to find out. Your team has investigated your community in several ways. Get out your Community Identity Map from Task 1, your record of how your community changed from Task 2, and your record of your community decision-making from Task 3.

1. Work with your team. Title a sheet of paper or a digital document Part 2 Organizer. Make three columns. Write the words “Know,” “Think,” and “Wonder” at the top of the columns.
2. List or draw everything your team knows about your community in the *Know* column. Include anything you learned from your investigations. And include anything you already knew about your community because you experienced it yourself. Consider:
 - a. Who is in our community?
 - b. How has our community changed?
 - c. Who makes decisions in our community?
 - d. How can including the community help make better decisions?
 - e. For example, maybe you know that there are people living in your community who are thought to be different in some way. You can write that down.
3. List or draw everything your team thinks about your community under the *Think* column. Consider:
 - a. Why are certain people picked as decision-makers in our community?
 - b. Does decision-making our community exclude certain people?



- c. Do we think there are problems with the way decisions are made in our community?
- d. For example, maybe you think it is a problem that decision-making in your community excludes the ideas of the people who are thought to be different.
4. List or draw everything your team still wonders about your community under the *Wonder* column. Consider:
 - a. Are there questions you still have about people in your community?
 - b. Are there actions you could take that would change your community for the better?
 - c. For example, maybe you wonder if you could include the ideas of people who are thought to be different when you are making decisions.
5. Keep the *Part 2 Organizer* safe. You will need it again.



Understand: *How can we share what we have learned with others?*

You have gotten a lot of information from your community. Action researchers also give information back to the community. Partnering with your community means understanding the best ways to reach them. In this activity you will investigate the best ways to communicate with your local community.

1. First read Angela's ideas and think about why you believe it is important to share information you find out with your community.

Angela Says . . .



Sharing your research with the community is an important part of the relationship you are building. I think it's so important for researchers to do that. Don't be "helicopter researchers," where they come in, they ask their questions, they leave, and then they never come back. If we don't give back to communities and share what we have learned, how are they ever going to change, grow, or be better? When you share back with the community, they can use your results to implement changes or create policy. Figuring out who needs to do what in order to make a better place, that's what research should really be doing.



2. Think about how you get information about what is going on in your local community. Do you:
 - a. Hear it from others, like your friends and family
 - b. See or hear it on television or radio
 - c. Read it in print, like a newspaper or flyer
 - d. Use the Internet, like an online news site or social media
 - e. Read it on a cell or mobile phone, like through SMS/text alerts
 - f. Get it another way
3. Talk with the rest of your team. Share with one another how you get information. Discuss whether you trust some information sources more than others.
4. Now you need to talk to other community members to see how they get their information.
5. There are several ways you can do this. You can choose one or two methods to get more information. You can:
 - a. **Interview:** Have each team member talk to a few people in the community about how they get their information. It may be easiest to talk to people who you already know, like trusted adults or friends.
 - b. **Survey:** Design and give a survey that asks questions about how people get information.
 - c. **Observation:** Move around your local community and notice how information is communicated. Are there billboards, signs, announcements, radio programs, or other things you notice that are designed to communicate information?
6. Come back together and share the information you learned with the rest of your team.
7. In the future, you will need to communicate with your local community. Using what you learned, think with your team about:
 - a. What is the best way to communicate with the people in your local community?
 - b. Are there some people who get left out of community communications? For example, billboards and signs can exclude people who have low vision or are blind, or who can't read the language on the signs. Are there ways to communicate that include everyone in the community?



8. Record these ideas to help you remember how to communicate with your community. You can title a piece of paper Community Communication and write down your ideas. Or find another way to help you remember, like drawing a picture or recording your voices.



Act: *How will we change our goals after thinking about other perspectives?*

You have learned that including more people can help you make better decisions. As a team, you have made decisions about goals you think will help create a balanced community. Now you will get opinions on those goals from other people in your community. Then consider if you want to change any of your goals.

1. Think about a person or some people in your local community who know your community well. Some ideas might be:
 - a. Parents or other trusted family members who live in your local community
 - b. School leaders, like a teacher or principal
 - c. Elders or other trusted adults in your community
 - d. Other children or teenagers
 - e. Another idea you have
2. As a team or on your own, share your Balanced Community Goals with the person or people your team chose. Ask them:
 - a. Do these goals make sense for our community?
 - b. Are some of the goals more important than others?
 - c. Are there goals that should be added?

 **Emotional Safety Tip**

Sometimes people you talk to may have different opinions than you. That's okay. Listen respectfully but remember that just because someone else believes something does not mean you need to believe it. It is okay to pause or stop a conversation if you are uncomfortable or upset.



3. Come back together as a team. Discuss:
 - a. Did anyone you talked to have ideas that surprised you?
 - b. Which ideas did you agree with?
 - c. Which ideas did you disagree with?
4. Do you want to change your *Balanced Community Goals* after hearing some new ideas? If so, do that now. Remember, just because you talked to someone with different ideas, does not mean you have to use those ideas. You and your team make the final decision about which goals you think are most important.

Angela Says . . .



Come at the research with your whole heart. Be mindful of people and try to be inclusive of everyone. If you've done the research and if you're passionate about the results, the community will see that. If you did it in a good way, the community's going to want to take up your recommendations and your results. Because I've seen communities decide to create programs and services and policies that will change things, based on what you say. Youth have a bigger voice than they give themselves credit for. They seem to think that adults aren't listening to them, but we really are. The problem is you're coming with new, fresh ideas. Sometimes older people are kind of set in our ways and not listening well enough. Don't give up hope that your actions and your research is not important, because it is.

Congratulations!

You have finished Part 2.

Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definition, or anything else that will help you. Add other words to the glossary if you would like.

Access: Able to reach a place, thing, or idea

Action researchers: People who use their own knowledge and information they find out from their community to make decisions and take action on important issues

Allyship: Providing help and support to someone going through a struggle

Anonymous: People do not list their name

Approve: to allow to happen

Case study: A record of something that happened

Census: A list of information about people in the community which may include age, gender, family, religion, income (how much money a person or family makes per year), or race

Cis-gender: A person whose gender identity matches the sex they were assigned at birth. For example, a person who was assigned female at birth and thinks of themselves as a girl or woman.

Community: A group of people that have a place or other thing in common

Concept map: A visual that helps you show information



Deny: to prevent from happening

Design: Decide on the look and function of a building, space, process, or object

Economic: About money, income, and use of wealth

Emissions: material that is sent into the air, such as exhaust from a car

Environmental: About the natural world

Ethical: The fairness of something

Exclusion: Being kept out of something

Identity: Characteristics that make up each person or thing

Inclusive: Making sure no one is left out

Indigenous: A group of people or other living things that are native to a place and have not migrated from elsewhere

Investigation: Finding out more information

Iridescent: Color that changes depending on which angle you view it from

Mentor: Someone who has experience and can help guide you

Minority: The smaller amount in a group



Observation: Recording what you notice without adding your own opinion

Oral history: Recording information from people about their past

Ornithology: The study of birds

Paradigm: A way of thinking about the world

Perspective: A specific way of thinking about the world around us

Reflect: Think carefully about something

Social: About the interaction of people in a community

Sustainable: A balanced, long-term approach to social, environmental, economic, and ethical concerns

Survey: A list of questions that you can give to a group of people

Traumatic: Causing harm, stress, or anxiety, either physically or mentally

Unceded: Territory or items that have that have been taken without permission from the original owners

Other words:



BIODIVERSITY!



Part 3:

**How can I balance
the needs of
people and other
living things in
my community?**

**SUSTAINABLE
DEVELOPMENT GOALS**

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE
HEALTH
POLICY**
the interacademy partnership

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Image Credits

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Figure 3.1: Ximena Velez-Zuazo headshot: Ricardo Stanoss/NZP-SCBI

Reynaldo Linares-Palomino headshot: Ricardo Stanoss/NZP-SCBI

Figure 3.1: Ximena Velez-Zuazo

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Figure 3.3: Logan Schmidt/SSEC

Figure 3.4: Ultima_Gaina/iStock/Getty Images Plus

Figure 3.5: Logan Schmidt/SSEC

Figure 3.6: Reynaldo Linares-Palomino

Figure 3.7: Reynaldo Linares-Palomino

Figure 3.8: Sebastian Lozano, SCBI/CCS-BMAP

Figure 3.9: Brian Griffiths: ACEER, OnePlanet



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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What living things are in our research area?					
Discover	Consider the living things in your community and the senses you use to observe them.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 	<u>Living Things Identity Map</u> (Part 1, Task 2)	20 minutes	112
Understand	Use tools to investigate what living things are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 	<u>My Research Area map</u> (Part 1, Task 4)	20 minutes + investigation time	115
Act	Classify living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 		30 minutes	119
Task 2: What do the living things in our research area need to survive?					
Discover	Discuss with your team what the living things in your research area might need to survive	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1)	15 minutes	123
Understand	Investigate the different needs of the living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • 3 plants • Soil • 3 plastic cups • Water 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Oral History Instructions</u> (Part 2, Task 2), optional	45 minutes	124
Act	Share the different needs of living things in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2) <u>Balanced Community Goals</u> (Part 1, Task 3)	25 minutes	127



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What do the people in our community need to survive?					
Discover	Identify what you need and how you meet those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	129
Understand	Investigate the needs and wants of the people living in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Photos of research area (optional, Investigation D) 	<u>Survey Instructions</u> (Part 2, Task 2), optional <u>My Research Area map</u> (Part 1, Task 4), optional	30 minutes + investigation time	130
Act	Share your communities needs and wants.	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	25 minutes	132
Task 4: What are the conflicts between people and other living things in my community?					
Discover	Examine conflicts from various perspectives.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Computer (optional) 		25 minutes	134
Understand	Explore a case study about conflict between people and living things.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		30 minutes	136
Act	Identify some conflicts between people and other living things in your community.	<ul style="list-style-type: none"> • Paper • Pencils 	<u>Part 3 Organizer</u> (Task 1)	30 minutes	140



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	143
Understand	Decide on individual actions you will take to help your community.		<u>Part 3 Organizer</u> (Task 1)	15 minutes	144
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	146

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



3

Part 3. How can I balance the needs of people and other living things in my community?

In Parts 1 and 2 your team gathered information about the living things in your community. You started to think about your goals for a balanced community. In this Part your team will collect even more information about the people and other living things in your research area. You will find out more about the **biodiversity**, or the different types of living things, in your research area. You will also investigate what the living things and people in your research area need to live. You will learn how scientists try to balance the needs of people and other living things. This will help your team take action to balance the needs of people and other living things in your community in Part 7.

Remember: *In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.*

Your Research Mentors

Sharing your experiences with others and learning from others' experiences is part of being a good action researcher. In Part 3 you will have two research mentors. A mentor is someone who has experience and can help guide you. The research mentors in this Part will help you understand some of the issues related to biodiversity and how you can investigate and take action on those issues.

Meet Ximena and Reynaldo, Your Part 3 Research Mentors



This is Dr. Ximena Velez-Zuazo. Ximena (Hee-MEN-ah) is a scientist who works for the Smithsonian Institution. Ximena leads a research team in Peru. Ximena's research area includes a **breakwater**. A breakwater is a large structure that protects a port from waves and storms and allows ships to safely approach. It is built by humans. Ximena works near a breakwater at the end of a



pipeline. A pipeline is a structure that moves gas or liquid from one place to another. It is also built by humans.

Building a breakwater can disturb living things. It can also attract living things to live in that area. Ximena's job is to figure out what things are living at the breakwater. She collects data to figure out if the biodiversity in her research area changes because of the breakwater.



This is Dr. Reynaldo Linares-Palomino. Reynaldo (Ray-NALL-doh) also works for the Smithsonian Institution and leads a research team in Peru. His research area includes the same pipeline that Ximena works near. But Reynaldo's team works on the part of the pipeline that is on land.

Reynaldo's job is to figure out what things are living near the pipeline. He also collects data to figure out if the biodiversity in his research area changes because of the pipeline.

Ximena and Reynaldo have knowledge and perspectives that came from their identities. Since Ximena and Reynaldo are now working with you, it is important to understand who they are.

To help you, Ximena and Reynaldo filled out an identity map, just like you did in Part 1. Ximena's identity map includes the following things:

Ximena included the following things in her identity map:

- I am 47 years old
- I am female
- I am Latin, Amerindian, European, and Chinese
- I live in Lima, Peru
- I have brown hair, brown eyes, wear glasses, and have tan skin
- I am funny in my own language, positive, optimistic
- I am the middle sibling
- I love arts and crafts, sports, and the ocean
- I am part of groups for women in science, technology, engineering, and math (STEM), and women who code



Reynaldo included the following things in his identity map:

- I am 49 years old
- I am male
- I am Latino
- I live in Lima, Peru
- I am from Peru but lived almost a third of my life in Germany
- Cuzco and Tarapoto are important cities for my family
- I have long black hair and glasses
- I am “pensativo” (thoughtful), quiet, and calm but with a big laugh
- I am a dad to a 14-year-old and a 5-year-old
- I love hearing and making music, and reading about the history of science
- I love being outdoors, hiking, running, and reading

Before you begin the rest of Part 3, think quietly to yourself about Ximena and Reynaldo’s identity maps.

- Are there things you have in common with Ximena and Reynaldo?
- Are there ways in which you are different from Ximena and Reynaldo?
- Can you see anything about Ximena and Reynaldo’s identities that would help them understand how to balance the needs of people with the needs of living things?



Task 1: What living things are in our research area?

Your team is trying to achieve the goal of a balanced community. In other words, you are trying to meet the needs of the people living in your community while also meeting the needs of other living things. For example, people need space to live. But so do the plants, animals, fungi, and bacteria in your community. To figure out the best way to share that space, you need to know which plants, animals, fungi, and bacteria are living in your research area.

In this task you will explore what else is living in your research area besides people. You will **discover** how to use your senses and other tools to help you find living things. You will plan an investigation to **understand** what living things are in your research area. Then you will **act** to **classify** and record these living things.



Discover: *What living things did we discover already?*

In Part 1 your team started exploring what living things are in your community. You made a map of some of the living things in your community. Now your team will find even more living things in your research area. You will learn from other scientists how to use your senses and other tools to do this.

1. Take out your *Living Things Identity Map* from Part 1, Task 2, Act.
2. Consider the map with your team. Discuss what kinds of living things your team observed most often. Did you notice more animals, plants, fungi, or bacteria? Remember that it's okay if you didn't notice bacteria. They are very small and you can't easily observe them.
3. You may have noticed that your team observed one kind of living thing more often than the others. Remember this when you are planning your investigation in the Understand activity. Try to search for the living things that your team didn't notice as often in Part 1.
4. Consider *Living Things Identity Map* from Part 1 again. Discuss how your team completed that activity. How did each person use their senses to observe the living things in your community?
 - a. Remember that you did not use your sense of taste because that sense is unsafe in this kind of scientific investigation.



5. Work as a team to record your answers. Record them in whatever way works best for your team, such as a list, drawing, video, or some other way. However you record it, leave some extra space because your team will add to this as you learn more in the next few steps.
6. In the next activity your team will use your senses and other tools to find living things in your research area. Learn how Ximena and Reynaldo use their senses to find living things. You will also learn how they use tools, such as cameras, to help them make their observations.

Ximena says...



I use my sense of hearing underwater. I hear whales, dolphins, fishes, and other living things in the ocean that make noise. I use my sense of sight to identify and locate fish underwater. I use my sense of touch, although never to touch corals! I use my sense of touch to handle fishes, sea turtles, or sharks. Out of the water I use smell, definitely with seabirds and their guano.

The tools we use include drones underwater and flying drones above water. We use camera traps and webcams, machines that record sound underwater, GoPro cameras, microscopes, rulers, and scales.



Figure 3.1: Ximena also uses a wetsuit, mask, and fins to help her swim around and find living things underwater.



Reynaldo says:

I use my vision to look at different forms and colors. I also use touch to see if a leaf or bark is leathery, rough, or soft, because those differences allow me to classify the different kinds of plants. Smell helps. For example, when I slash the bark, does the sap that comes out smell sweet or bitter? And when I'm in the middle of the jungle and there are lots of potentially dangerous animals, you have to be aware of noises as well, like bees and wasps and snakes.

One of the main tools I use is a handheld magnifying lens. Sometimes you need to look at really small parts of flowers or leaves, and they are not easy to see, especially for me, who uses glasses! We usually have magnifying glasses around our necks and carry them everywhere. We use measuring tapes, too. We used to use heavy and expensive cameras but now you can get a clear picture with a simple cell phone, so we take cell phones with us. You don't need expensive equipment.



Figure 3.2: Reynaldo collects data about organisms in the desert of Peru.

7. Think about how Ximena and Reynaldo use their senses and other tools to find the living things in their research area. Take out the record you made in step 5 and discuss the following questions as a team:



- a. Could you use any of the same senses or tools that Ximena, Reynaldo, and their teams used?
 - b. What other senses or tools do you want to use?
8. Add any useful suggestions from Ximena and Reynaldo to your record.
 9. This record will help you plan an investigation in the next activity. Your team will use your senses and other tools to find the living things in your research area.



Understand: How can we investigate our research area?

In the Discover activity you thought about how you can use your senses or other tools to find living things in your research area. Now your team will use this information to plan an investigation. Don't worry about trying to find all of the living things in your research area in this activity. Just do the best you can. If your team completes Parts 4, 5, and 6 you will have more chances to find living things.

1. Gather your team and take out the *My Research Area* map you made in Part 1, Task 4, Act. Recall where your research area is.
2. Your team will observe the living things in your research area.
3. Read *Investigation Instructions* for more information about how to observe living things in your research area.

Investigation Instructions

Where to investigate:

- a. It can feel overwhelming to explore your entire research area. But you do not have to explore your entire research area all at once! Start with just one space. For example, you might only observe the space right outside of your home or school.
- b. Some scientists observe a very small section of their research area at a time. For example, the Biocube activity from the Smithsonian National Museum of Natural History describes how you can use a 1-meter cube to explore your research area. This allows you to explore a small area very thoroughly before moving on. More information about the Biocube activity is in the *Biodiversity!* StoryMap.



- c. Pick a space that you can safely and comfortably go back to. You may need to observe that space more than once to find living things.

Tools you can use:

- a. You can use your senses. Consider what you recorded in the Discover activity about how your team, Ximena, and Reynaldo all use their senses to find living things. Make this a part of your plan. Remember to never use your sense of taste. Read the Physical Safety Tips at the bottom of this box for more information on using your senses safely.

 **Emotional Safety Tip**

Remember to be an inclusive team member. Every person on your team brings different skills and perspectives. Some members of your team may not want to or be able to use all of their senses. That is fine. Talk to your teammates and find a way for everyone to participate and feel comfortable.

- b. A magnifying glass can help you look closely at living things or find very small living things.
- c. A camera can help you record the living things you find so you can observe more closely later. You can also use photos to share what you find with your teammates or other scientists.
- d. Paper and a writing tool can help you record a description or draw the living things that you find.

Tips for doing this investigation:

- a. Record when you find a living thing. You could make a list, draw a picture, say it into an audio recorder, or use another way.
- b. If you find the same kind of living thing more than once you should write that down. For example, if you find four pine trees in the space outside of your home, record “four” next to where you recorded “pine trees.”
- c. Try moving through your area in a pattern. For example, start by searching for living things high up, then at the level of your head, then down by the



- ground. Or place a string or rope in a straight line through your research area and observe things only within 1 meter of that line.
- d. It can be easier to find living things on land. But remember to also search for living things in water, such as puddles, streams, ponds, or the ocean. Consider using a container to collect some water so you can closely observe the living things.
 - e. Remember to search for living things in the air. You can also search for living things in high places. If you are able, a tool like a pair of binoculars can help you observe living things in the air or high places such as tall trees.
 - f. Observe living things at different times of day or the year. For example, try observing your research area at dawn, dusk, or at night. Some living things only come out at those times. Remember to get permission from an adult to observe living things at night to make sure it is safe to do so. If you use a light to search for animals be careful not to shine it directly at them. You can also observe living things during different seasons. For example, some living things may only be visible during the wet season.
 - g. Explore in, around, and under any human-made structures or objects. Some living things use human-made spaces as habitat. For example, sometimes birds build their nests in buildings or plants grow in the cracks in pavement.



Figure 3.3: Search for living things everywhere. They may be growing in places you wouldn't expect. This plant is growing underneath a highway in an area of rock and concrete.



- h. Be quiet as you observe. Loud noises may scare away animals.
- i. Consider staying in one part of your research area for several minutes to allow living things to return to the area after being disturbed. Notice what you observe after 1 minute, 5 minutes, and 15 minutes. This can be a good time to just listen for living things if that sense is available to you.
- j. Try not to disturb the living things as you explore your research area. If you pick something up or take it with you, try to return it to exactly where you found it.
- k. Observe animals that are wild. Do not observe animals that are being cared for by people. For example, do not observe pets, animals in zoos or aquariums, or animals that are on farms.

Safety Tips for Observing Outside:

Talk to your teacher first for guidelines. They will know what is safest in your community.

Physical Safety Tip

Do not observe a research area by yourself. Always work with at least one other person, which could be an adult or a teammate. Be a good ally to your teammates and notice if they are uncomfortable or unsafe. Offer to pause the investigation or move to another part of the research area. Always pay attention to local guidance on whether it is safe to interact with people outside of your home.

Do not use your sense of taste to try to observe living things. Do not touch living things that you are unsure are safe to touch. For example, some plants and fungi can irritate your skin and some animals may bite or sting.

Emotional Safety Tip

Do not be discouraged if it is difficult to find living things. Every research area is different. Some areas may have many living things and some may have very few. It is not your fault if you have trouble finding living things. Just practice using your senses and other tools to do your investigation. If you feel sad or wish there were more living things in your research area, remember that you will take action to make this possible!



4. If finding living things outside doesn't sound like the right investigation for your team, that's okay! You can pick another way to collect information about your research area.
 - a. You can use online tools, such as iNaturalist, to find out what living things have already been found in your research area. More information about iNaturalist is in the *Biodiversity!* StoryMap.
 - b. You can use books, lists, websites, videos, artwork, photos, stories, or other records of your research area and notice the different kinds of living things they show. Try to use records that have been made recently to make sure you are only observing living things that still live in your research area.
 - c. You can write, call, or talk to local scientists, researchers, older people who have lived in the community a long time, gardeners, or other experts on living things in your research area. Ask them to describe what living things they have observed in your research area.
5. Decide as a team how you will investigate.
6. Remember, including everyone on your team is important. Try to pick a way to investigate that allows everyone to participate. Don't forget to think about the timing, comfort, location, and format of your investigation to make sure everyone on the team feels included. You can reread Part 2, Task 2, Understand if you need more information about making your investigation inclusive.
7. Next, work with your team to plan how you will do your investigation. For example, if you decide to do an observation, decide which teammates will observe which parts of the research area. Decide how long you will spend finding living things. Decide how you will record the living things you find and who will do the recording.
8. Finally, do your investigation with your team.



Act: *How can we classify the living things in our research area?*

Your team has just completed a very important step in helping to balance the needs of people and other living things in your community. You have observed the kinds of living things in your research area. Now you will classify these living things. This information will help you complete the rest of this Part and to take action in Part 7 to create a balanced community.



1. Your team is going to classify the living things you just found in your research area. Classify means to name or identify something and to sort it into a group. Classifying living things can help you understand more about the biodiversity in your research area. Remember that biodiversity is a measurement of how many different living things are in an area. To measure biodiversity in your research area, you need to know how many different kinds of living things you observed.
2. Read [Tools to Help Classify Living Things](#) for more information about how to classify living things in your research area.

Tools to Help Classify Living Things

1. A field guide is a tool that has the names, images, and descriptions of living things in an area. Field guides may be printed (such as books) or online.
2. If you do not have a field guide, your team can come up with your own names for living things in your research area. Read [How to Classify Living Things](#) for more information.
3. You can use an online tool such as the iNaturalist website, which is also known as a community science tool. People in a community take photos or describe what living things they have noticed in their area. They send the photos and descriptions to scientists through the website. The scientists help identify what the living things are. This helps scientists and community members keep a record of what kinds of living things are in an area. More information for iNaturalist is in the *Biodiversity!* StoryMap.
4. Communicate with a person who is respected in your community because of their knowledge of the environment and living things. This might be someone who has lived in the community for a long time, someone with traditional knowledge, or someone who gardens.
5. If you don't have access to any tools to help you classify, just try to notice if the living things you observed are different from each other. For example, maybe you observed a plant in your research area that had small, spiky leaves and another plant that had large, flat leaves. Even though you don't know the names of the plants, you can tell that they are not the same. Record that you observed two different plants in your research area.



3. Read *How to Classify Living Things*. It explains that there are many ways to classify a living thing. No matter which way you choose to classify the living things in your area, remember that your way is valuable because it came from you.

How to Classify Living Things

You can use a field guide to help you find out the names of living things in your area. The field guide may use scientific names. Scientific names are two-part names that some people in the scientific community use to identify living things. For example, the scientific name for a puma is *Puma concolor*.

But a scientific name is not the “right” or only way to identify living things in your research area. You may already have a name for living things in your own language or in your own community. For example, the scientific name of the bird in Figure 3.3 is *Paroaria gularis*. This bird is called a red-capped cardinal in English. But in the Ese'Eja language this bird is called chaji'i'i or enaena. There are many different names for the living things on Earth. Search for the name that works best for you or create your own.

If you can't find or think of a name, you can also identify a living thing based on what you observe about it. You could identify it based on what it means to people in your community. Or you could identify it based on something that living thing does or represents. For example, if the Ese'Eja hear the chaji'i'i bird singing it means it is about to rain. What do some of the living things in your community mean to you? Do you notice them at particular times of year or day?



Figure 3.4: A chaji'i'i or enaena.



4. Work with your team. Title a sheet of paper or a digital document *Part 3 Organizer*. Make three columns just like you did for your *Part 2 Organizer*. Write the words “Know,” “Think,” and “Wonder” at the top of the columns.
5. Create a list in the *Know* column of the living things that your team found in the research area.
 - a. Record the name of each living thing you found. If you were not able to find or create a name you can write a description, use a symbol, or make a drawing.
 - b. Record whether the living thing you found was a fungus, plant, bacterium, or animal.
 - c. List how many of that living thing you found.
 - d. If several team members found the same living thing, combine those numbers and record the total. For example, if one person found four pine trees in their part of the research area and another person found five pine trees in their part of the research area, record “nine pine trees.”
6. Discuss the following questions as a team:
 - a. Consider your *Know* column. Did your research area have many different kinds of living things? Or did it have the same kind of living thing over and over?
 - b. Were there any living things that you found more than once? For example, did you find a type of fungus more than once?
7. Answer the following questions in the *Think* column:
 - a. What does your team think or feel about the biodiversity in your research area?
8. Answer the following questions in the *Wonder* column:
 - a. What other kinds of living things do you think might live in your research area?
 - b. Do you wish your research area had more kinds of living things?
9. Keep the *Part 3 Organizer* in a safe place.



Task 2: What do the living things in our research area need to survive?

In this task your team will explore what the living things in your research area need to survive. You will **discover** what you already know about the needs of living things. Then you will use an investigation to **understand** what the living things in your research area need. Finally, you will **act** on this information to decide how well your community is meeting those needs.



Discover: *What do we already know about what living things need?*

In the Part 1, Task 1, Understand activity you observed a living thing in the community and thought about what it might need to survive. Now you will work with your team to discuss what living things in your research area might need to survive. This will help prepare you for the investigation in the Understand activity.

1. Take out your *Part 3 Organizer*.
2. Consider the list of living things in the *Know* column.
3. Choose a living thing that you observed and think about these questions on your own:
 - a. What do you think that living thing needs to survive?
 - b. What did you notice about where you found this living thing? For example, was it near water? Did you notice it eating anything near it? Was it in a sunny place?
4. Gather as a team and have the team leader share what they think their living thing needs. For example, if they observed a mushroom and they think it needs a wet, soggy place to grow they would write that next to “mushroom” in the *Know* column.
5. Share what you think your living thing needs. Either you or the team leader can record your answer in the *Know* column.
6. Record the answer of everyone else on the team. Remember that your teammates are just sharing their thoughts and guesses. Do not worry about being right. Your team will have a chance to find out more in the Understand activity and add to your answers in the Act activity.





Understand: How can we investigate what living things need to survive?

Living things need certain things to survive. For example, humans and many other kinds of animals need oxygen to survive. Every time you breathe in and out you are meeting your needs.

Many living things share a need for water, space, and a source of energy. But each living thing on Earth is different. Some plants can survive for a long time without water. Bacteria only need a very small space to live in, while a fungus may spread out for hundreds of meters underground. Plants can make their own energy using sunlight, carbon dioxide, and water, while an animal has to eat other living things to survive. In this activity your team will investigate the different needs of the living things in your research area.

1. Gather your team together and take out your *Part 3 Organizer*.
2. Read through the list of living things in the *Know* column. Remind yourself of what is living in your research area. Remember that your team thought about what these living things might need in the Discover activity. Now you will need to work as a team to find out what these living things actually need to survive.
3. Discuss how you will investigate the needs of the living things in your research area. Remember that in general, living things need water, space, and a source of energy. Each living thing needs different amounts and may meet its needs from different sources. For example, a small plant living in cracks in the pavement might only need a little bit of space for its roots. But a pine tree may need several meters of space for its roots.
4. There are many ways to investigate. You could:
 - a. Plan another observation like you did in Task 1. You could observe each living thing outdoors and notice how it is meeting its needs for water, space, and a source of energy. Be aware that some needs may be more difficult to observe than others. It can be hard to notice what an animal needs to eat if it isn't eating when you observe it.
 - b. Interview an expert in your community on the phone, online, or in person. An interview is similar to the oral history you collected in Part 2, Task 2, Understand. But instead of asking about the past you will ask people about



what they know now. Go back to Part 2, Task 2, Understand if you need help with this kind of investigation. You could interview:

- i. Older people who have lived in the community a long time and know about the living things in it
 - ii. A person who is respected in your community because of their knowledge of the environment and living things
 - iii. Someone with traditional knowledge of living things
 - iv. A scientist that studies living things
 - v. A gardener, landscaper, or tree surgeon
 - vi. A volunteer at a local nature preserve or wildlife refuge
 - vii. A farmer or another person who works with crops
 - viii. A person who works or volunteers with living things
- c. Use books, websites, videos, artwork, audio recordings, or other records of what the living things in your research area need. Try to use records that have been made recently to make sure you are only learning about the living things that still live in your research area.
- d. Do an experiment like the one in *Experiment: Plant Needs* to observe what certain living things need to survive.

Experiment: Plant Needs

You can use plants to demonstrate the needs of living things. Note: It is not ethical to use animals in this kind of experiment.

1. Get three plants. The plants should be exactly the same kind.
2. It is best to grow, borrow, or purchase plants in containers. It makes it easier to move them to do the experiment. Do not use expensive or precious plants. Use plants that an adult says it is okay to experiment with.
3. Place one plant in a dark space with no light. Continue to give it water as normal.
4. Place one plant in a space with plenty of light. Sunlight is best but light from a lamp can also work. Do not water it.



5. Place one plant in a space with plenty of light. Continue to give it water as normal.
6. Observe each plant every few days.
7. Record how the plants change over time. It may take several days or weeks to notice a change.
8. Which plants seem unhealthy over time? What does this tell you about what plants need to survive?



Figure 3.5: This is one way label the plants in your experiment.

- e. Think of your own way to collect information.
5. It might be difficult to get all of the information you need from just one kind of investigation. You may need to combine more than one kind.
 6. Decide what kind of information you want from this investigation.
 - a. Remember that living things have three basic needs: water, space, and a source of energy. You will need to find out how the living things in your research area are meeting these needs.
 - b. In the next activity you will start to think about how your community is meeting the needs of living things. So try to notice or ask if some of the living things in your research area are having trouble meeting their needs. For example, you may observe that some plants don't seem to have enough



room to grow. Or you may learn in an interview that there are fewer frogs in your community than there used to be because the pond has been drained to make space for a building.

7. Plan your investigation. Decide what needs to be done and who will do each part. You can:
 - a. Split up the list of living things from the *Know* column among your team members. One way is to assign some people to investigate animals, some people to investigate plants, and some people to investigate fungi and bacteria.
 - b. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.
 - c. Decide who will lead the investigation and who will record the information from those investigations.
8. Work with your team to do your investigation.



Act: *How can our community meet the needs of living things?*

Your team has investigated the needs of the different living things in your research area. Now, your team will share what you observed and use that information to decide how well your community is meeting those needs.

1. Take out the information you recorded from the Understand activity.
2. Take out your Part 3 Organizer.
3. Remember that your team recorded what they think some of those living things need in the *Know* column. Now you will have a chance to add to or change your answers.
4. Have the team leader record what they found out in the Understand activity. They should put their answers in the *Know* column. For example, the team leader may have learned from an interview with a scientist that the eagles in the research area need a safe, high space to build a nest and raise chicks. Eagles meet this need by building nests in places like tall trees or human-built towers.
5. Let the team leader know if they describe a need that you also found in the investigation. For example, if you found out that squirrels need space to build



nests and also use tall trees. Circle that need or make some other mark next to it. This will help you record that this is something that more than one living thing needs or wants.

6. Next, share any needs you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
7. You should now have a list of what the living things in your research area need.
8. Discuss what you learned about in the investigation as a team.
 - a. What needs are shared by many different kinds of living things in your research area?
 - b. Are any living things in the research area struggling to meet their needs?
9. Take out your *Part 2 Organizer* or the information from your investigation in Part 2, Task 2, Act. Remember that you investigated how your community changed over time. Information from this investigation can help your team discuss how well your community is meeting the needs of living things. Discuss:
 - a. In the past did your community have a resource that helped meet the needs of living things, such as an area with trees that provided habitat for animals?
 - b. What happened to that resource?
 - c. Why did it change over time?
10. Take out your *Balanced Community Goals*. Review them with your team. Discuss the following questions:
 - a. How well do you think your community is meeting the needs of the living things in your research area?
 - b. Do you think it is important to meet the needs of living things other than people? Why or why not?
 - c. Are there goals in the *Balanced Community Goals* that would help your community meet the needs of living things? If not, think about adding those goals now.



Task 3: What do the people in our community need to survive?

Your team has found out information about the needs of living things in your research area. Now, you will **discover** what you need from your community. You will use an investigation to **understand** what other people need from their community. You will **act** on this information to decide how well your community is meeting those needs.



Discover: *What do I need to survive?*

Your team is trying to create a balanced community. This means that you need to balance the needs of all living things including people in your community. You have already investigated what the other living things in your research area need to survive. Now your team needs to find out what people in your community need. Your team members are an important part of this community. So any research into what people in your community need should start with you.

Emotional Safety Tip

It can be hard to think about what you need, especially if you feel like you or your caregivers aren't able to meet all of your needs. It is not your fault if you can't meet your needs and everyone deserves to have their needs met. It is okay to skip some of the questions in this activity or keep your thoughts to yourself. You don't have to share anything from your personal life with your team if you don't want to. If you feel you need to discuss this more, you can talk to your teacher or another trusted adult.

1. Think quietly to yourself about the following questions. You can record your answers if you would like:
 - a. What do I need in my life? Some examples are listed here:
 - Food
 - Clean water to drink or wash with
 - Space to live in
 - Air to breathe



2. What are things that I don't necessarily need but make me happy? You can also think of these as "wants." Some examples are listed here:
 - Space to play or gather with friends
 - Things that help me get around my community, like roads, buses, or bicycles
 - Places to buy or trade things
 - Products that I enjoy
 - A place to relax, be around living things, or enjoy quiet time
 - Pets or houseplants
3. How does my community help me get what I need and want? Are there places, buildings, spaces, services, or other things that help me?
4. Are my needs more important than the needs of other people?
5. Are my needs more important than the needs of other living things in my community?



Understand: *How can we investigate what our community needs to survive?*

Now that you have thought about what you need and want, you will work with your team to find out what other people in your community need and want. You will do this with an investigation. The information from this investigation is very important because you will use it again in Parts 4, 5, 6, and 7.

1. Discuss how you will investigate the needs and wants of the people living in your community. There are many ways to investigate. You could:
 - a. Interview people in the community on the phone, online, or in person. Ask them about their needs and wants and how the community helps them meet those needs and wants. Remember that an interview is similar to the oral histories you collected in Part 2, Task 2, Understand. But instead of asking about the past you will ask people about what they know now. Go back to Part 2, Task 2, Understand if you need help with this kind of investigation.
 - b. Survey people in the community about their needs and wants and how the community helps them meet those needs and wants. Remember that a survey is a list of simple questions that you can give to a group of people. For example, you can ask "Where do you go in the community to get clean water?" Go back to Part 2, Task 1, Understand if you need help with this kind of investigation.



- c. Move around your research area and make observations about how people in the community are meeting their needs and wants. For example, where do you notice people buying or trading food? How do people in your community earn money? What makes people in your community happy?
- d. You could also do an investigation using maps or photos of your community. This kind of investigation is described in *Investigation of Space in the Community*:

Investigation of Space in the Community

Take out the *My Research Area* map that your team made in Part 1, Task 4, Act. Make a copy of this map. Or if you are able, find a digital map or other kind of map that shows your research area with lots of detail. You need to be able to know what is in each part of the map. For example, it would help if your map had labels for buildings such as, “Community center” or showed the name of a park. If your research area is small and you can take an overhead photo of the entire area, that works well, too.

1. Consider the copy of your research map. You are going to notice how space is used in your community to meet the needs of people and other living things.
2. How much space is used mostly by people to meet their needs and wants? For example, buildings, parking lots, or schools. Find a way to show this on the copy of your map. For example, you could shade in those parts using a certain color.
3. How much space is used mostly by other living things to meet their needs? For example, an abandoned field, a nature preserve, or a river where no one is allowed to boat or fish. Find a way to show this on the copy of your map. Use a different way or color than you did in step 2.
4. How much space is used by both people and other living things to meet their needs and wants? For example, a park, a field where crops are growing, or a pond where both people and animals catch fish to eat. Find a way to show this on the copy of your map. Use a different way or color than you did in step 3.
5. Consider the copy of your research map. Notice the part of the map that is used mostly by people.



6. Notice the part of the map that is used mostly by other living things.
7. Notice the part of the map that is used by both people and living things.
8. Who is using the largest part of the research area? People? Other living things? Or both people and other living things?

2. Decide as a team how you will investigate.
3. Now that you have decided how you will get information about what people need and want, your team needs to decide what information you would like to get.
4. Discuss what you might want to find out about what people need and want. Some examples are listed here:
 - a. What do the people in my community need?
 - b. What do the people in my community want?
 - c. Where do they go to meet their needs and wants?
 - d. What do they do to meet their needs and wants?
 - e. What is more important to the people in my community, a need or a want?
 - f. Do people think their needs and wants are more important than the needs of other living things?
5. Next, work with your team to plan how you will do your investigation. For example, if you decide to pass out a paper survey, decide who will type or write the survey, who will make copies, who will pass the survey out, and who will collect the finished surveys.
6. Finally, do your investigation with your team.



Act: *How is our community meeting the needs of people?*

Your team has investigated what people in your research area need and want. Now, your team will share what you observed.

1. Take out the observations you recorded from the Understand activity.
2. Take out your *Part 3 Organizer*.
3. Have the team leader record what they found out in the Understand activity. They should put their answer in the *Know* column. For example, the team leader may



have learned from an interview that a person in the community needs money to buy food for their family and so they work at a factory to earn money. This person needs roads and buses to help them get to the factory. For this person, being able to earn money for their family is more important than protecting the habitat that the roads cut through.

4. If the team leader shares any needs or wants that you also found in your investigation, let them know. Circle that need or make some other mark. This will help you record that this is something that more than one person needs or wants.
5. Next, share the needs and wants you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
6. You should now have a list of what the people in your community need and want.
7. Discuss what you learned about in the investigation as a team. Record your answer in the *Know* column.
 - a. What are the things that people need and want most often?
 - b. Where do they go to meet their needs and wants?
 - c. What do people do to meet their needs and wants?
 - d. What do people think is more important, a need or a want?
 - e. Do people think their needs and wants are more important than the needs of other living things?
8. Take out your *Balanced Community Goals*. Review them with your team. Discuss the following question:
 - a. Think about how people are using the community to meet their needs and wants. Does this match with the goals we have in our *Balanced Community Goals*?
 - b. If not, what would we need to change about how people are meeting their needs and wants?
9. In the *Think* column, record what your team thinks about the following statement: My community meets the needs and wants of people but not of other living things.
 - a. Do you agree or disagree? Why or why not?
10. Finally, under *Wonder*, consider what you don't know.
 - a. What questions do you still have?



Task 4: What are the conflicts between people and other living things in my community?

In this Task you will **discover** how you think and feel about **conflicts** between people and other living things. Then you will use a case study to **understand** what can happen when people and living things have similar needs. You will **act** to figure out the conflicts you discovered in your investigations and think about what you would change about your community.



Discover: *How do I feel about conflicts between people and living things?*

Sometimes people and other living things have very similar needs or wants. For example, people need space to live, work, and grow food. They want space to relax and play. But other living things need space too. They need space to live, grow, or get food or energy. Sometimes people and other living things can share space. But other times, when people use space to meet their needs, they prevent other living things from being able to meet their needs. For example, if people build a road where plants are growing, those plants can no longer grow there.

1. Think about a time when you and another person both wanted the same thing. Maybe a younger sibling wanted one of your toys or items of clothing but you wanted to keep it for yourself. Or you and someone in your household both needed the bathroom to wash and get clean but only one of you could use it at a time.
2. Think quietly to yourself about the following questions:
 - a. How did it feel to need or want the same thing as someone else?
 - b. How did you decide who would get the thing you both needed or wanted?
 - c. Which is more difficult for you: trying to share something you need or trying to share something you want?
3. When two people need or want the same thing, it can be difficult or impossible to meet those needs at the same time. This is called a conflict. A conflict is a kind of disagreement. There can be conflicts between people when they need or want the same thing. There can also be conflicts between people and other living things in a community when they need or want the same things.



4. Gather as a team.
5. Your team leader is going to share some conflicts between people and other living things in a community. You will share how you feel about each one. These conflicts will help you think about the four perspectives you learned about in Part 1, Task 3.
 - a. If your team is together in the same room, you can move to or point to one part of the room to share how you feel about each sentence. Label three areas of the room "Agree," "Not Sure," and "Disagree."
 - b. If your team is not together in the same room you can share how you feel about each sentence by holding up piece of paper on a video call, send your answer in a text, saying your answer out loud on a phone call, or typing your answer in shared digital document or website.
6. Have the team leader share the following conflicts one at a time. Each one is labeled with the perspectives it includes. Share how you feel about each conflict:
 - a. Environmental, social, and ethical: Our community has some ants and wasps that bother people. It is okay to kill the ants and wasps because they are just insects.
 - b. Economic and environmental: A company in our community is causing **pollution**. This pollution harms the plants, fish, turtles, and insects living in the river. But a lot of people in our community earn money at this company so we should let it keep polluting.
 - c. Ethical and social: In order to protect the living things in our community we should make certain spaces into nature preserves. The people who live in those spaces now will need to find other places to live.
 - d. Environmental and social: Our community has a pond that is a habitat for living things such as salamanders, beavers, and willow trees. But our community needs more space for people to have fun, have festivals, and eat together so we should fill in the pond to make that space.



 **Emotional Safety Tip**

You may have a strong opinion about some of these statements. Remember to be respectful in how you share your thoughts and how you listen to others. It is okay to disagree but remember to disagree with ideas and not people.

***Understand:*** *How can we learn about solving conflicts from others?*

Some people think about the conflicts between people and other living things because it is important to their way of life or it is their job. They want to help make balanced communities. These people think about and try to solve the same kinds of problems you are trying to solve in this guide. As you can guess, these can be difficult problems to solve! But you can learn from others to help you take action.

1. Your research mentors Ximena and Reynaldo try to protect the living things in their research areas. To do this, they have to think about how to balance the needs of people with the needs of living things. The following case study describes some of their work in Peru near a pipeline.
2. Read through the case study two times.
 - a. The first time you read the case study, notice what the people need and want. Notice what they do to meet their needs and wants. Mark the sentences that describe what people need and want. You can underline, use a symbol, a highlighter, a different color pen, or another way.
 - b. The second time you read the case study, notice what the other living things need. Notice what they do to meet their needs. Mark the sentences that describe what living things need. Do it in a different way than you did above.

Case Study

Remember that Ximena and Reynaldo study living things near a breakwater and pipeline in Peru. The pipeline is used to move a kind of **fossil fuel** called **liquefied natural gas**. This fuel is used to heat homes and cook food. The pipeline is owned



by several companies. When the people at these companies sell the fuel, they make money. They keep some of the money. The rest goes to the government of Peru. The government uses some of that money for things the country needs, such as roads, healthcare, or education. Some of the money goes directly to the communities where the pipeline or breakwater has been built.

The people at the pipeline companies want to make money by building and using the pipeline. But building a pipeline uses space. Some of that space is **habitat** for other living things. Habitat is the space that plants, animals, fungi, and bacteria need to live and grow. Building a pipeline can damage the habitat of living things. So before they started building the pipeline, the people at the companies asked scientists from the Smithsonian Institution to make a plan to protect living things.

Part of the plan was building the pipeline underground instead of on the surface. This involved digging a long hole, placing the pipeline in the hole, and putting the soil back on top. Sometimes, when the companies dug up soil that contained plants, animals, fungi, and bacteria they carefully placed the soil to the side. Once the pipeline was placed in the hole, the company put the soil back. This helped save many of the plants, animals, fungi, and bacteria that were living in the soil.



Figure 3.6: Construction equipment lowers the pipeline into the hole.



Building the pipeline underground allowed large animals to move around their habitat easily after the construction was finished. But some smaller animals could not move around easily until more plants grew back in the area. Reynaldo explains, "Most of the bigger animals like birds, foxes, and small cats have not been impacted by the construction. A 20-meter gap without plants is okay for them to cross. But for rodents and lizards, 20 meters is a huge area to cross. They could easily get eaten by a hawk. We needed plants to re-grow before these animals could cross the bare area left after the construction of the pipeline."



Figure 3.7: The bare ground shows where the pipeline has been buried.

The people at the companies also tried to avoid building in areas that were very important for living things. For example, if an area had **rare** plants, animals, or fungi, the company would not build the pipeline there. Or if the area had something that many living things needed, like a pond or a wetland, the companies would not build the pipeline there. But they could not always avoid those areas. Sometimes they had to build the pipeline anyway.

The pipeline ends near the ocean. Ships pick up the gas at a **port**. The company built a large structure called a **breakwater** in the ocean near the pipeline. A breakwater is a large pile of rocks that protects the port from waves and storms.



The area near the pipeline used to have a flat, sandy bottom. Now the breakwater has added many rocks to the area. This helps living things meet their needs. Ximena explains, "Some living things need the rocks to hide and build their homes." Living things like fish, crabs, octopus, and penguins use the breakwater as a home. But there are also risks. Before the gas can go on ships it has to go through a special process. This process makes a lot of very salty water. The water is even saltier than ocean water. When this very salty water is released into the ocean it can harm the living things near the pipeline. Another risk is the living things growing on piles. Piles are the long columns that hold up the port. Ximena explains, "A lot of animals are growing on the piles. But they produce a lot of feces, or poop. This reduces the oxygen in the water. And when there is less oxygen in the water it's like having less oxygen in the air. Many other living things will leave and find other places to live. So once in a while you need to remove the living things on the piles."



Figure 3.8: The long pile of rocks is the breakwater. It is located in front of the port. It protects the ships in the port from strong waves and storms.



3. Look at the sentences you marked in the case study. Think quietly to yourself about the following questions.
- Did the people and the other living things in the case study ever need the same thing?
 - How did the people at the pipeline company try to fix these conflicts?
 - How do you feel about the pipeline? Would you have decided to build it if you were in charge?
 - The pipeline helps meet some people's needs. Is that more important than meeting the needs of the living things near the pipeline?



Act: *What kinds of conflicts exist in our community?*

Your team is working to create a balanced community. To help you do this, you need to find out if the people and other living things in your community have similar needs. Having similar needs can cause a conflict. The more you know about those conflicts, the more prepared you are to take action.

- Remember that in the Discovery activity you thought about a time when you and another person needed the same thing. Your team is going to think about the same kind of conflict. But this time you will try to find out what both people and other living things need.
- If you would like to learn about an example of a conflict between people and the other living things in a community, read the following case study. It describes a conflict between people and other living things on the land that the Ese'Eja used to own. If you don't have time to read it you can skip to the next step.

Case Study

Remember that the Ese'Eja used to own a large area of land in Peru. But the government of Peru created a new law that took away 96% of that land.

Now other people use the land that the Ese'Eja used to own. They cut down trees to get wood for building things or for fuel. Sometimes they even do this



illegally, which means without permission. Some people dig into the ground to get gold so they can sell it for money. These other people are getting what they want and need by using the land and the living things there. But these other people are making it difficult and sometimes impossible for other living things to meet their needs.

Many kinds of living things in this area need the trees for food, a home, and a place to raise young. When the trees are cut down other living things cannot meet their needs. When people dig into the ground to get minerals they also pollute the rivers. When the rivers are polluted the things living there cannot meet their needs.



Figure 3.9: People can use trees for fuel and building materials. But trees are also an important habitat for many kinds of living things.



The actions of other people make it difficult and sometimes impossible for the Ese'Eja to meet their needs. The Ese'Eja explain that "When the habitats of birds, amphibians, mammals, insects, and plants are gone, the creatures lose the ability to survive. When there are no more peccaries and monkeys to hunt, or nuts and seeds to gather, our way of life will be lost ... No longer will our grandfathers show the children how to make hunting bows, or gather macaw feathers to put on the arrows. Our grandmothers will not be able to show their granddaughters how to weave baskets or make our traditional cloth."

3. Take out your team's *Part 3 Organizer*.
4. Consider the information in the *Know* column of your *Part 3 Organizer*. Discuss these questions as a team:
 - a. Do you notice that people and other living things in your community need the same things?
 - b. How could this cause a conflict?
 - c. For example, you may have observed that fish in your research area need a pond to live, grow, raise young, and find food. But people need the same pond to catch animals for food. And they want to use the pond for relaxing and playing.
 - d. Or you may have observed that people in your community use roads and cars to get to their jobs so they can earn money. But those roads and cars make it difficult for animals in your research area to move around safely to look for food. The pollution from the road makes it difficult for plants and fungi to grow.
5. Record your answers in the *Know* column.
6. Consider the list of conflicts your team just made.
 - a. Who got their needs met in each conflict? People? Other living things? Both?
 - b. Why do you think this is?
 - c. What would you do differently?
7. Record your answers in the *Know* column. You will come back to these answers in Part 7.



Task 5: How can I take action to balance needs in my community?

Change happens on different levels. There are things you can change about your own behavior. There are also changes that happen within the whole community. In this task you will **discover** what you know about changes needed for your community. Your team will use this information to decide on your community action plan in Part 7. You will also **understand** some ways you can personally change your behavior to help your community. Then you will **act** on those ideas.



Discover: *What are the most important conflicts in our community?*

In any community there are people and other living things trying to meet their needs. Sometimes these needs cause conflict. Now you will use what you have learned in this Part to think about ways you could make those conflicts better.

1. Take out your *Part 3 Organizer*.
2. Your team has already listed information you found out from your investigations in the *Know* column. Add any additional information you want to remember.
3. Now you will list or draw everything your team thinks about your community under the *Think* column. Consider:
 - a. What do we think are the most important conflicts to solve between people and other living things in our community?
 - b. What do we think are some good ways to try to solve those conflicts?
 - c. Do we think our community could do better at meeting the needs of living things?
4. Take out your Balanced Community Goals. Compare them to the things you *Know* and *Think*. Your Balanced Community Goals show you how your team wants your community to be. What you *Know* and *Think* shows you how your community is. When your community is not the way you want it to be, that is a problem.
5. As a team discuss:
 - a. Did we find any information from our investigations that shows we are not meeting our Balanced Community Goals?
 - b. Record those now in your *Think* column.



6. Think back to the investigations you did in Part 2, Task 3, Understand about who makes decisions in your community. Think about how people your age are involved in making decisions.
 - a. Which conflicts do you think you could take action on?
 - b. Which conflicts would you need help with?
 - c. Record those now in your *Think* column.
7. List or draw everything your team still wonders about your community under the *Wonder* column. Consider:
 - a. Are there questions you still have about how your community meets the needs of people and other living things?
 - b. Are there actions you could take that might help your community balance the needs of people and living things?
8. Keep the Part 3 Organizer safe. You will need it again.



Understand: *How can I choose an action to take in my community?*

In this Part you investigated how the living things in your research area meet their needs. You also learned how the people in your community meet their needs and wants. You noticed how those needs might cause conflicts. You thought about ways that your community could better balance the needs of people and other living things. You will have a chance to put some of these ideas into action in Part 7. However, there are always ways that you could make things in your community better through your own individual actions.

1. Consider the *Think* and *Wonder* sections of your Part 3 Organizer. Are there any problems that you could help to change all on your own? Are there any actions you could take on your own?
2. Discuss your ideas with your team. For example:
 - a. Maybe you noticed that most of the space in your community helps only people meet their needs. You could add something to the space outside of your home to help meet the needs of living things, like a plant that is native to your area. That plant could be a source of energy or habitat for animals, fungi, or bacteria.



- b. If you know a construction project is about to happen in your community, you could share some of the solutions you read about in Case Study #1 with the people managing the construction.
 - c. You could make choices about the things that you buy or do that reduce the amount of waste or pollution coming from your household.
 - d. You could work with the people in your household to make a list of your needs and wants. Then, you all could think about which needs and wants might make it difficult for other living things to meet their needs. Are there any things that you need or want that you could use less of?
 - e. You could ask a member of your household to do one of the observations or experiments from this Part with you so they learn more about the needs of people or living things.
 - f. Come up with your own ideas.
3. Read some examples of action from your research mentors, Ximena and Reynaldo.

Ximena says...



For any kids near the coast, where there are boats, I would have them ask about the quality of the water. How are people handling the water that is used to clean boats? How are people getting rid of the oil from boat motors? Is there a cleaning or recycling system for the water near the boats? Just knowing would be great.

Reynaldo says...



I think we're at a part of history where every person has the power to do things, even if it's small things. It's great if a kid says, "I'm recycling, or I'm walking instead of taking the bus, or I'm using my bicycle instead of being driven to school." Small things show that there are **alternatives** and that we can contribute to something the world needs. Everything that you can do, even if you think it's little, is definitely a huge contribution.



4. Think quietly to yourself about a change you want to make in the way you act. Why do you think this change is important?



Act: *How can I plan an action in my community?*

Changing our own behavior is often the first step. Now that you have decided what you will do to improve your community, you need to put that idea into action.

1. Make a plan for how you will put your idea into action. If you need to share information, where, when, and with whom will you share it. If you need to do something, what do you need to do it.
2. Put your plan into action.
3. Quietly reflect on your action by yourself:
 - a. What seemed to go well?
 - b. What was hard?
 - c. Were you able to make the changes you thought you would be able to make?
 - d. Will you keep going with your change or are there things you would do differently in the future?

Congratulations!

You have finished Part 3.

Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definition, or anything else that will help you. Add other words to the glossary if you would like.

Alternative: Another choice or way of doing something

Biodiversity: The many different living things on Earth; or a measurement of how many different living things are in an area

Breakwater: A large structure that protects a port from waves and storms and allows ships to safely approach

Classify: To name or identify and sort into groups

Conflict: A disagreement

Fossil fuel: A type of fuel that comes from the fossilized remains of plants and animals

Habitat: The space that living things need to live and grow

Illegal: Without permission or against the law

Liquefied natural gas: A type of fossil fuel

Pipeline: A structure that moves a gas or liquid from one place to another

Pollution: Materials that harm the environment or things living in it



Port: A place where ships can stop

Rare: Not often found or very few left

Other Words:



BIODIVERSITY!



Part 4:

**How can I balance
the needs of people
and animals in my
community?**

**SUSTAINABLE
DEVELOPMENT GOALS**

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE
HEALTH
POLICY**
the interacademy partnership

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Anish Andheria Headshot: Anish Andheria

Figure 4.1: Anish Andheria

Figure 4.2: Anish Andheria

Figure 4.3: Anish Andheria

Figure 4.4: Anish Andheria

Figure 4.5: Aditya Joshi

Figure 4.6: Smithsonian Conservation Biology Institute

Figure 4.7: Logan Schmidt/SSEC

Figure 4.8: Logan Schmidt/SSEC

Figure 4.9: Wildlife Conservation Trust

Figure 4.10: Anish Andheria

Figure 4.11: Anish Andheria

Figure 4.12: Anish Andheria



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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What animals are in our research area?					
Discover	Consider the animals in your community and the senses you use to observe them.		<u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	158
Understand	Use tools to investigate what animals are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Research Area</u> (Part 1, Task 4, Act) *StoryMap extension available	20 minutes + investigation time	161
Act	Classify the animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	167
Task 2: What do the animals in our research area need to survive?					
Discover	Discuss how you use space to meet your needs.			15 minutes	170
Understand	Investigate the different needs of the animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 4 Organizer</u> (Part 4, Task 1) <u>Oral History Instructions</u> (Part 2, Task 2, optional)	20 minutes + investigation time	172
Act	Share the different needs of animals in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	25 minutes	174



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and animals in my community?					
Discover	Explore conflicts between people and animals.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		30 minutes	176
Understand	Investigate conflicts between people and animals in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		15 minutes + investigation time	179
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	30 minutes	180
Task 4: What are people already doing to balance the needs of people and animals?					
Discover	Consider different perspectives on conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	20 minutes	182
Understand	Investigate one conflict from your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1)	25 minutes	184
Act	Begin to consider an action you could take to solve conflict in your community.			15 minutes	185
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 4 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	188
Understand	Decide on individual actions you will take to help your community.		<u>Part 4 Organizer</u> (Task 1)	15 minutes	189
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	191

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



4

Part 4: How can I balance the needs of people and animals in my community?

In Part 3 your team gathered information about the living things in your research area. You did an investigation about what people in your community need. This helped you explore how to balance the needs of people with the needs of living things in your community. But you need more information about your research area. More information will help you take more meaningful and sustainable action.

In this Part, you will learn more tips and tools for finding animals in your research area. You will learn more about the conflicts that can happen between people and animals. You will challenge yourself to start thinking of solutions that are inclusive and sustainable. All of this will help your team take action to balance the needs of people and other living things in your community in Part 7.

Remember: *In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.*

Your Research Mentor

Sharing your experiences with others and learning from others' experiences is part of being a good action researcher. In Part 4, you will have a research mentor. A mentor is someone who has experience and can help guide you. The research mentor in this Part will help you understand some of the issues related to animal biodiversity and how you can investigate and take action on those issues.

Meet Anish Andheria, Your Part 4 Research Mentor



This is Dr. Anish Andheria. Anish (Ah-NEESH) is a scientist and the president of the Wildlife Conservation Trust. Anish leads a team in India that tries to find out what causes problems between people and animals. The team focuses on observing and researching tigers. Anish's team tries to solve problems between tigers and people in a sustainable way.



Remember that a sustainable solution is one that considers social, environmental, economic, and ethical perspectives. If you can balance these perspectives the solution will last for a long time. Anish and his team think about these perspectives when they are solving problems.

Anish has knowledge and perspectives that came from his identity. Since Anish is now working with you, it is important to understand who he is.

To help you, Anish filled out an identity map, just like you did in Part 1. Anish's identity map includes the following things:

- I am 49 years old
- I am male
- I am a Hindu
- I live in Mumbai, India, but I think of this entire planet as my country. I am a global citizen!
- I enjoy chemical engineering, singing, walking through the woods, watching birds, rescuing snakes (I've rescued more than 500 snakes) and crocodiles, jackals, squirrels, and scorpions. I most recently rescued a rat snake.
- I used to play cricket in college
- I like country music
- I am brown, bearded, and fit
- I love cracking jokes and making people laugh
- I am a big sibling. I have a brother who is 6 years younger. I am also an uncle to my brother's daughter.





Figure 4.1: Anish educates people about a rescued snake before releasing it.

Before you begin the rest of Part 4, think quietly to yourself about Anish's identity map.

- Are there things you have in common with Anish?
- Are there ways in which you are different from Anish?
- Can you see anything about Anish's identity that would help him understand how to balance the needs of people with the needs of animals?



Task 1: What animals are in our research area?

Your team did great work observing and **classifying** living things in Part 3. In this Part, you are going to focus on observing animals. This task uses some of the same skills that you learned in Part 3. But observing animals is different from observing plants or fungi. You will need new skills. You will learn those new skills in this task.

In this task you will explore the animals that live in your research area. You will **discover** how to use your senses and other tools to help you find animals. You will plan and carry out an investigation to **understand** what animals are in your research area. Then you will **act** to classify and record these animals.



Discover: *What animals did we discover already?*

You may have already observed and classified some of the animals in your research area in Part 3. Now your team will observe more animals in your research area. Try to focus on finding the kinds of animals you may not have noticed before. You will learn from your research mentor about how to use your senses and other tools to search for animals.

1. Take out your *Part 3 Organizer*. Remember that your team recorded a list of the living things you found in your research area in Part 3. This list included animals.
2. Discuss as a team:
 - a. What kinds of animals did you observe and classify in Part 3?
 - b. Why do you think you noticed those animals and not others?
 - c. What other kinds of animals do you think are in your research area?
3. Think about the following questions by yourself:
 - a. Are there some animals in your research area that you like best or are more exciting to observe than others? Why?
 - b. Are some animals more helpful to people than others?
 - c. Are some animals in your research area more important to you than others? Why or why not?
 - d. What was the last animal you observed? How did it make you feel?



4. In the next activity your team will use your senses and other tools to find animals in your research area. Learn about how Anish and his team use their senses and use tools, such as cameras, to help them observe animals.

Anish says:



When you work with **carnivores** (animals that eat other animals) you have to use all your senses and more. You have to use your ears, your eyes, your smell, and your understanding of the forest. Tigers don't make noise when they walk. But other animals tell you they can see a carnivore. When an animal sees a tiger, it will give a call that is different from its usual call. This is called an alarm call. When I go and track tigers, most of my sightings happen the help of these alarm calls.

My team also looks for **evidence** that a tiger has been around. We look for **scat**, which is also called feces or poop. After a tiger deposits scat, they use their hind limbs and clear the grass in that area. That's called a scrape. They also scrape on trees. The claws are so powerful they rip the bark off the tree.

We also use camera traps that sense motion and heat, radio collars and antennae, dogs to track animals, photographs, measuring tape, a clicker that helps us count animals, a range finder that tells us the distance between us and the animal, mobile phones, and binoculars.



Figure 4.2: Tiger scat (next to a mobile phone to show size of scat).





Figure 4.3: A tiger scrape on the ground.



Figure 4.4: Tiger tracks.

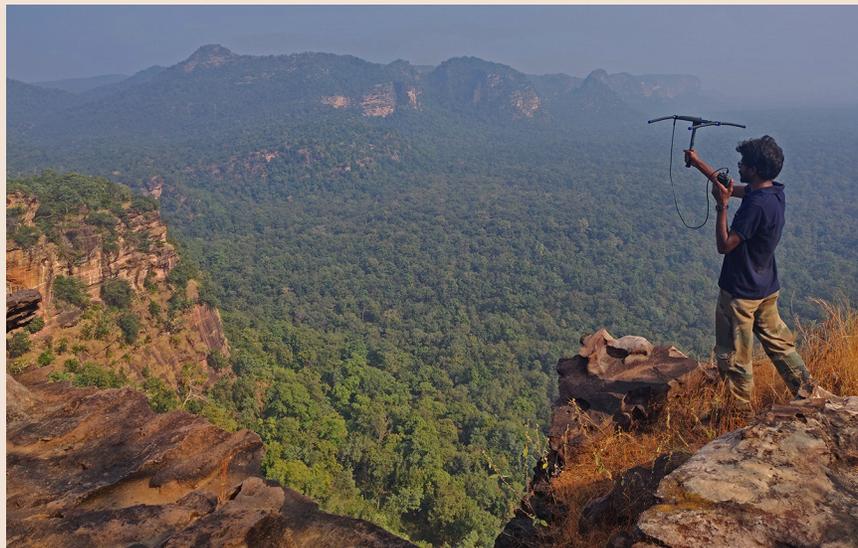


Figure 4.5: A team member using an antenna to find a tiger with a radio collar.



5. Think about how Anish and his team use their senses and other tools to find animals in their research area. Discuss the following questions as a team:
 - a. Could you use any of the same senses or tools that Anish and his team used?
 - b. What other senses or tools do you want to use?
6. Your team will plan and carry out an investigation in the next activity. You will use your senses and other tools to find animals in your research area.



Understand: How can we investigate our research area?

In the last activity you thought about how you can use your senses or other tools to find animals in your research area. Now your team will use this information to plan and carry out an investigation to observe the animals in your research area. Just like in Part 3, don't worry about trying to find all of the animals in your research area in this activity. Just do the best you can.

1. Gather your team and take out the *My Research Area* map you made in Part 1, Task 4, Act. Recall where your research area is.
2. Read *Observation Instructions* for more information about how to observe animals in your research area.

Observation Instructions

Where to investigate:

1. Review the tips from the Part 3, Task 1, understand activity.
2. You can go back and make observations in the same parts of your research area that you did in Part 3. Or you can make observations in a new part of your research area.
3. Remember that this time you are only observing animals. There are many different kinds of animals in your research area. It might be easiest to observe animals that are large, common in your area, or familiar to you. But try to find other kinds of animals. Use the following list to help you search for many different kinds of animals. This list does not include every kind of animal but it can help you start.



- a. If you search for animals on land, you might find insects, spiders, worms, birds, mammals, reptiles, amphibians. Remember to also search for animals that might be underground by looking in **soil** and **sediment**.
- b. If you search for animals in the air, you might find birds, insects, or mammals that glide or jump.
- c. If you search for animals in water, you might find fish, insects, amphibians, reptiles, birds, mammals (such as whales or dolphins), mollusks (such as squid, octopus, or snails), sponges, corals, or stinging animals (such as jellies and anemones). Remember to look in both fresh water and saltwater.

Tools you can use:

1. Review the tips from the Part 3, Task 1, Understand activity that describe how to use your senses and other tools, such as a magnifying glass, a camera, or paper and a writing tool. Remember that you also thought about how you could use your senses in the Discover activity.



Emotional Safety Tip

Remember to be an inclusive team member. Every person on your team brings different skills and perspectives. Some members of your team may not want to or be able to use all of their senses. That is fine. Work with your teammates to find a way for everyone to participate and feel comfortable.

2. Some animals are hard to observe because they are very good at hiding, only come out at night, or avoid people. A camera trap is a special camera that can help you observe these animals. A camera trap is a camera that you leave outside. It only takes a photo when something moves in front of the camera. It can help you observe animals even when you are not in that part of your research area. Discuss with your team or an adult to find out if you can make a camera trap on your own. More information about camera traps is in the *Biodiversity!* StoryMap.





Figure 4.6: This photo was taken by a Smithsonian Institution camera trap in a rainforest in Peru. The camera took a photo of a jaguar. Jaguars are very hard to photograph because they avoid people. Find out more about this camera trap in the *Biodiversity!* StoryMap.

3. An audio recorder or **acoustic** trap (“acoustic” means “related to sound”) can help you record the sounds animals make. An audio recorder can help you observe animals that are hard to photograph. Discuss with your team or an adult to find out if you can leave an audio recorder outside. It will record all the sounds nearby until you come back. More information about audio recorders is in the *Biodiversity!* StoryMap.

Tips for doing this investigation:

1. Review the tips from the Part 3, Task 1, Understand activity.
2. If you can't easily find animals in your research area, you can still search for signs that they have been there. You can search for scat, or animal feces (also known as poop). You can search for eggs or eggshells. If it is snowing or muddy where you are you can search for animal tracks. Notice any holes or burrows. They may be used by animals as homes or a place to store food.



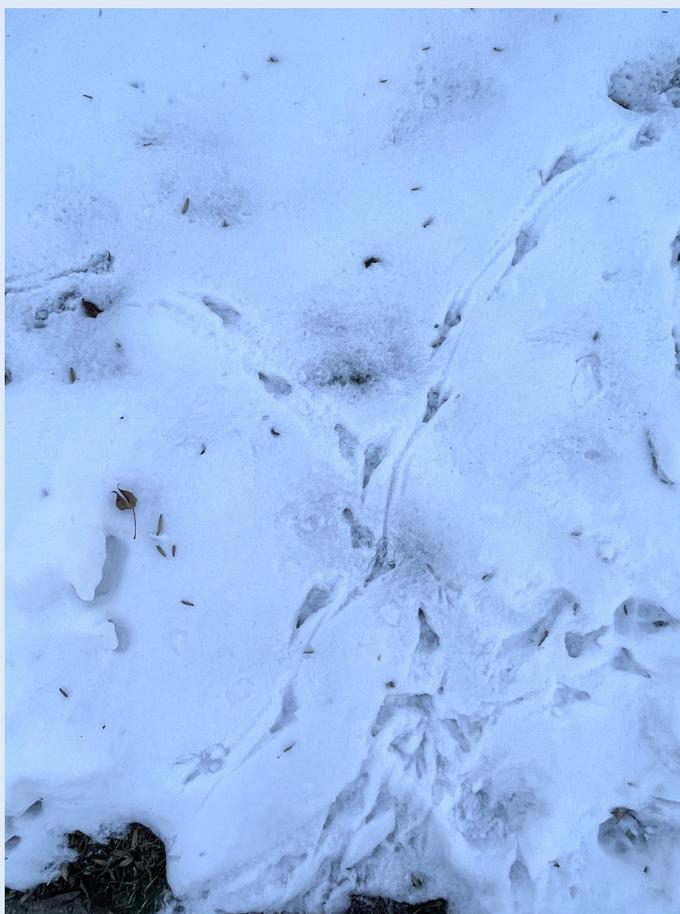


Figure 4.7: These tracks in the snow show that animals have been in this area.

3. Some animals make their homes under objects such as logs, rocks, leaves, or under soil and sediment. You can search for these animals by gently lifting up objects and observing what is living underneath. Or you can dig a few inches into soil and sediment. Always place any objects, soil, sediment, or animals back exactly where you found them.
4. Some animals avoid people. You can try to observe these animals by hiding in your research area. Hide behind a screen or inside a small house-like structure (sometimes called a “hide”) or wear clothing that blends into the research area. Try to make your observations near a place that animals are likely to be, like near their nests, along a path they use to get from place to place, or a source of water.





Figure 4.8: This small house-like structure is set up near several bird nests. The structure hides the person sitting inside. The person can observe the birds that are nearby without disturbing them.

Safety Tips for observing outside:

Ask your teacher first for guidelines. They will know what is safest in your community.

Physical Safety Tip

Do not observe a research area by yourself. Always work with at least one other person, which could be an adult or a teammate. Notice if your teammates are uncomfortable or if they feel unsafe. Offer to pause the investigation or move to another part of the research area.

Always pay attention to local guidance on whether it is safe to interact with people outside of your home.

Do not use your sense of taste to try to observe animals. Do not touch animals that you are unsure are safe to touch. For example, some animals may bite or sting.



 **Emotional Safety Tip**

Do not be discouraged if it is difficult to find animals. Every research area is different. Some areas may have many animals and some may have very few. It is not your fault if you have trouble finding animals. Just practice using your senses and other tools to do your investigation. If you feel sad or wish there were more animals in your research area, remember that you will take action to make this possible!

3. If finding animals outside doesn't sound like the right investigation for your team, that's okay! You can pick another way to collect information about your research area.
 - a. You can use online tools, such as iNaturalist or eBird, to find out what animals have already been found in your research area. More information about these tools is in the *Biodiversity!* StoryMap.
 - b. You can use books, lists, websites, videos, artwork, photos, stories, or other records of animals in your research area. Try to use records that have been made recently to make sure you are only observing animals that still live in your research area.
 - c. You can write, call, or talk to local scientists, researchers, older people who have lived in the community a long time, or other experts on animals in your research area. Ask them to describe what animals they have observed in your research area.
4. Decide as a team how you will investigate.
5. Remember, including everyone on your team is important. Try to pick a way to investigate that allows everyone to participate. Don't forget to think about the timing, comfort, location, and format of your investigation to make sure everyone on the team feels included. You can reread Part 2, Task 2, Understand if you need more information about making your investigation inclusive.
6. Next, work with your team to plan how you will do your investigation. For example, if you decide to do an observation, decide which teammates will observe



which parts of the research area. Decide how long you will spend finding animals. Decide how you will record the animals you find and who will do the recording.

7. Finally, do your investigation with your team.



Act: *How can we classify the animals in our research area?*

Your team has just completed a very important step in helping to balance the needs of people and animals in your community. You observed the kinds of animals in your research area. Now you will classify these animals. This information will help you complete the rest of this Part and get ready to take action in Part 7 to create a balanced community.

1. Your team is going to classify the animals you just found in your research area. Classify means to name or identify something and to sort it into a group. Classifying living things can help you understand more about the biodiversity in your research area. Remember that biodiversity is a measurement of how many different types of living things are in an area. To measure biodiversity in your research area, you need to know how many different kinds of animals you observed.
2. Read *Tools to Help Classify Animals* for more information about how to classify animals in your research area.

Tools to Help Classify Animals

1. A **field guide** is a tool that has the names, images, and descriptions of animals in an area. Field guides may be printed (such as books) or online.
2. You can use an online tool such as the iNaturalist or eBird website, which is also known as a community science tool. People in a community take photos or describe what animals they have noticed in their area. They send the photos and descriptions to scientists through the website. The scientists help identify what the animals are. This helps scientists and community members keep a record of what kinds of animals are in an area. More information for iNaturalist and eBird is in the *Biodiversity!* StoryMap.



3. Communicate with a person who is respected in your community because of their knowledge of the environment and animals. This might be someone who has lived in the community for a long time, someone with traditional knowledge, or someone who works or volunteers in the outdoors.
4. If you don't have access to any tools to help you classify, just try to notice if the animals you observed are different from each other. For example, maybe you observed a bird in your research area that had a small body and bright red feathers and another bird that had a large body and striped brown feathers. You may be able to use sound to tell animals apart. Notice their calls or other noises they make. Even though you don't know the names of the animals, you can tell that they are not the same. Record that you observed two different animals in your research area. Some examples of classifying animals by their sound are in the *Biodiversity!* StoryMap.
5. If you do not have a field guide, your team can come up with your own names for animals in your research area. Review the case study in Part 3, Task 1, act for more information.

3. Remember from the case study in Part 3, Task 1, Act that there are many ways to classify a living thing. No matter which way you choose to classify the animals in your area, remember that your way is valuable because it came from you.
4. Work with your team. Title a sheet of paper or a digital document *Part 4 Organizer*. Make three columns just like you did for your *Part 3 Organizer*. Write the words "Know", "Think," and "Wonder" at the top of the columns.
5. Create a list in the *Know* column of the animals that your team found in the research area.
 - a. Record the name of each animal you found.
 - b. List how many of that animal you found.
 - c. If several team members found the same animal, combine those numbers and record the total. For example, if one person found four green, spotted caterpillars in their part of the research area and another person found five green, spotted caterpillars in their part of the research area, record "nine green, spotted caterpillars."



6. Consider your *Know* column. Discuss the following questions as a team. Record your answers in the *Think* column:
 - a. Did your research area have many different kinds of animals?
 - b. Did it have the same kind of animals over and over?
 - c. Did it have very few animals?
 - d. Do you think there might be animals living there that you weren't able to observe?
7. Answer the following questions in the *Think* column:
 - a. How does your team feel about the kinds of animals in your research area? Are there animals you like more than others?
 - b. Do you wish you had more kinds of animals in your research area?
 - c. Which animals did you notice most easily? Why do you think that is?
 - d. Are any animals more important to you? Why or why not?
8. Finally, under *Wonder*, consider what you don't know.
 - a. What questions do you still have?
9. Keep the Part 4 Organizer in a safe place.



Task 2: What do the animals in our research area need to survive?

In Task 1 your team observed as many animals as you could in your research area. Now it is time to figure out how those animals are meeting their needs. First, you will **discover** how you meet your needs using the spaces around you. Then you will use an investigation to **understand** how the animals in your research area meet their needs using the spaces around them. Finally, you will **act** on this information to record those needs and think about how well your research area is able to meet them.



Discover: *How do we use space to meet our needs?*

In the Part 3, Task 3, Discover activity you thought about what you need to survive. You also thought about how your community helps you meet those needs. Now you are going to think more about how you use space in your community. You are going to focus on space because many conflicts between people and animals happen because of how people use space. You will also learn from your research mentor. This will help prepare you for the investigation in the Understand activity.

1. Remember your answers from the Part 3, Task 3, Discover activity. Then, think quietly to yourself about the following questions:
 - a. Can you meet all your needs in just one place?
 - b. What other spaces in your community help you meet your needs?
 - c. What would happen if you couldn't move from space to space as easily? Would it make it harder to meet your needs?
 - d. What would happen if those spaces weren't there at all? Would it make it harder to meet your needs?
 - e. What would happen if those spaces weren't usable? Would it make it harder to meet your needs?
2. You aren't the only kind of animal that needs to use different spaces to meet your needs. Many of the other animals in your research area do, too. They move around to different spaces to find food, water, mates, shelter, and other important things.



They need to be able to get from one space to another. They need those spaces to be usable.

3. Read the following information from your research mentor, Anish. He explains what the tigers in his research area need.

Anish says . . .



Tigers need space, food, water, and mates. And when I say space, I mean that space needs to be undisturbed. A road, canal, or a power or railway line should not cut through a forest. That will have impact on movement of animals. You see this all across America with skunks and squirrels and badgers getting hit on roads every day.

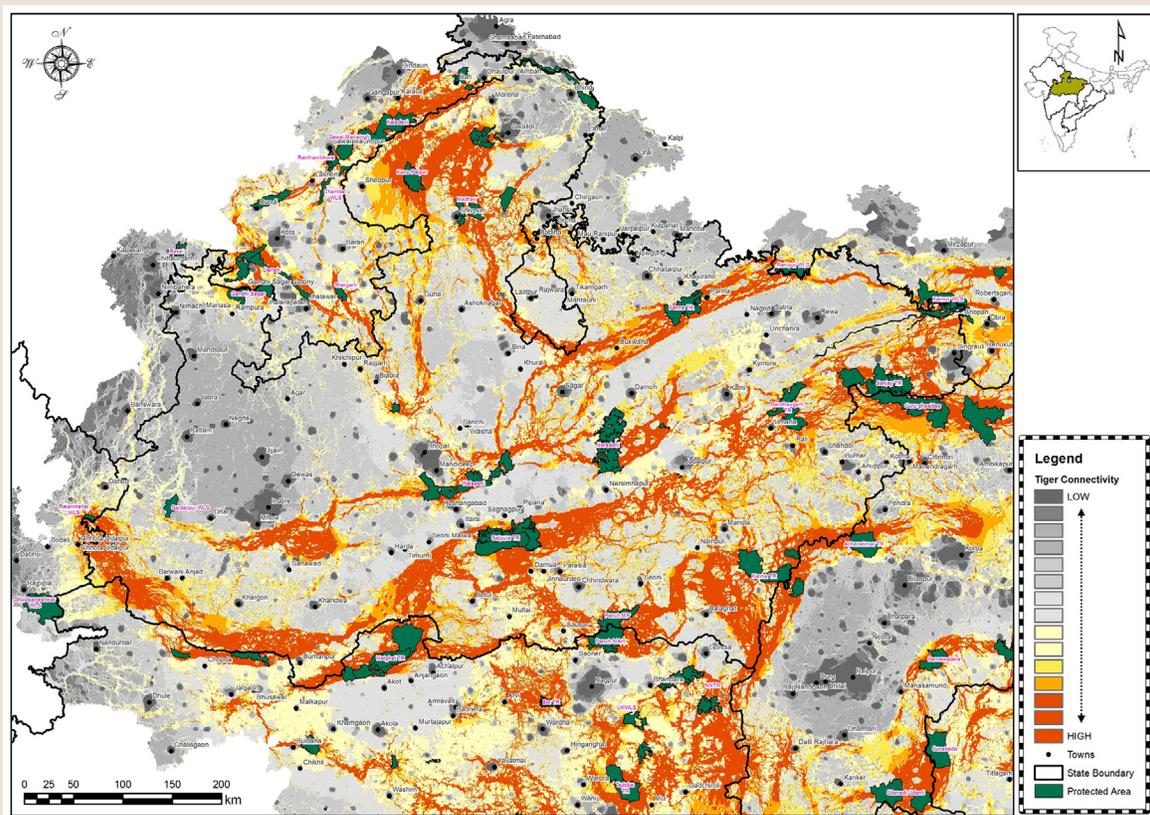


Figure 4.9: This map shows a part of India. Anish and his team built this map using data from their research. The colors show areas where tigers could move from space to space. Orange means that the tigers could move very easily. Gray means that the tigers cannot move very easily. This map helps other people understand where they should not build roads, canals, or other barriers.





Understand: How can we investigate what animals need to survive?

In the Part 3, Task 2, Understand activity your team did an investigation of how the living things in your research area meet their needs. That investigation may have already included some of the animals from your research area. Now you are going to add to that investigation by finding out more about the animals you observed in the Part 4, Task 1, Understand activity. This will help you fully understand how the animals in your research area are using that space to meet their needs.

1. Gather your team together and take out your Part 3 Organizer and your Part 4 Organizer.
2. Read through the list of animals in the *Know* columns. Remind yourself of what animals are in your research area.
3. Now your team will plan an investigation into how the animals in your area meet their needs. Read What Do Animals Need? to find out more about the basic needs of animals.

What Do Animals Need?

Animals need food, water, and space.

Animals eat other organisms for energy. Some animals eat other animals. Some animals eat plants. Some animals eat a variety of living things, including plants, animals, and fungi.

Animals need clean water to drink. Some animals also need clean water to live in or reproduce in.

Animals need space. This space is called their habitat. Animals use space to raise young, find and store food, find mates, rest, hide, and to meet other needs. Some animals need more space than others.

4. Just like in Part 3, you will observe how the animals in your research area meet needs such as food, water, and space. But this time you will pay special attention to how the animals in your research area are using space. This includes which spaces the animals seem to use the most or how they move from space to space.



5. Discuss how you will investigate the needs of animals in your research area. There are many ways to investigate. You could:
- Plan an observation like you did in the Part 3, Task 2, Understand activity. You could observe each animal outdoors and notice how it is meeting its needs for food, water, oxygen, and space. Just like in Part 3, be aware that some needs may be more difficult to observe than others.
 - Interview an expert in your community on the phone, online, or in person. An interview is similar to the oral history you collected in Part 2, Task 2, Understand. But instead of asking about the past you will ask people about what they know now. Go back to Part 2, Task 2, Understand if you need help with this kind of investigation. You could interview:
 - Older people who have lived in the community a long time and know about local animals
 - A person who is respected in your community because of their knowledge of the environment and animals
 - Someone with traditional knowledge of animals
 - A scientist that studies animals
 - A volunteer at a local nature preserve or wildlife refuge
 - A person who works or volunteers with animals
 - Use books, websites, videos, artwork, audio recordings, or other records of what the animals in your research area need. Try to use records that have been made recently to make sure you are only learning about the animals that still live in your research area.
 - Think of your own way to collect information.
6. It might be difficult to get all of the information you need from just one kind of investigation. You may need to combine more than one kind.
7. Decide what kind of information you want from this investigation.
- Animals have four basic needs: food, water, oxygen, and space. You will need to find out how the animals in your research area are meeting these needs. For example, what are they eating? Where are they getting their water? Where are they building nests or sheltering from weather?



- b. Be sure to pay special attention to how the animals in your research area use space. Think about the following guiding questions as you make your observations:
- Which spaces are used most often by animals?
 - How do animals move from space to space?
 - Are there any problems in the spaces where animals are meeting their needs? For example, if many animals use a river to get water, does the river appear and smell clean? Does it have trash in it or near it? Is it polluted?
- c. In the next activity you will start to think about how your community is meeting the needs of animals. So try to notice or ask if some of the animals in your research area are having trouble meeting their needs.
8. Plan your investigation. Decide what needs to be done and who will do each part. You can:
- a. Split up the list of animals from the *Know* columns among your team members.
 - b. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.
 - c. Decide who will lead the investigation and who will record the information from those investigations.
9. Work with your team to do your investigation.



Act: *How can we share what we learned about what animals need?*

Your team has investigated the needs of animals in your research area. Now, your team will share what you observed and use that information to decide how well your community is meeting those needs.

1. Take out the information you recorded from the Understand activity. Take out your Part 4 Organizer.
2. Have the team leader record what they found out in the Understand activity. They should put their answers in the *Know* column. For example, the team leader may have learned from an observation that the deer in your research area get their water from a local stream.



3. Let the team leader know if they describe a need that you also found in the investigation. If you found out that other animals are also using that local stream to get water, circle that need or make some other mark next to it. This will help you record that this is something that more than one animal needs or wants.
4. Next, share any needs you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
5. You should now have a list of what the animals in your research area need.
6. Discuss what you learned about in the investigation as a team. Record your thoughts in the *Think* column.
 - a. What needs are shared by many different kinds of animals in your research area?
 - b. Are any animals in the research area having trouble meeting their needs?



Task 3: What are the conflicts between people and animals in my community?

Your team found out information about the needs of animals in your research area. Now, you will **discover** some of the conflicts between people and animals that make it harder for animals to meet their needs. You will use an investigation to **understand** if any parts of your research area have these conflicts. You will **act** on the information from the investigation to identify the problems in your community and start thinking about how to solve them.



Discover: *How does conflict make it harder for animals to meet their needs?*

In the Task 2, Understand activity you learned that animals meet their needs in the space around them. Animals need many different kinds of spaces. They also need to be able to move from space to space. And animals need the spaces to be usable. Now you will learn about how certain kinds of conflict make it harder for animals to use the space in their communities.

1. As a team get out a single piece of paper. You can also do this with a shared digital document that you can write or draw on. Save the digital document as an image because you will make changes to that image during the activity.
2. Think back to what you observed in the Task 2, Understand activity. Think of the spaces that helped the animals in your research area meet their needs. Write, draw, or find another way to record those spaces on your piece of paper. Don't worry about putting them in exactly the right place. Just spread them out on the paper.
3. This piece of paper represents your research area. This area is habitat for the animals living there. It helps them meet their needs.
4. Now divide the paper into nine equal pieces. If you are working with paper cut the paper. If you are working with a digital image, use a digital tool to separate the image into nine separate pieces.
5. Spread the pieces apart from each other. There should be a gap between each piece of the habitat.
6. You have made a model. This model shows something called **habitat fragmentation**. This is a term that describes a habitat that has been split into



separate parts. Fragmentation comes from the word “fragment,” which means “a small piece broken off from something else.”

7. Habitat fragmentation can happen naturally. For example, a rockslide or mudslide can make it harder for animals to move from one place to another because the rocks or mud block their way. People can also cause habitat fragmentation. Roads, cable or power lines, canals, fences, nets, ditches, parking lots, dams, and other human-made things can separate a habitat and make it hard for animals to move around to meet their needs.
8. Imagine that the spaces between the parts of your model are four-lane roads where people drive at high speeds. Imagine that the roads also have a metal barrier in the middle. Discuss these questions as a team:
 - a. How might that affect the animals that live in your research area?
 - b. Which animals might still be able to move around to meet their needs?
 - c. Which animals might not be able to move around to meet their needs?
9. Now remove, cross out, or delete three of the pieces of your model. It doesn't matter which three. You can choose randomly.
10. You have made a model of **habitat loss**. This is a term that describes a habitat that has been destroyed.
11. Habitat loss can happen naturally. A river can flood and wash away the habitat that was on the riverbank. People can also cause habitat loss. When people build a crop field or a parking lot it destroys the habitat that was there. The living things that were there can no longer use that habitat to meet their needs.
12. Consider the pieces you removed from your model. Discuss these questions as a team:
 - a. What parts of your research area did you lose?
 - b. How did those parts help animals meet their needs?
 - c. Which animals in your research area might have trouble meeting their needs now?
13. Now use a writing tool or a digital tool to color in or shade one half of each of the remaining pieces of the model. Imagine that the colored-in or shaded parts are unusable for the animals in your research area.
14. You have made a model of **habitat degradation**. This is a term that describes a habitat that has been damaged. This damage means that less of the habitat is available to use. Degradation comes from the word “degrade” which means “to



break down.” People can cause habitat degradation. When people pollute the ocean with trash or certain chemicals it can make it difficult for living things to meet their needs. Or when people use too much water from a river or stream it may leave very little for other living things.

15. These three conflicts are not the only ones that make it harder for animals to meet their needs. As you read, other conflicts include poaching, overfishing, and people introducing animals that are not native to an area. But in this Part you are going to think mostly about habitat fragmentation, loss, and degradation.
4. Read the following information from your research mentor, Anish. He explains how changes in habitat can cause conflict between people and tigers.

Anish says . . .



The main reason for conflict between people and tigers is that the forest is thinning and disappearing. The forest is also divided into smaller chunks. When this happens, there are fewer **prey** animals for the tigers to eat. Some tigers in the population can't meet their needs. So they move to other spaces. These spaces often have people and livestock living there. Instead of eating wild prey, the tigers start eating livestock. Livestock is much easier to catch. The people who own the livestock don't like losing it to tigers. When the livestock dies the people lose money. They might poison the dead livestock and when the tiger comes back to finish eating, it dies.



Figure 4.10: This photo shows cattle grazing in an area that also has tigers. The tigers eat the cattle because they are easy to catch. This creates a conflict between people and tigers.





Understand: How can we find out more about the conflicts in our research area?

Habitat fragmentation, loss, and degradation are three conflicts that can make it hard for animals to meet their needs. When animals can't meet their needs, sometimes they move away to another area. Sometimes they die. Moving away or dying causes a decrease in biodiversity in that area. Remember that biodiversity is the measure of different kinds of living things in an area.

Your team is trying to figure out how to solve problems related to biodiversity in your research area. To help you do this, your team will do another investigation. You will find out if your research area has habitat fragmentation, habitat loss, habitat degradation, or any other conflicts that affect the animals living there.

1. As a team, think back to what you observed in the Task 2, Understand activity. Discuss the following questions as a team:
 - a. Did you notice that any animals had trouble meeting their needs?
 - b. Do you think your research area has any habitat fragmentation, loss, or degradation? Why or why not?
2. Gather your team together and take out your Part 3 Organizer and your Part 4 Organizer.
3. Read through the list of animals in the *Know* columns. Remind yourself of the kinds of animals in your research area.
4. Now your team will do an investigation of your research area. You will find out if there is any evidence of habitat fragmentation, loss, degradation, or any other conflicts that affect the animals living there.
5. Each team member should choose one animal from one of your *Know* columns.
6. You are going to think and move around your research area like the animal you chose. If movement is not the best choice for you, you can imagine moving around your research area using the My Research Area map or another map of this area. Use the following checklist of questions to help you notice conflicts in the research area. Remember that you are thinking and acting like an animal:



a. Habitat Fragmentation:

- How do I move from space to space to get what I need? Do I fly, swim, walk, slither, run, or move in another way?
- Is there anything in this research area that makes it hard for me to move around? (for example, roads, power lines, canals, fences, dams, parking lots, or other human-made things)
- Is there any space that I might need but can't get to?

b. Habitat Loss:

- Is most of the space in the area meant to be used by people or by animals? (Remember that your team gathered some information about this in the Part 3, Task 3, Understand activity)
- Are there spaces that I once used but no longer can? (Remember that your team gathered some information about this in the Part 2, Task 2, Understand activity)

c. Habitat Degradation:

- Is there any pollution in this area?
- Is there enough of what I need in this area? Is there plenty of food, water, oxygen, and space?
- Are people taking things or using things from this area? Does that leave less for me?

d. Other Problems

- Are there any other parts of this area that make it hard for me to meet my needs?

7. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.

8. Work by yourself to conduct your investigation.



Act: *What do we think about the conflicts in our research area?*

Your team has investigated how animals in your research area might have problems meeting their needs. Now, your team will share what you observed and think about how people may be involved in these conflicts.



1. Take out the observations you recorded from the Understand activity.
2. Take out your Part 4 Organizer.
3. Have the team leader record what they found out in the Understand activity. They should put their answer in the *Know* column. For example, the team leader may have learned that fences in your research area make it difficult for animals to move from space to space. The fences block the animals from getting the food and water they need to survive.
4. If the team leader shares any conflicts that you also found in your investigation, let them know. Circle that need or make some other mark. This will help you record that this is something that is a conflict for more than one animal.
5. Next, share the conflicts you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
6. You should now have a list of the conflicts in your research area.
7. Take out your Part 3 Organizer. The *Know* column has information about what the people in your community need.
8. As a team, compare the information in the *Know* column of your Part 3 Organizer to the information in the *Know* column of your Part 4 Organizer. Discuss the following questions as a team. Record your answers in the *Think* column of your Part 4 Organizer:
 - a. Did the animals in your research area have a problem meeting their needs because of habitat fragmentation, loss, degradation, or anything else?
 - b. Consider the needs of the people in your community. Remember that you recorded this information in your Part 3 Organizer. Do you think any of these needs are causing the conflicts between people and animals?



7. Remember the four perspectives you learned about in Part 1, Task 3. The following situations involve at least one of those perspectives. Read each situation and identify the conflict in each one. Then, discuss with a teammate how each conflict makes you feel. Which perspective is most important to you? What do you think you would choose to do about each conflict?
- Economic and ethical perspective:** Some of the animals in a certain community are illegal to own, kill, sell, or trade. But if someone sold one, they could earn a lot of money for their family.
 - Social and ethical perspective:** Plastic straws cause waste than can end up in the ocean. The straws can harm animals living in or near the ocean, such as sea turtles and birds. But straws are an important tool for certain people with disabilities. Straws help them drink liquids and meet their needs.
 - Ethical, economic, and environmental perspective:** A person is changing the oil in their car. After they are done, they need to get rid of the old oil. They will have to pay a fee if they get rid of it at the town dump. If they just dump the oil in the street they won't have to pay a fee. But the oil may harm other living things in that neighborhood. Or, when a storm comes and washes the oil into a stream, river, or the ocean, it could harm animals even further away.

 **Emotional Safety Tip**

You may have a strong opinion about some of these statements. Remember to be respectful in how you share your thoughts and how you listen to others. It is okay to disagree but remember to disagree with ideas and not people.

8. Read the following information from your research mentor, Anish. He explains how perspectives have changed over time in his research area.



Anish says . . .

We have to evolve with changing times. The solutions that worked a decade ago won't work today. You have to think about economics, the behavior of people, politics, and technology.

The government in India used to create large protected spaces for tigers and other animals. The people living in these spaces had to leave. If you look at it from the tiger perspective, that worked. But, from a human rights perspective, you needed better thinking.

In the last 40 or 50 years, there has been a shift and now people's rights are important. In 2006 the Indian government passed the Forest Rights Act. This law recognized the rights of people who have always lived in the forest. The government is now giving these people money to move out of forests that are important for tigers. No one can force these people to move out—those days are gone, and that's good. But if they want to move out, they are offered money and land. When people leave there is more space for wildlife and the people are closer to urban spaces. It's not perfect. But as time passes, the solutions to help animals are getting more inclusive. Human rights and animal rights have to be balanced. Otherwise, you will only gain in the short term.

**Understand:** *How can we find out more about solving conflicts?*

As you learned in Part 3, there are some people who think about the conflicts between people and other living things because it is important to their way of life or it is their job. These people think about and try to solve the same kinds of problems you are trying to solve in this guide. These can be difficult problems to solve!

In this activity, you will think about just one conflict in your research area. You will try to find out what people in your community are already doing about this problem. You will learn more from your research mentor. This will help you create solutions that are sustainable and inclusive.



1. You can work on this activity by yourself or with the teammate you worked with in the Discover activity.
2. Remember which conflicts felt most important to you in the Discover activity.
3. Choose one of those conflicts to learn more about.
4. By yourself, record what the animal(s) in that conflict need. Remember that you can find that information in your *Part 4 Organizer*.
5. Next, record what the people in that conflict need. Remember that you can find that information in your *Part 3 Organizer* or your *Part 4 Organizer*.
6. Finally, record how the needs of animals and people cause or contribute to this conflict.
7. For example, maybe your research area has a small dam across a river. This dam causes a conflict between people and the fish in the river. You would record:
 - a. What the animals need: The fish in your research area need to be able to swim up and down the river to find food, habitat, and lay eggs.
 - b. What the people need: The people in your community need the water trapped by the dam for drinking, washing, and for cleaning clothes.
 - c. What causes the conflict: The dam helps people meet their needs but it also creates habitat fragmentation. The fish cannot move from one part of their habitat to another. The fish cannot meet their needs.
8. Decide if you need more information about this conflict from your research area or community. You can do another investigation in your research area or community to find out more about what the animals or people in this conflict need. If you feel you need more information, gather it now.



Act: *How can I take action on conflicts in my community?*

Now that you have learned more about the conflict you chose, you are going to think about what you would need in order to take action. This information will help your team complete Task 5.

1. You can work on this activity by yourself or with the teammate you worked with in the Discover and Understand activities.
2. Think about the conflict that you learned more about in the Understand activity.



3. Answer the following questions by yourself or with your teammate:
 - a. What would you do to try to solve this conflict?
 - b. Who would your solution help? People? Animals? Both?
 - c. Which group's needs are most important to you? Why?
4. Take out your *Part 2 Organizer*.
5. Consider the information in the *Know* column.
6. Answer the following questions by yourself or with your teammate:
 - a. Who makes decisions in your community?
 - b. Who are the people in your community who don't usually get to share their ideas or help with decisions?
 - c. How can we make sure those people are included?
 - d. How can we find out what people are already doing to solve conflicts between people and animals in our community?
7. Have you noticed any perspectives in your community that help people avoid conflicts with animals? For ideas, read what Anish says about how the culture of India helps keep tigers safe.

Anish says . . .



India has nearly 75% of all the tigers in the world. India also has the second highest human population in the world. You may not expect India to have so many tigers when it has so many people. But India still has many tigers because of its **culture**.

Many of our gods, such as the Durga goddess, are associated with the tiger. And Indian culture is connected with wildlife in a very big way. In the West you talk about recreation or going into the wilderness. The outdoors is outside of your life. Whereas in India, people don't think of wildlife as outside of themselves. So when a problem happens and a tiger kills somebody, people never say, "I want to kill all tigers." You wouldn't have all the tigers we have in India if the culture didn't support favoring them. Science alone cannot explain why there are so many tigers in India. It is also the culture.





Figure 4.11: Tigers included in a religious display in India.



Task 5: How can I take action to balance needs in my community?

Change happens on different levels. There are things you can change about your own behavior. There are also changes that happen within the whole community. In this task you will **discover** what you know about changes needed for your community. Your team will use this information to decide on your community action plan in Part 7. You will also **understand** some ways you can personally change your behavior to help your community. Then you will **act** on those ideas.



Discover: *How is our community meeting the needs of people and animals?*

In any community there are people and other animals trying to meet their needs. Sometimes these needs cause conflict. Now you will use what you have learned in this Part to think about ways you could make those conflicts better.

1. Take out your Part 4 Organizer.
2. Your team has already listed information you found out from your investigations in the *Know* column. Add any additional information you want to remember.
3. Now you will list or draw everything your team thinks about your community under the *Think* column. Consider:
 - a. Think about the work you did in Task 4. What do we think are the most important conflicts to solve between people and animals in our community?
 - b. What do we think are some good ways to try to solve those conflicts?
 - c. Do we think our community could do better at meeting the needs of animals?
4. Take out your Balanced Community Goals. Compare them to the things you *Know* and *Think*. Your Balanced Community Goals show you how your team wants your community to be. What you *Know* and *Think* shows you how your community is. When your community is not the way you want it to be, that is a problem.
5. As a team discuss:
 - a. How well do you think your community is meeting the needs of the animals in your research area?



- b. Are there goals in the *Balanced Community Goals* that would help your community meet the needs of animals? If not, think about adding those goals now.
 - c. Do you think it is important to meet the needs of animals? Why or why not?
 - d. Record these thoughts in your *Think* column.
6. Think back to the investigations you did in Part 2, Task 3, Understand about who makes decisions in your community. Think about how people your age are involved in making decisions.
 - a. Which conflicts do you think you could take action on?
 - b. Which conflicts would you need help with?
 - c. Record those now in your *Think* column.
7. List or draw everything your team still wonders about your community under the *Wonder* column. Consider:
 - a. Are there questions you still have about how your community meets the needs of people and animals?
 - b. Are there actions you could take that might help your community balance the needs of people and animals?
8. Keep the *Part 4 Organizer* safe. You will need it again.



Understand: How can I solve conflicts?

In this Part you investigated how the animals in your research area meet their needs. You also learned how the people in your community meet their needs and wants. You noticed how those needs might cause conflicts. You thought about ways that your community could better balance the needs of people and animals. You will have a chance to put some of these ideas into action in Part 7. However, there are always ways that you could make things in your community better through your own individual actions.

1. Consider the *Think* and *Wonder* sections of your *Part 4 Organizer*. Are there any problems that you could help to change all on your own? Are there any actions you could take on your own?



2. Discuss your ideas with your team. For example:
 - a. Suggest any of your ideas about reducing conflict from Task 4.
 - b. Maybe you noticed that most of the space in your community helps only people meet their needs. You could add something to the space outside of your home to help meet the needs of animals, like a **native plant** that provides habitat. A native plant is a plant that has always grown in an area and provides food and habitat to the other living things in that area.
 - c. You could make choices about the things that you buy or do that reduce the amount of waste or pollution coming from your household.
 - d. You could think of ways to help connect the spaces in your schoolyard, the area outside of your home, or your research area to help animals move from space to space.
 - e. You could work with the people in your household to make a list of your needs and wants. Then, you all could think about which needs and wants might make it difficult for animals to meet their needs. Are there any things that you need or want that you could use less of?
 - f. Come up with your own ideas.
3. Read some examples of action from your research mentor Anish.

Anish says . . .



During the COVID-19 pandemic, a lot of things happened online that allowed students to join cross-border groups. Students could build relationships or contact organizations that work far away. They could help compile and analyze data. They could even form groups with students in India that work with tigers!

I would also recommend that students only use what you need. Students should learn from all species. They should observe a butterfly, a bird, a reptile, and understand how much each species needs. Even a housecat is good enough to teach people that we don't need to overuse things. Any way you can reduce your use of electricity and water, you must do. You don't need a lawn if you live in a place that doesn't have a lot of water. That is basically wasting water, and



you're using pesticides, fertilizer, all of that is going into the rivers. Change your lifestyle and use less. Every toilet or tissue paper you use, every watt of electricity is a choice. There is always a way to make the right choice.



Figure 4.12: These students are ambassadors for tigers in India. They educate people about tigers and raise money to help protect tigers.

4. Think quietly to yourself about a change you want to make in the way you act. Why do you think this change is important?



Act: How can we take action and reflect?

Changing our own behavior is often the first step. Now that you have decided what you will do to improve your community, you need to put that idea into action.

1. Make a plan for how you will put your idea into action. If you need to share information, where, when, and with whom will you share it. If you need to do something, what do you need to do it.
2. Put your plan into action.
3. Quietly reflect on your action by yourself:
 - a. What seemed to go well?
 - b. What was hard?



- c. Were you able to make the changes you thought you would be able to make?
- d. Will you keep going with your change or are there things you would do differently in the future?

Congratulations!

You have finished Part 4.

Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definition, or anything else that will help. Add other words to the glossary if you would like.

Acoustic: Related to sound

Carnivore: An animal that eats other animals

Classify: To find the name of something or put it in a category

Culture: The way of life for a particular group of people

Evidence: A sign that something exists

Field guide: A collection of descriptions and images that helps identify living things

Habitat fragmentation: A habitat that has been split into separate parts

Habitat loss: A habitat that has been destroyed

Habitat degradation: A habitat that has been damaged

Native plant: A plant that has grown in an area for hundreds or thousands of years

Prey: An animal that is eaten by another animal for food

Scat: Animal feces, waste, or poop



Sediment: The soil-like material that lines the bottom of a body of water

Soil: The mix of minerals, air, water, and living things that sits on Earth's surface

Other Words:



BIODIVERSITY!



Part 5:

**How can I balance
the needs of people
and plants in
my community?**

**SUSTAINABLE
DEVELOPMENT GOALS**

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE
HEALTH
POLICY**
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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What plants are in our research area?					
Discover	Consider the plants in your community and the senses you use to observe them.		<i>Part 3 Organizer</i> (Part 3, Task 1)	20 minutes	206
Understand	Use tools to investigate what plants are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation tools 	<i>My Research Area</i> (Part 1, Task 4, Act) <i>Investigation Tips</i> (Part 3, Task 1) *StoryMap extension available	20 minutes + investigation time	210
Act	Classify plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	217
Task 2: What do the plants in our research area need to survive?					
Discover	Reflect on how your identify and experiences relate to plants.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<i>My Identity Map</i> (Part 1, Task 2)	15 minutes	222
Understand	Investigate the different needs of the plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Books (optional) • Computer (optional) 	<i>Part 3 Organizer</i> (Part 3, Task 1) <i>Part 5 Organizer</i> (Task 1)	20 minutes + investigation time	223
Act	Share the different needs of plants in your community and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<i>Part 5 Organizer</i> (Task 1)	20 minutes	226



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and plants in my community?					
Discover	Explore conflicts between people and plants.	<ul style="list-style-type: none"> • Paper • Pens or pencils • 3 Cups or containers of soil (optional) • Vegetable seeds (optional) • Water (optional) • Salt (optional) 		10 minutes + investigation time	228
Understand	Investigate conflicts between people and plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 5 Organizer</u> (Task 1)	10 minutes + Investigation time	232
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	235
Task 4: What are people already doing to balance the needs of people and plants?					
Discover	Consider different perspectives on conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1)	20 minutes	236
Understand	Investigate one conflict from your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2)	25 minutes	237
Act	Begin to consider an action you could take to solve conflict in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	239



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	241
Understand	Decide on individual actions you will take to help your community.		<u>Part 5 Organizer</u> (Task 1)	15 minutes	242
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	244

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



5

Part 5: How can I balance the needs of people and plants in my community?

In Part 3 your team gathered information about the living things in your research area. You did an investigation about what people in your community need. This helped you explore how to balance the needs of people with the needs of living things in your community. But you need more information about your research area. More information will help you take more meaningful and sustainable action.

In this Part, you will learn more tips and tools for finding plants in your research area. You will learn more about the conflicts that tend to happen between people and plants. You will challenge yourself to start thinking of solutions that are inclusive and sustainable. All of this will help your team take action to balance the needs of people and other living things in your community in Part 7.

Remember: *In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.*

Your Research Mentor

Sharing your experiences with others and learning from others' experiences is part of being a good action researcher. In Part 5, you will have a research mentor. A mentor is someone who has experience and can help guide you. The research mentor in this Part will help you understand some of the issues related to plant biodiversity and how you can investigate and take action on those issues.

Meet Steve Canty, Your Part 5 Research Mentor



Meet Dr. Steve Canty. Steve (STEEV) is a **marine biologist** who works at the Smithsonian National Museum of Natural History. He leads a team at the Smithsonian Marine Station that studies mangroves and seagrasses in Mexico, Belize, Guatemala, and Honduras. Mangroves and seagrasses are two types of plants that live in water. Mangrove trees usually grow along a coastline and in salt water.





Figure 5.1: The underwater roots of a mangrove tree.

One of Steve's projects is working with communities to figure out the best way to **manage** mangrove forests. He collects data about mangroves and gives that data to the communities to help them make decisions. Mangrove plants help keep and increase biodiversity. Many types of living things such as bacteria, fungi, animals such as fish and birds, and other kinds of plants make their home in mangrove forests.





Figure 5.2: Many kinds of animals, such as this bird, use mangrove forests for habitat.

Steve has knowledge and perspectives that came from other parts of his identity. Since Steve is now working with you, it is important to understand who he is. To help you, Steve filled out an identity map, just like you did in Part 1. Steve's identity map includes the following things:

- I am 41 years old
- I am British
- I am male
- I live in the United States, but Honduras is an important country to me. I lived there for 7 years and worked closely with the communities there.
- I enjoy anything having to do with the ocean. I like fishing. I like to get other people interested in the ocean and help them work together.
- I like playing sports, especially rugby. I've played it, coached it, and set up teams. I like running, too.
- I wear glasses and am average height. I have brown hair and a beard.
- I am sarcastic, a pessimistic optimist, and an introvert though I get more extraverted when talking about topics that I love, like mangroves.
- I am a little brother of two, and an uncle to a niece and nephew
- I am a liberal socialist. That means I believe that everyone should get the same opportunities regardless of where you come from, what your social standing is, or where you live. Everyone deserves an opportunity!



- I want young people to know that you don't have to be the best, but you do have to have a passion for what you want to do and work hard. Then you can achieve many things. If you enjoy what you're doing, some of the other challenges don't matter as much.

Before you begin the rest of Part 6, think quietly to yourself about Steve's identity map.

- Are there things you have in common with Steve?
- Are there ways in which you are different from Steve?
- Can you see anything about Steve's identity that would help him understand how to balance the needs of people with the needs of plants?



Task 1: What plants are in our research area?

Your team did great work observing and **classifying** living things in Part 3. In this Part, you are going to focus on observing plants. This task uses some of the same skills that you learned in Parts 3 and 4. But observing plants is different from observing animals, fungi, or bacteria. You will need new skills. You will learn those new skills in this task.

In this task you will explore the plants that live in your research area. You will **discover** how to use your senses and other tools to help you find plants. You will plan and carry out an investigation to **understand** what plants are in your research area. Then you will **act** to classify and record these plants.



Discover: *What plants did we discover already?*

You may have already observed and classified some of the plants in your research area in Part 3. Now your team will observe more plants in your research area. Try to focus on finding the kinds of plants you may not have noticed before. You will learn from your research mentor about how to use your senses and other tools to search for plants.

1. Gather as a team. Observe this image.



Figure 5.3: A group of living things in their habitats.



2. What living things can you observe in this photo? As a team, list all the living things that you notice.
3. Answer the following questions as a team:
 - a. Which living things did you notice first?
 - b. Did you list any of the plants shown in this photo?
4. Read the information in *Noticing Plants*.

Noticing Plants

One important part of resolving conflicts between people and plants is helping people notice and care about the plants living in their communities. Many people are more likely to notice the animals in an image or in real life instead of the plants. Plants sometimes blend into the background even though they are an important part of the landscape and ecosystem.

5. As you complete the rest of this Part, think about how you can help people notice and care about the conflicts between people and plants. You could even try doing Steps 1 through 3 with some people in your household or community.
6. Take out your *Part 3 Organizer*. Remember that your team recorded a list of the living things you found in your research area in Part 3. This list included plants.
7. Discuss as a team:
 - a. What kinds of plants did you observe and classify in Part 3?
 - b. Why do you think you noticed those plants and not others?
 - c. What other kinds of plants do you think are in your research area?
8. Think about the following questions by yourself:
 - a. Are there some plants in your research area that you like best or are more exciting to observe than others? Why?
 - b. Are there any plants that are helpful to you?
 - c. Are some plants in your research area more important to you than others? Why or why not?
 - d. When was the last time you noticed a plant? What did you notice about it? Do you remember how it made you feel?



9. In the next activity your team will use your senses and other tools to find plants in your research area. Learn about how Steve and his team use their senses and use tools, such as cameras, to help them observe plants.

Steve says:



Smell is the best sense to use for finding mangroves. Mangrove forests can smell pretty bad! The soil where mangroves live has bacteria that release **sulfur**. Sulfur smells like rotten eggs. So if you smell rotten eggs that may mean you are near a mangrove forest.

You can also use your sense of touch. **Bark** can tell you quite a bit. Has your skin ever felt dry and papery when you haven't had enough water? The same can happen to a tree. If a tree needs water or if a fire has gone through, you can feel that on the bark.

Mangroves usually live in salt water. Some mangroves have roots that prevent salt from ever coming into the plant. Some mangroves can't do that. These mangroves get rid of the salt through their leaves. You can use your sense of touch to feel the salt crystals on the back of the leaf. You can tell what kind of root system a mangrove has by feeling for salt crystals.



Figure 5.4: Salt crystals on the back of a mangrove leaf



You can use your sight to tell what kind of plant you are looking at. For example, the red mangrove, or *Rhizophora*, normally sits on the front of a mangrove forest in the Caribbean. It has spider-like roots. You can see it from really far away. The black mangrove, or *Avicennia* has roots that come up out of the ground like snorkels. It's a really easy way to say, "Oh, that's a black mangrove."



Figure 5.5: A black mangrove with snorkel-like roots.

The best tool we have is asking the community. We need to talk to the people that live there. We might say, "We are searching for some healthy, tall mangroves that are in a lagoon," and someone in the community will say, "Oh, yeah, we have those and I can take you there."

When we are searching for mangroves, we bring tape measures and rulers. We also use cameras. Cameras are the best way to record what you have seen because your memory can play tricks on you!

Comparing photographs from different years can be very, very powerful. We have some photos that show a place that lost up to 75% of its mangroves over 12 years. We think that's mainly due to **climate change** and sea-level rise.

Maps can help, too. They can help you get back to the same place where you saw an interesting or important plant.





Figure 5.6: Steve and a teammate using tools to collect data in a mangrove forest.

10. Think about how Steve and his team use their senses and other tools to find plants in their research area. Discuss the following questions as a team:
 - a. Could you use any of the same senses or tools that Steve and his team used?
 - b. What others senses or tools do you want to use?
11. Your team will plan and carry out an investigation in the next activity. You will use your senses and other tools to find plants in your research area.



Understand: How can we investigate our research area?

In the last activity you thought about how you can use your senses or other tools to find plants in your research area. Now your team will use this information to plan and carry out an investigation to observe the plants in your research area. Just like in Part 3, don't worry about trying to find all of the plants in your research area in this activity. Just do the best you can.

1. Gather your team and take out the My Research Area map you made in Part 1, Task 4, Act. Recall where your research area is.



2. Read the *Investigation Instructions* for more information about how to observe plants in your research area.

Investigation Instructions

Where to investigate:

1. Review the tips from the Part 3, Task 1, understand activity.
2. You can go back and make observations in the same parts of your research area that you did in Part 3. Or you can make observations in a new part of your research area.
3. Remember that this time you are only observing plants. It might be easiest to observe plants that are easy to find, common in your area, or familiar to you. But try to find other kinds of plants.
4. Use the following suggestions to help you decide where to search:
 - a. Search for plants on land. Some plants may be rooted in soil or sand. Some may be growing on rocks. Others have roots in the open air. Some plants grow on top of other plants, such as a vine on a tree. Plants may be growing in or around human-made objects, such as an ivy plant growing along a wall or building or moss growing in a sidewalk crack.
 - b. Search for plants in water. Plants may be in both fresh water and salt water. Plants may be on top of the water or under the water and rooted in the **sediment**.



Figure 5.7: This is a very close photo of several kinds of mosses. These mosses are growing in a narrow space between two parts of a sidewalk.



Tools you can use:

1. Review the tips from the Part 3, Task 1, Understand activity that describe how to use your senses and other tools, such as a magnifying glass, a camera, or paper and a writing tool. Remember that you also thought about how you could use your senses in the Discover activity.

 **Emotional Safety Tip**

Remember to be an inclusive team member. Every person on your team brings different skills and perspectives. Some members of your team may not want to or be able to use all of their senses. That is fine. Work with your teammates to find a way for everyone to participate and feel comfortable.

2. Some plants are underwater. It can be difficult to see through the water to find plants. You can make a simple tool to help observe plants underwater. This tool is called an underwater scope.
 - a. Find a can. You can also use a plastic bottle or another kind of cylinder.
 - b. Use a can opener to remove the bottom and top lids of the can. If using another type of cylinder, remove the bottom and top parts using scissors or ask an adult for help.
 - c. Wrap a piece of clear plastic film around one end of the cylinder. Keep it in place with a rubber band or tape.
 - d. Place the end with plastic film against the surface of the water. Look through the cylinder. You should be able to see into the water. This works best in bodies of water that are clear or shallow. It will not work well in water that is cloudy or deep.
3. Some plants are very tall. For example, the tallest tropical tree in the world is 100 meters tall. It can be hard to observe an entire plant from the ground. Use a camera that can zoom or binoculars to help you see the parts of the plant that are far away.



4. Some plants are very small. It can be hard to see details of the plants. Use a camera that can zoom or a hand lens to help you see small plants. If you do not have either tool, you can make a simple hand lens out of a plastic bottle:
 - a. Find a clear plastic bottle with a curved top.
 - b. Cut a small circle out of the curved part of the bottle.
 - c. Pour a small amount of water into the curved part of the bottle.
 - d. Hold the curved part of the bottle over the plant you are trying to see.
The curve of the bottle and the water will magnify the plant.

Tips for doing this investigation:

1. Review the tips from the Part 3, Task 1, Understand activity.
2. It can be easiest to find plants during the growing season. This is the time of year when conditions are right for plants to grow. The growing season may be different depending on where you live in the world. Some places may have a very short growing season. Some places may have a growing season all year! Ask someone in your community about when the growing season is in your area.
3. You can still search for plants even if the growing season is over. Some plants keep their leaves and stems all year. Those plants are easier to find after the growing season is over. Some plants may lose their stems or leaves when the growing season is over. They may become **dormant**. You can still search for evidence of these plants. Explore your research area for twigs, dead leaves, stems, bark, berries, or nuts. These items can help you figure out what kinds of plants live in your research area.
4. Because many plants are green, a group of several different plants may appear like one plant from a distance. Try getting close to the plants in your research area so you can see each plant individually. You might be surprised how many different plants are growing in one area.
 - a. For example, the following photos show the same area. But each photo gets closer and closer to the plants in that area. At first, it just looks like mostly grass is growing there. But as the photos get closer you can observe different types of mosses, clover, and grass.





Figure 5.8: An area of plants taken from about a meter away. You can observe some grasses and some clovers.



Figure 5.9: A closer view of the same area of plants. You can now observe some mosses among the grasses and clovers.





Figure 5.10: The closest view of an area of plants. You can now observe several moss plants.

5. You may live in an area that has mostly human-made surfaces. Or you may live in an area that has conditions that make it hard for plants to grow. It can be discouraging to feel like you can't find many plants in your area. But plants can be found almost everywhere on Earth! Try searching for plants in unexpected places. Search for plants between cracks in pavement or bricks or where water pools after a rainstorm.

Safety Tips for observing outside:

Ask your teacher first for guidelines. They will know what is safest in your community.

Physical Safety Tip

Do not observe a research area by yourself. Always work with at least one other person, which could be an adult or a teammate. Notice if your teammates are uncomfortable or if they feel unsafe. Offer to pause the investigation or move to another part of the research area.

Always pay attention to local guidance on whether it is safe to interact with people outside of your home.

Do not use your sense of taste to try to observe plants. Do not touch plants that you are unsure are safe to touch. For example, some plants may bite or sting.



 **Emotional Safety Tip**

Do not be discouraged if it is difficult to find plants. Every research area is different. Some areas may have many plants and some may have very few. It is not your fault if you have trouble finding plants. Just practice using your senses and other tools to do your investigation. If you feel sad or wish there were more plants in your research area, remember that you will take action to make this possible!

3. If finding plants outside doesn't sound like the right investigation for your team, that's okay! You can pick another way to collect information about your research area.
 - a. You can use online tools, such as iNaturalist or PlantNet, to find out what plants have already been found in your research area. More information about these tools is in the *Biodiversity!* StoryMap.
 - b. You can use books, lists, websites, videos, artwork, photos, stories, or other records of plants in your research area. Try to use records that have been made recently to make sure you are only observing plants that still live in your research area.
 - c. You can write, call, or talk to local gardeners, farmers, scientists, researchers, older people who have lived in the community a long time, or other experts on plants in your research area. Ask them to describe what plants they have observed in your research area.
4. Decide as a team how you will investigate.
5. Remember, including everyone on your team is important. Try to pick a way to investigate that allows everyone to participate. Don't forget to think about the timing, comfort, location, and format of your investigation to make sure everyone on the team feels included. You can reread Part 2, Task 2, Understand if you need more information about making your investigation inclusive.
6. Next, work with your team to plan how you will do your investigation. For example, if you decide to do an observation, decide which teammates will observe which parts of the research area. Decide how long you will spend finding plants. Decide how you will record the plants you find and who will do the recording.
7. Finally, do your investigation with your team.





Act: *How can we classify the plants in our research area?*

Your team has just completed a very important step in helping to balance the needs of people and plants in your community. You observed the kinds of plants in your research area. Now you will classify these plants. This information will help you complete the rest of this Part and get ready to take action in Part 7 to create a balanced community.

1. Your team is going to classify the plants you just found in your research area. Classify means to name or identify something and to sort it into a group. Classifying living things can help you understand more about the biodiversity in your research area. Remember that biodiversity is a measurement of how many different types of living things are in an area. To measure biodiversity in your research area, you need to know how many different kinds of plants you observed.
2. Read *Tools to Help Classify Plants* for more information about how to classify plants in your research area.

Tools to Help Classify Plants

1. A **field guide** is a tool that has the names, images, and descriptions of plants in an area. Field guides may be printed (such as books) or online.
2. You can also use a **dichotomous key**. This is a tool that asks you questions about the parts of a plant to help you classify it. Try finding a dichotomous key for plants in your area of the world. If you need an example of a dichotomous key, you can find one in the *Biodiversity! StoryMap*.
3. You can use an online tool such as the iNaturalist or PlantNet website, which is also known as a community science tool. People in a community take photos or describe what plants they have noticed in their area. They send the photos and descriptions to scientists through the website. The scientists help identify what the plants are. This helps scientists and community members keep a record of what kinds of plants are in an area. More information for iNaturalist and PlantNet is in the *Biodiversity! StoryMap*.



4. Communicate with a person who is respected in your community because of their knowledge of the environment and plants. This might be a gardener, a farmer, a logger, someone who has lived in the community for a long time, someone with traditional knowledge, or someone who works or volunteers in the outdoors.
5. If you do not have a field guide, your team can come up with your own names for plants in your research area. Review the case study in Part 3, Task 1, Act for more information.

Tips to Help Classify Plants

1. If you don't have access to any tools to help you classify, just try to notice if the plants you observed in your research area are different from each other. For example, you might observe that one plant in your research area has wide, striped leaves with serrated edges and another plant has narrow, branching leaves with scales. Even though you don't know the names of these plants, you can tell that they are not the same. Record that you observed two different plants in your research area.



Figure 5.11: This photo shows a plant with wide, striped leaves with serrated edges and a plant with narrow, branching leaves with scales.



2. Plants have many parts. Observing and comparing these parts can help you classify the plants in your research area. Observing the parts on this list can help you match a plant to its description in a field guide or a dichotomous key. If you don't have any tools to help you classify the plants in your research area you can use these observations to just describe each plant. For example, you could describe a plant as "reddish leaves with rough bark." You may not be able to see a plant's roots without digging into the soil. If you feel like you may harm the plant by trying to look at the roots you don't have to observe them.

a. Leaves

- Does the plant have leaves?
- What size are they?
- What color are they?
- What shape are they?
- What do the edges look like?
- How are they arranged on the plant?

b. Flowers, fruits, or nuts

- Does the plant have any flowers, fruits, or nuts?
- What size are they?
- What color are they?
- What shape are they?

c. Bark

- Does the plant have bark?
- What texture is it?
- What color is it?
- Does it have a smell?

d. Roots

- Are the roots under the soil or in the air?
- Is there one large root?
- Or are there many roots spread out?





Figure 5.12: These three tree species have different kinds of bark.

3. Sometimes a young plant looks very different from the adult plant. You might think they are two different plants. For example, a pine tree seedling may only be a meter or two tall. It only has a few leaves. An adult pine tree is many, many meters tall. It has many leaves. A young pine tree and an adult pine tree may look like two different plants even though they are the same **species**. Just do the best you can and remember to ask for help from people in your community who know about plants.

3. Remember from the case study in Part 3, Task 1, Act that there are many ways to classify a living thing. No matter which way you choose to classify the plants in your area, remember that your way is valuable because it came from you.
4. Work with your team. Title a sheet of paper or a digital document *Part 5 Organizer*. Make three columns just like you did for your *Part 3 Organizer*. Write the words “Know,” “Think,” and “Wonder” at the top of the columns.
5. Create a list in the *Know* column of the plants that your team found in the research area.
 - a. Record the name of each plant you found. If you were not able to find or create a name you can write a description, use a symbol, or make a drawing.
 - b. List how many of that plant you found.



- c. If several team members found the same plant, combine those numbers and record the total. For example, if one person found four smooth mesquite trees in their part of the research area and another person found five smooth mesquite trees in their part of the research area, record “nine smooth mesquite trees.”
6. Consider your *Know* column. Discuss the following questions as a team:
 - a. Did your research area have many different kinds of plants?
 - b. Did it have the same kind of plants over and over?
 - c. Did it have very few plants?
 - d. Do you think there might be plants living there that you weren't able to observe?
7. Answer the following questions in the *Think* column:
 - a. How does your team feel about the kinds of plants in your research area? Are there plants you like more than others?
 - b. Do you wish you had more kinds of plants in your research area?
 - c. Which plants did you notice most easily? Why do you think that is?
 - d. Are any plants more important to you? Why or why not?
8. Is there anything else you would like to investigate about the plants in your research area? Or anything else you would like to know? Record your answers in the *Wonder* column.
9. Keep the Part 5 Organizer in a safe place.



Task 2: What do the plants in our research area need to survive?

In Task 1 your team observed as many plants as you could in your research area. Now it is time to figure out how those plants are meeting their needs. First, you will **discover** how your experiences and identity are related to plants. Then you will use an investigation to **understand** how the plants in your research area meet their needs. Finally, you will **act** on this information to record those needs and think about how well your research area is able to meet them.



Discover: *How are plants important to me and my community?*

In this activity you are going to think about how your identity and your memories relate to plants.

1. Take out *My Identity Map* that you completed in Part 1. Review what you recorded in this identity map.
2. You are going to use your identity map and your memories to do a sharing activity. You can share with a partner or with your whole team. Or you can record your thoughts by writing, making a recording, drawing, or another way and share them with others.
3. Examine the following prompts. Choose one or more to respond to.
 - a. Describe a time that a plant made you happy.
 - b. What is a favorite meal in your family? What plants are included in that meal?
 - c. Can you remember the texture of a kind of plant? What does it feel like when you touch it?
 - d. Have you ever grown a plant and eaten it? What was that experience like?
 - e. Think about the place you live now or a place that is important to you or your family. What plants are always found in this place? Can you describe what these plants look like and where they grow?
 - f. Are there plants inside or outside your household? Who takes care of them? What do they do to care for them?
 - g. What is a plant that you use all the time? What do you use it for?



4. This activity helps show that plants are an important part of your life. You probably eat something made from plants each day. You may live in a household made out of plant parts. You may have plants growing near or inside your household. Plants are a part of your identity and your memories. It is important to know what plants need to survive so they can continue to be a part of your life and the lives of other living things.



Understand: How can we investigate what plants need to survive?

In the Part 3, Task 2, Understand activity your team did an investigation of how the living things in your research area meet their needs. That investigation may have already included some of the plants from your research area. Now you are going to add to that investigation by finding out more about the plants you observed in the Part 5, Task 1, Understand activity.

1. Gather your team together and take out your Part 3 Organizer and your Part 5 Organizer.
2. Read through the list of plants in the *Know* columns. Remind yourself of what plants are in your research area.
3. Now your team will plan an investigation into how the plants in your area meet their needs. Read What Do Plants Need? to find out more about the basic needs of plants.

What Do Plants Need?

Plants need light, carbon dioxide, water, and space.

Plants use light, water, and carbon dioxide to make their own energy. Many plants get light from sunlight. Plants can also get light from artificial light, such as from a lamp.

Plants need clean water. Plants can absorb water from their environment. And some plants live partly or completely underwater.



Plants need space to grow and **reproduce**. Some plants need more space than others.

Some plants need **pollinators** to help them reproduce, or make more plants. Pollinators are animals that spread **pollen** from plant to plant to help with reproduction.

4. Before you begin your investigation, read the following information from your research mentor, Steve. He explains what the plants in his research area need.

Steve says . . .



Mangroves need some kind of **barrier** to protect them from strong waves. A coral reef is one kind of barrier that you can find near mangrove forests. It slows down the waves before they get to the mangroves. Mangroves also need the tide going in and out. Remember that some mangroves can keep salt from coming into the plant. But that salt builds up near the roots. The tide helps flush the salt away from the roots. Otherwise the salt stays behind and stresses the plant.

Mangroves also need to be connected to each other. When mangroves die from a hurricane or a lightning strike they only grow back if there are other mangroves nearby to spread seeds and grow new plants.

Mangroves also need clean water. If you stir up the sediment that is upstream of a mangrove forest, it can have really big impacts downstream. It can pull too much sediment downstream and bury the mangrove roots. Remember that some mangroves that have roots that are like a snorkel. The roots help the plants take in fresh water and keep salt out. If those roots get buried by sediment then the mangrove can't take in fresh water.

As action researchers, you can tell if a plant in your research area isn't getting what it needs. Look for signs that the plant is stressed. Smell the soil, touch the bark, and look at the leaves. For example, if you see an evergreen tree with lots of yellow leaves, that tree is likely showing signs of stress, because evergreen leaves should be green all the time.



5. Discuss how you will investigate the needs of plants in your research area. There are many ways to investigate. You could:
 - a. Plan an observation like you did in the Part 3, Task 2, Understand activity. You could observe each plant outdoors and notice how it is meeting its needs for sunlight, water, and space. Just like in Part 3, be aware that some needs may be more difficult to observe than others.
 - b. Interview an expert in your community on the phone, online, or in person. An interview is similar to the oral history you collected in Part 2, Task 2, Understand. But instead of asking about the past you will ask people about what they know now. Go back to Part 2, Task 2, Understand if you need help with this kind of investigation. You could interview:
 - Older people who have lived in the community a long time and know about local plants
 - A person who is respected in your community because of their knowledge of the environment and plants
 - Someone with traditional knowledge of plants
 - A scientist that studies plants
 - A volunteer at a local nature preserve or wildlife refuge
 - A person who works or volunteers with plants
 - c. Use books, websites, videos, artwork, audio recordings, or other records of what the plants in your research area need. Try to use records that have been made recently to make sure you are only learning about the plants that still live in your research area.
 - d. Think of your own way to collect information.
6. It might be difficult to get all of the information you need from just one kind of investigation. You may need to combine more than one kind.
7. Decide what kind of information you want from this investigation.
 - a. Plants have three basic needs: sunlight, water, and space. Many plants also need pollinators. You will need to find out how the plants in your research area are meeting these needs. You can also begin to notice if the plants in



1. Take out the information you recorded from the Understand activity. Take out your *Part 5 Organizer*.
2. Have the team leader record what they found out in the Understand activity. They should put their answers in the *Know* column. For example, the team leader may have learned from an observation that the plants in your research area get their water from rain.
3. Let the team leader know if they describe a need that you also found in the investigation. Circle that need or make some other mark next to it. This will help you record that this is something that more than one plant needs or wants.
4. Next, share any needs you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
5. You should now have a list of what the plants in your research area need.
6. Discuss what you learned about in the investigation as a team. Record your thoughts in the *Think* column.
 - a. What needs are shared by many different kinds of plants in your research area?
 - b. Are any plants in the research area having trouble meeting their needs?



Task 3: What are the conflicts between people and plants in my community?

Your team found out information about the needs of plants in your research area. Now, you will **discover** some of the conflicts between people and plants that make it harder for plants to meet their needs. You will use an investigation to **understand** if any parts of your research area have these conflicts. You will **act** on the information from the investigation to identify the problems in your community and start thinking about how to solve them.



Discover: *How does conflict make it harder for plants to meet their needs?*

In the Task 2, Understand activity you learned how the plants in your research area meet their needs for sunlight, water, and space. You also began to notice if any plants were having trouble meeting their needs. Now you will learn about how certain kinds of conflict between people and plants make it harder for plants to meet their needs.

1. You and your team can choose to complete one or more of the following observations. These observations will help you learn more about some of the conflicts between people and plants. If you do not have the time or materials to do these observations you do not have to complete them. You can still do the next activity in this task.

Observation #1: Space

1. Plant a seed in a very small container of soil, about 3 cm across. Vegetable seeds such as pumpkin, radish, or peas are usually inexpensive and easy to grow. You may also be able to get seeds from a fruit or vegetable that you have eaten, or you can ask an adult in your community for seeds from their garden. If you can, use a clear container such as a glass or plastic cup.
2. Keep the container in a well-lit area and water the soil when it is dry.
3. After the plant sprouts allow it to keep growing in the small container. Continue to keep the plant in a well-lit area and water the soil when it is dry.



4. Observe the plant over the next several weeks. Notice what happens to the parts of the plant above the soil. If you used a clear cup, observe what happens to the roots through the side of the cup. If you did not use a clear cup, gently pull the plant partway out of the container to observe the roots and then re-pot it.

Plants need space to grow. Sometimes people do not leave enough space for plants. For example, sometimes people plant trees in small areas surrounded by roads, sidewalk, or buildings. The tree may not have enough room to grow its roots. This can make it harder for it to absorb water. Plants that cannot meet their needs for space may become stressed, grow smaller than normal, send roots above the soil, or even die.

Observation #2: Pollution

1. Get two containers of soil. Plant a seed in each one. Vegetable seeds such as pumpkin, radish, or peas are usually inexpensive and easy to grow. You may also be able to get seeds from a fruit or vegetable that you have eaten, or you can ask an adult in your community for seeds from their garden. The size and material of the container do not matter in this observation. You can also use two plants that are already growing in containers if you do not want to wait for a seed to grow.
2. Keep the containers in a well-lit area and water the soil when it is dry.
3. After the plants sprout, start watering one of the plants with salty water. Water the other plant with just water.
4. Observe what happens to the plants over time. Do the plants look similar or different?

Plants need clean water to grow. Sometimes people make choices that cause water pollution. This can harm plants. This observation mimics what sometimes happens to plants that grow on the side of the road. Salt is sometimes used in cold climates to help melt the ice on roads. The salt washes off the road and is absorbed by the soil. Some plants can tolerate it but many cannot. They become stressed or die. Feel free to try this observation again with other materials that are in your research area and might wash into the soil, such as cooking oil or dish soap.



Observation #3: Climate Change

1. Get three containers of soil. Plant a seed in each one. Vegetable seeds such as pumpkin, radish, or peas are usually inexpensive and easy to grow. You may also be able to get seeds from a fruit or vegetable that you have eaten, or you can ask an adult in your community for seeds from their garden. The size and material of the container do not matter in this observation. You can also use the three plants that are already growing in containers if you do not want to wait for a seed to grow.
2. Keep the containers in a well-lit area and water the soil when it is dry.
3. After the plants sprout, allow them to grow for a week.
4. Then, change how you water the three plants. Continue to water the first plant only when the soil is dry. Stop watering the second plant. Water the third plant enough times a day that the soil is always soaking wet.
5. Observe what happens to the plants over time. Do the plants look similar or different?

Climate change affects living things all around the world. This observation mimics some of the effects of climate change. Some places are experiencing **droughts** that are longer and more harsh than usual. Some places are experiencing storms that are more frequent, stronger, and have more rain than usual. Some plants can tolerate these changes but many cannot. They become stressed or die.

Scientists at the Smithsonian Environmental Research Center are doing an experiment similar to this observation. You can learn more about it in the *Biodiversity!* StoryMap.

2. These observations helped mimic some of the conflicts between people and plants. But these conflicts are not the only ones that make it harder for plants to meet their needs. You will learn about more kinds of conflicts in the Understand activity.
3. Read the following information from your research mentor, Steve. He explains some of the conflicts between people and mangroves.



Steve says . . .

If you damage a mangrove forest, you'd be surprised how quickly the plants grow back. If there are mangroves upstream, then the seeds will come downstream and the forest can grow back. But when we start messing around and blocking these connections by putting in roads, or shipping **channels**, or **dredging**, we change the whole makeup of the area. Someone might say, "Oh, the mangroves aren't doing very well." Well, yeah! Because you've built a road across an important area and cut the mangroves off from the rest of the population, so they can't grow back.

Agriculture is also a conflict. Rice paddies, palm oil plantations, and shrimp farms can cause runoff of fertilizer and other nutrients. Too many nutrients can hurt the mangrove plants.

Mangroves live in prime real estate. They are right on the coast. Hotels and tourism is a massive reason mangrove forests get cut down. Many of these coastal properties used to be mangrove forests. And you can smell it! If you ever go to one of these places and it smells like there might be some sewage drains around, nope. That smell is because the hotel is sitting on old mangrove soil that is filled with sulfur.

Climate change is another conflict. Climate change can cause droughts. Droughts make it harder for mangrove forests to get fresh water from upstream. They need that fresh water to help dilute the salty ocean water.



Figure 5.13: This photo shows a beach being used by a hotel. Mangroves have been cleared from the beach to make room for people to use the space. You can still observe some mangroves growing on the right side of the photo.





Understand: How can we find out more about the conflicts in our research area?

When plants can't meet their needs, they become stressed. Sometimes they die. When plants are stressed or they die, this causes a decrease in biodiversity in that area. Remember that biodiversity is the measure of different living things in an area. Many living things depend on plants to survive, so a decrease in plant biodiversity can cause huge problems in an ecosystem.

Your team is trying to figure out how to solve problems related to biodiversity in your research area. To help you do this, your team will do another investigation. You will find out what the conflicts are between people and plants in your research area.

1. As a team, think back to what you observed in the Task 2, Understand activity. Discuss the following questions as a team:
 - a. Did you notice that any plants had trouble meeting their needs?
2. Gather your team together and take out your Part 3 Organizer and your Part 5 Organizer.
3. Read through the list of plants in the *Know* columns. Remind yourself of what plants are in your research area.
4. Now your team will do an investigation of your research area. You will find out if there is any evidence of conflict between people and plants.
5. Use the following checklist of questions to help you notice conflicts in the research area. You learned about some of these conflicts already in the Discover activity. Some of the conflicts may be new to you:
 - a. Space:
 - How much space in my research area is space where plants can grow?
 - How much is space where plants cannot grow or are not growing?
 1. If you can, try to calculate this. For example, imagine your research area is 100 square meters and you measure or estimate that only 10 square meters of space can be used by plants. That means that 10% of your research area can be used by plants.



- Why are there spaces where plants cannot grow? What is that space being used for instead?
 - Who makes decisions in my research area about where plants can grow?
- b. Pollution:
- Are the plants in my research area affected by pollution? How?
 - What kinds of pollution are in my research area?
 - Where does the pollution come from?
 - Are people using harmful chemicals on purpose? For example, are they using chemicals to kill certain kinds of plants?
- c. Climate change:
- Is there any evidence of drought affecting the plants in my research area?
 - Is there any evidence of flooding affecting the plants in my research area?
- d. Native and non-native species
- Are there any plants in my research area that are **native** to this area? That means that these plants have grown in this area for hundreds or thousands of years.
 - Are there any plants in my research area that are non-native? This means that these plants do not typically grow in this area. They were either accidentally or purposefully brought to this area from somewhere else.
 1. If you can, try to calculate the percentage of non-native plants. For example, imagine that you have 25 kinds of plants in your research and 5 of them are non-native. That means that 20% of the plants in your research area are non-native.
 - Are any non-native plants making it difficult for native plants to meet their needs in my research area?
 - Did people plant the non-native plants in my research area? Why?
- e. Diversity of plants
- Are there spaces in your research area that have the same kinds of plants over and over again? For example, a lawn is an example of a large space that only has one kind of grass.
 - Who makes decisions about the kinds of plants that grow in your research area?



f. Pollinators

- Is there anything that prevents pollinators from visiting the plants in your research area?
- Are any of the pollinators in your research area considered pests by the people living there?
- Do people use pesticides to kill any pollinators in your research area?
- Is there enough habitat in your research area for pollinators to live?

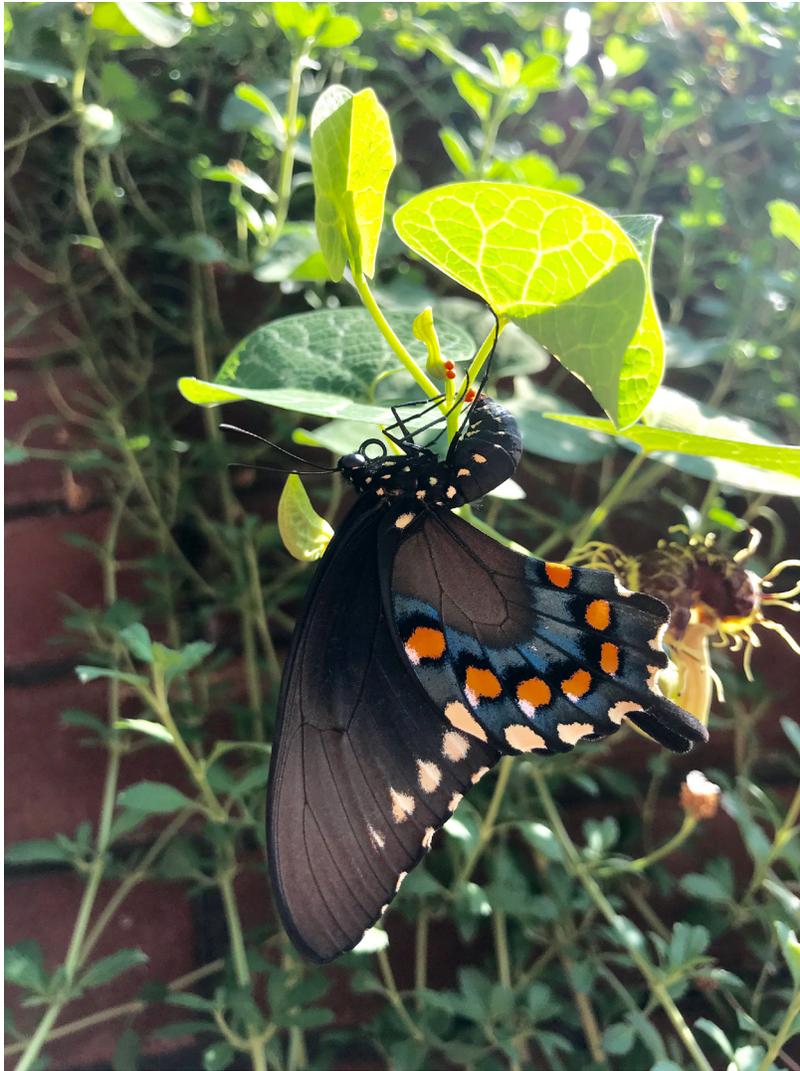


Figure 5.14: This pipevine swallowtail butterfly is laying eggs on a host plant in the Smithsonian Mary Livingston Ripley Garden. Having this plant in the garden gives the butterfly important habitat to lay eggs.

6. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.
7. Work by yourself to conduct your investigation.





Act: *What do we think about the conflicts in our research area?*

Your team has investigated how plants in your research area might have problems meeting their needs. Now, your team will share what you observed and think about how people may be involved in these conflicts.

1. Take out the observations you recorded from the Understand activity.
2. Take out your Part 5 Organizer.
3. Have the team leader record what they found out in the Understand activity. They should put their answer in the *Know* column. For example, the team leader may have learned that your research area has some fields for growing crops. A crop is a plant your community sells or uses for food. These crop fields have the same plant over and over again in one space. People don't allow any other kinds of plants to grow there. This area has low plant biodiversity.
4. If the team leader shares any conflicts that you also found in your investigation, let them know. Circle that need or make some other mark. This will help you record that this is something that is a conflict for more than one plant.
5. Next, share the conflicts you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
6. You should now have a list of the conflicts in your research area.
7. Take out your Part 3 Organizer. The *Know* column has information about what the people in your community need.
8. As a team, compare the information in the *Know* column of your Part 3 Organizer to the information in the *Know* column of your Part 5 Organizer. Discuss the following questions as a team:
 - a. Did the plants in your research area have a problem meeting their needs because of space, pollution, climate change, non-native species, or the diversity of plants in that area?
 - b. Consider the needs of the people in your community. Remember that you recorded this information in your Part 3 Organizer. Do you think any of these needs are causing the conflicts between people and plants?
9. Record your answers in the *Think* column of your Part 5 Organizer.



Task 4: What are people already doing to balance the needs of people and plants?

In this task you will **discover** how you think and feel about conflicts between people and plants in your research area. Then you will use information from your community and your research mentor to **understand** how people are already working to solve these conflicts. You will **act** to think about what you would do about the conflicts in your community.



Discover: *What is my perspective on the conflicts in my research area?*

In Task 3 your team identified the conflicts between people and plants in your community. There can be many perspectives on conflicts. You probably have your own thoughts and feelings. Other people might have other ideas and perspectives.

1. Consider what your team wrote in the *Know* column of the Part 5 Organizer.
2. Think quietly to yourself about the following questions:
 - a. How do the conflicts between people and plants in your research area make you feel?
 - b. Which conflicts are most important to you?
 - c. Think back to your answer from Task 1 about the plants that you like best in your research area. Did you choose a conflict that involves a plant you like? If so, is that the right reason?
 - d. Which conflicts do you think will be the hardest to solve?
 - e. Which conflicts do you think you are able to take action on?
3. Take out or remember your identity map from Part 1. How do you think your identity affects how you think and feel about the conflicts in your research area?
4. Pair with a teammate.
5. Ask your teammate the same questions from Step 2.
6. Think quietly to yourself about the following questions.
 - a. How are your answers similar to your teammate's answers?
 - b. How are they different?
 - c. Have you changed your mind about any of your answers?



7. Remember the four perspectives you learned about in Part 1, Task 3. The following situations involve at least one of those perspectives. Read each situation and identify the conflict in each one. Then, discuss with a teammate how each conflict makes you feel. Which perspective is most important to you? What do you think you would choose to do about each conflict?
- Economic and environmental perspective:** A farmer needs to add more fields to her farm so she can grow more crops. Her harvest last year was not as large as she expected and she has some debt. She has a part of her farm that she isn't using. It has several types of wild, native grasses. She wants to dig up those grasses and plant corn instead.
 - Social and environmental perspective:** The people in a community have built a new park. It has large grass fields where people can play sports, spend time with each other, and have events. But the type of grass in the park is not native. And it is cut every week, so it is never able to flower. Some people ask to introduce native plants to the park. But other people protest. They say that the native plants will make it harder to use the space.
 - Ethical and social:** A part of the community has a native plant that is the only kind of food for a certain insect. But the native plant causes a severe allergic reaction in several children in the community. Some people in the community want to get rid of the plant. Others say the plant must stay because it is the only food source for that insect.

 **Emotional Safety Tip**

You may have a strong opinion about some of these statements. Remember to be respectful in how you share your thoughts and how you listen to others. It is okay to disagree but remember to disagree with ideas and not people.



Understand: *How can we find out more about solving conflicts?*

As you learned in Part 3, there are some people who think about the conflicts between people and other living things because it is important to their way of life or it is their job. These people think about and try to solve the same kinds



of problems you are trying to solve in this guide. These can be difficult problems to solve!

In this activity, you will think about just one conflict in your research area. You will try to find out what people in your community are already doing about this problem. You will learn more from your research mentor. This will help you create solutions that are sustainable and inclusive.

1. You can work on this activity by yourself or with the teammate you worked with in the Discover activity.
2. Remember which conflicts felt most important to you in the Discover activity.
3. Choose one of those conflicts to learn more about.
4. By yourself, record what the plant(s) in that conflict needs. Remember that you can find that information in your *Part 5 Organizer*.
5. Next, record what the people in that conflict need. Remember that you can find that information in your *Part 3 Organizer* or your *Part 5 Organizer*.
6. Finally, record how the needs of plants and people cause or contribute to this conflict.
7. For example, maybe your research area has a community gathering space that has many different kinds of beautiful plants. But some of the plants are not native and are also invasive. This community gathering space causes a conflict between people and plants. You would record:
 - a. What the plants need: The native plants in your area need space to grow. Invasive plants grow quickly and aggressively and can take over spaces that once had native plants. This leaves less space for native plants to grow.
 - b. What the people need: The people in your community need spaces to gather with each other. The beautiful plants help them feel relaxed and happy.
 - c. What causes the conflict: The people are growing plants that meet their needs. But these plants are invasive and are taking up space. This makes it harder for native plants to survive. It also makes it harder for the pollinators and soil organisms that depend on the native plants to survive.
8. Decide if you need more information about this conflict from your research area or community. You can do another investigation in your research area or community to find out more about what the plants or people in this conflict need. If you feel you need more information, gather it now.





Act: *How can I take action on conflicts in my community?*

Now that you have learned more about the conflict you chose, you are going to think about what you would need in order to take action. This information will help your team complete Task 5.

1. You can work on this activity by yourself or with the teammate you worked with in the Discover and Understand activities.
2. Think about the conflict that you learned more about in the Understand activity.
3. Answer the following questions by yourself or with your teammate:
 - a. What would you do to try to solve this conflict?
 - b. Who would your solution help? People? Plants? Both?
 - c. Which group's needs are most important to you? Why?
4. Take out your *Part 2 Organizer*.
5. Consider the information in the *Know* column.
6. Answer the following questions by yourself or with your teammate:
 - a. Who makes decisions in your community?
 - b. Who are the people in your community who don't usually get to share their ideas or help with decisions?
 - c. How can we make sure those people are included?
 - d. How can we find out what people are already doing to solve conflicts between people and plants in our community?
7. Read what Steve says about how talking to the community can help you gain important knowledge.

Steve says . . .



Respect the community's knowledge of what is in their area. For example, this is what I tell people about fishing. You've got 500 years of knowledge in most fishermen. When you're talking to them, most of them will have been taught by their grandparents, who were also taught by their own grandparents,



and so on. So you've got huge amounts of knowledge not just about the fish, but the weather, and what that ecosystem should be giving to the fish. The fishermen, they know how weather effects fish behavior. So they might say, "Oh, when it rains we all go to this spot because that's where the fish will be." Without asking people in the community, it's such a waste of your own effort. There's so much knowledge in the people there.



Task 5: How can I take action to balance needs in my community?

Change happens on different levels. There are things you can change about your own behavior. There are also changes that happen within the whole community. In this task you will **discover** what you know about changes needed for your community. Your team will use this information to decide on your community action plan in Part 7. You will also **understand** some ways you can personally change your behavior to help your community. Then you will **act** on those ideas.



Discover: *How is our community meeting the needs of people and plants?*

In any community there are people and other plants trying to meet their needs. Sometimes these needs cause conflict. Now you will use what you have learned in this Part to think about ways you could make those conflicts better.

1. Take out your *Part 5 Organizer*.
2. Your team has already listed information you found out from your investigations in the *Know* column. Add any additional information you want to remember.
3. Now you will list or draw everything your team thinks about your community under the *Think* column. Consider:
 - a. Think about the work you did in Task 4. What do we think are the most important conflicts to solve between people and plants in our community?
 - b. What do we think are some good ways to try to solve those conflicts?
 - c. Do we think our community could do better at meeting the needs of plants?
4. Take out your Balanced Community Goals. Compare them to the things you *Know* and *Think*. Your Balanced Community Goals show you how your team wants your community to be. What you *Know* and *Think* shows you how your community is. When your community is not the way you want it to be, that is a problem.
5. As a team discuss:
 - a. How well do you think your community is meeting the needs of the plants in your research area?



- b. Are there goals in the *Balanced Community Goals* that would help your community meet the needs of plants? If not, think about adding those goals now.
 - c. Do you think it is important to meet the needs of plants? Why or why not?
 - d. Record these thoughts in your *Think* column.
6. Think back to the investigations you did in Part 2, Task 3, Understand about who makes decisions in your community. Think about how people your age are involved in making decisions.
 - a. Which conflicts do you think you could take action on?
 - b. Which conflicts would you need help with?
 - c. Record those now in your *Think* column.
7. List or draw everything your team still wonders about your community under the *Wonder* column. Consider:
 - a. Are there questions you still have about how your community meets the needs of people and plants?
 - b. Are there actions you could take that might help your community balance the needs of people and plants?
8. Keep the *Part 5 Organizer* safe. You will need it again.



Understand: *How can I solve conflicts?*

In this Part you investigated how the plants in your research area meet their needs. You also learned how the people in your community meet their needs and wants. You noticed how those needs might cause conflicts. You thought about ways that your community could better balance the needs of people and plants. You will have a chance to put some of these ideas into action in Part 7. However, there are always ways that you could make things in your community better through your own individual actions.

1. Consider the *Think* and *Wonder* sections of your *Part 5 Organizer*. Are there any problems that you could help to change all on your own? Are there any actions you could take on your own?



2. Discuss your ideas with your team. For example:
 - a. Suggest any of your ideas about reducing conflict from Task 4.
 - b. You could try to create more space for plants in an area that you have permission to change, like a part of your household, schoolyard, classroom, or research area. You could add native plants to that space.
 - c. You could clear a small section of invasive plants from your community.
 - d. You could look around your household's outdoor space for any chemicals that might be leaking into the areas where plants grow. If you can, try to find a place in your community that gets rid of hazardous waste safely.
 - e. You could work with the people in your household to make a list of your needs and wants. Then, you all could think about which needs and wants might make it difficult for plants to meet their needs. Are there any things that you need or want that you could use less of?
 - f. Come up with your own ideas.

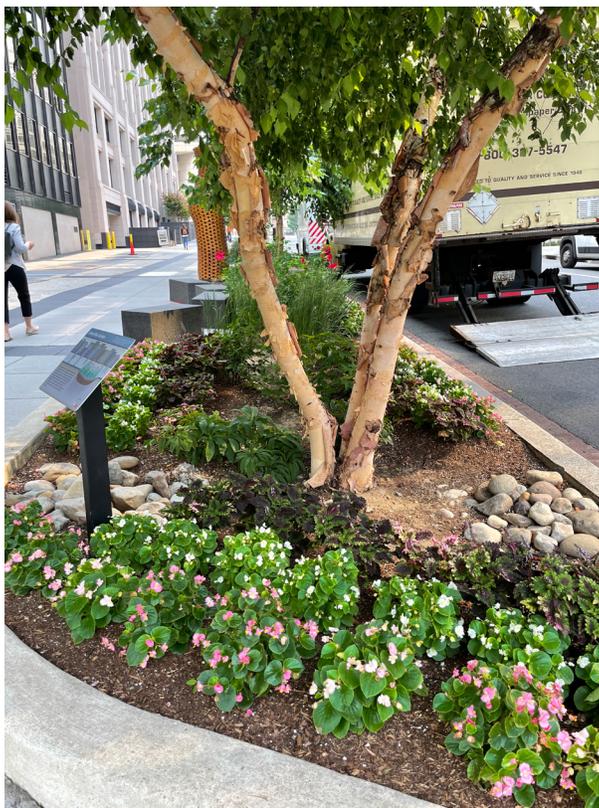


Figure 5.15: This urban rain garden is an example of a solution to help meet the needs of people and plants. The garden is small and narrow which allows people to still use the sidewalk and street. The plants in the garden absorb the water that normally washes away on the sidewalks and street. This water sometimes carries pollution from the sidewalk and streets to streams, rivers, and other waterways. The rain plants in the rain garden absorb this water and protect the waterways. The plants also provide habitat for pollinators.



3. Read some examples of action from your research mentor Steve.

Steve says . . .



Think about the pollinators. Be nice to bees, and wasps, and flies, and the critters that you might not like. They help plants reproduce. What can you do to help pollinators in your area? You could plant native plants. Native plants can grow better and use fewer resources than non-native plants.

The thing with plants is, if you leave them alone, they are generally good! But if the plants in your area are not growing well or growing back, check your soil. Soil is the source of all life on Earth. So check the soil before messing with any plants. There might be something wrong in the soil.

Your solution doesn't have to be fancy and over the top to be successful. Some of the most basic things can have the biggest impacts. Everyone is looking for very fancy solutions and sometimes it's like, "Leave the plant alone. Check the soil." You add a little fertilizer to the soil and all of the sudden, everything comes back. You didn't need to do all of these other things that cost a fortune. It was just that you put some fertilizer down and plants grew back.

4. Think quietly to yourself about a change you want to make in the way you act. Why do you think this change is important?



Act: *How can we take action and reflect?*

Changing our own behavior is often the first step. Now that you have decided what you will do to improve your community, you need to put that idea into action.

1. Make a plan for how you will put your idea into action. If you need to share information, where, when, and with whom will you share it. If you need to do something, what do you need to do it.
2. Put your plan into action.



3. Quietly reflect on your action by yourself:

- a. What seemed to go well?
- b. What was hard?
- c. Were you able to make the changes you thought you would be able to make?
- d. Will you keep going with your change or are there things you would do differently in the future?

Congratulations!

You have finished Part 5.

Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definition, or anything else that will help. Add other words to the glossary if you would like.

Bark: The tough outside layer of certain kinds of plants

Barrier: Something that blocks or protects

Classify: To find the name of something or put it in a category

Climate change: Changes in the patterns of temperature and precipitation on Earth

Channel: A deep part of a body of water

Dichotomous key: A tool that helps identify living things by choosing between two characteristics

Dredge: To dig into the sediment of a body of water to make that area deeper

Drought: A period of time with much less rain or moisture than usual

Dormant: Not actively growing

Field guide: A collection of descriptions and images that helps identify living things

Marine biologist: A scientist that studies the living things in saltwater environments

Manage: To handle or take care of



Native: an organism that has grown in an area for hundreds or thousands of years

Pollen: A grain-like substance in the male part of a flower that helps a plant reproduce

Pollinator: An animal that helps spread pollen from one flower to another

Reproduce: To make another living thing of the same species

Sediment: The soil-like material that lines the bottom of a body of water

Species: A group of living things that are similar and can reproduce

Sulfur: A chemical element that has a strong smell



BIODIVERSITY!



Part 6:

**How can I balance
the needs of people
and soil organisms
of my community?**

**SUSTAINABLE
DEVELOPMENT GOALS**

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE
HEALTH
POLICY**
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Figure 6.6: Logan Schmidt/SSEC

Figure 6.7: Logan Schmidt/SSEC

Figure 6.8: Christine Sprunger

Figure 6.9: SolStock/E+

Figure 6.10: Logan Schmidt/SSEC



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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Timing note: The time used for investigations, observations, and actions can vary. When different options are listed within an activity, some options may take longer than others.

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What soil organisms are in our research area?					
Discover	Consider the soil organisms in your community and the senses you use to observe them.		<u>Part 3 Organizer</u> (Part 3, Task 1)	20 minutes	259
Understand	Use tools to investigate what soil organisms are in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation tools 	<u>My Research Area</u> (Part 1, Task 4, Act) <u>Investigation Tips</u> (Part 3, Task 1) *StoryMap extension available	20 minutes + investigation time	262
Act	Classify the soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	*StoryMap extension available	30 minutes	272
Task 2: What do the soil organisms in our research area need to survive?					
Discover	Reflect on your experiences and how they relate to soil organisms.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		10 minutes	276
Understand	Investigate how the soil organisms in your research area meet their needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Books (optional) • Computer (optional) 	<u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 6 Organizer</u> (Task 1)	25 minutes + investigation time	277
Act	Share how soil organisms in your community get what they need to survive and decide how well your community is meeting those needs.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1)	20 minutes	281



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: What are the conflicts between people and soil organisms in my community?					
Discover	Explore conflicts between people and soil organisms.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		10 minutes	282
Understand	Investigate conflicts between people and soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils • Optional observation materials 		20 minutes + investigation time	283
Act	Create a shared list of the conflicts in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1)	30 minutes	290
Task 4: What are people already doing to balance the needs of people and soil organisms?					
Discover	Reflect on your thoughts and feelings about conflicts between people and soil organisms in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1) <u>My Identity Map</u> (Part 1, Task 2)	10 minutes	292
Understand	Explore what people in your community are doing about one conflict between people and living things in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 5 Organizer</u> (Task 1) <u>Part 3 Organizer</u> (Part 3, Task 1) <u>Part 2 Organizer</u> (Part 2, Task 2)	20 minutes + investigation time	294
Act	Prepare what you need to take action that will solve a conflict between people and plants in your research area.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	295



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 5: How can I take action to balance needs in my community?					
Discover	Consider what you now know, think, and wonder about conflicts in your community.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 6 Organizer</u> (Task 1) <u>Balanced Community Goals</u> (Part 1, Task 3)	15 minutes	298
Understand	Decide on individual actions you will take to help your community.		<u>Part 6 Organizer</u> (Task 1)	15 minutes	299
Act	Put your idea for individual change into action and reflect on it.			10 minutes + action time	301

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



6

Part 6: How can I balance the needs of people and soil organisms of my community?

In Part 3 your team gathered information about the living things in your research area. You did an investigation about what people in your community need. This helped you explore how to balance the needs of people with the needs of living things in your community. But you need more information about your research area. More information will help you take more meaningful and sustainable action.

In this Part, you will learn more tips and tools for finding organisms in the **soil** of your research area. Soil is the mix of minerals, air, water, and living things that sits on Earth's surface. You may have also heard soil called dirt. When soil-like material is at the bottom of a body of water, it is called **sediment**. You can also find living things in sediment. Soil is the home to many different kinds of organisms including bacteria, fungi, and animals. Soil organisms can be found on land, in saltwater habitats, and freshwater habitats. Anywhere there is soil, there are soil organisms.

In this Part, you will observe the bacteria, fungi, and animals living in and near soil. If you have had difficulty finding or observing bacteria, fungi, and animals in the other Parts, this Part will give you the tools and skills to observe them. Though the soil is a habitat for some larger animals such as snakes, rabbits, or moles, this Part will only focus on smaller animals that live in the soil, such as insects, earthworms, or millipedes.

Why is it important that you learn about and observe soil organisms? All of the living things you observed in Parts 3, 4, and 5 depend on the organisms in the soil for their survival. Soil organisms break down living things that have died. They return those nutrients to the soil so that other living things can use them for energy. Soil organisms are the "hidden heroes" of Earth.

You will learn more about the conflicts that tend to happen between people and soil organisms. You will challenge yourself to start thinking of solutions that are inclusive and sustainable. All of this will help your team take action to balance the needs of people and other living things in your community in Part 7.



Remember: In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.

Your Research Mentor

Sharing your experiences with others and learning from others' experiences is part of being a good action researcher. In Part 6, you will have a research mentor. A mentor is someone who has experience and can help guide you. The research mentor in this Part will help you understand some of the issues related to biodiversity in soil and how you can investigate and take action on those issues.

Meet Christine Sprunger, Your Part 6 Research Mentor



Meet Dr. Christine Sprunger. Christine (Kris-TEEN) is a soil scientist and professor at The Ohio State University in the United States. She is the leader of a laboratory that studies the living things in soil. Christine is most interested in **nematodes**. Nematodes are very small worms that live in soil.

She explains, "I am excited about nematodes because of where they fit in the soil food web. Some nematodes only feed on bacteria. Some nematodes only feed on fungi. Some nematodes eat plant roots. Some nematodes eat each other! We are starting to see that all these different nematodes impact the health of soil. We want to know how to manage the soil on farms to make sure that beneficial nematodes are thriving. Beneficial means good or helpful. Beneficial nematodes help crops grow. If the nematodes are thriving, they can increase **soil health**. And nematodes are also really sensitive to change, so they could help us tell how an ecosystem is responding to **climate change**."





Figure 6.1: A nematode seen through a microscope.

Christine has knowledge and perspectives that came from her identity. Since Christine is now working with you, it is important to understand who she is.

To help you, Christine filled out an identity map, just like you did in Part 1. Christine's identity map includes the following things:

- I am 33 years old
- I am Black, African American
- I was born in Haiti but I grew up in the United States
- I am adopted
- Haiti is important to me because I still have relatives there. One of the reasons I got interested in science was the tough environmental issues that Haiti has. That's really what motivated me to study soils.
- Originally I wanted to be a marine biologist—I was really impacted by the movie, "Free Willy"! And I grew up in Washington State, right on the coast. I was really interested in ocean systems. But as I got older and thought about environmental issues in Haiti, I realized that I really like soils. I can really link studying soil to food security issues and making environmental issues better, like climate change.



- I love anything to do with the outdoors. I like to spend time outside like going hiking. I also love biking. I have a stationary bike and do a lot of indoor biking. I really like trying different foods and trying new restaurants.
- I'm average height, 5 feet and 5 inches. I recently cut off most of my hair and am rocking the shorter hair! It's so much easier for maintenance. I wear glasses when I drive.
- I'm definitely an introvert, but a social introvert. I enjoy interacting with people but I definitely also like my downtime. I spend a lot of time reading and talking with close friends.
- I am the youngest of four daughters

Before you begin the rest of Part 3, think quietly to yourself about Christine's identity map.

- Are there things you have in common with Christine?
- Are there ways in which you are different from Christine?
- Can you see anything about Christine's identity that would help her understand how to balance the needs of people with the needs of soil organisms?



Task 1: What soil organisms are in our research area?

Your team did great work observing and **classifying** living things in Part 3. In this Part, you are going to focus on observing soil organisms. This task uses some of the same skills that you learned in Parts 3–5. But observing soil organisms is different from observing plants or animals. You will need new skills. You will learn those new skills in this task.

In this task you will explore the soil organisms that live in your research area. You will **discover** what you already know and feel about soil. You will also discover how to use your senses and other tools to help you find soil organisms. You will plan and carry out an investigation to **understand** what soil organisms are in your research area. Then you will **act** to classify and record these soil organisms.



Discover: *What soil organisms did we discover already?*

You may have already observed and classified some of the soil organisms in your research area in Part 3. Now your team will observe more soil organisms in your research area. Try to focus on paying attention to parts of your research area that you may not have explored before. You will learn from your research mentor about how to use your senses and other tools to search for soil organisms.

1. Think quietly to yourself and answer the following questions:
 - a. What images do you think of when you think about soil?
 - b. What smells do you think of when you think about soil?
 - c. When is the last time you touched soil? What did it feel like against your skin?
 - d. Do you remember seeing any living things in soil? What were they?
 - e. Is soil important to you? Why or why not?
 - f. What words do you or the people in your household or community use to describe soil?
2. Take out your *Part 3 Organizer*. Remember that your team recorded a list of the living things you found in your research area in Part 3. This list included soil organisms.



3. Discuss as a team:
 - a. Did you observe and classify any soil organisms in Part 3?
 - b. If you didn't, why do you think that is?
 - c. What living things do you think you will find in the soil in your research area?
4. Christine and her team look for soil organisms as part of their research. Read the following to learn more from her about what lives in soil.

Christine says:



I always ask students to imagine a spoonful of soil. In that spoonful of soil, there are over one billion bacteria, strands of fungi as long as multiple football fields, hundreds of nematodes, and hundreds of protozoa. The soil ecosystem also has many sizes of **arthropods** such as ants and mites. It has earthworms. There are also pieces of **organic matter**, such as dead plants **decomposing**.

The soil ecosystem has a food web. Nematodes feed on bacteria, fungi, and plant roots. Earthworms and arthropods feed on nematodes. The earthworms also break down organic matter which the bacteria and fungi feed on, so it's all a big cycle. They are all creating this ecosystem and habitat for hundreds, thousands, and billions of living things. Soil would not exist without these organisms.



Figure 6.2: This pile of dirt contains an earthworm and white, thread-like fungi.



5. In the next activity your team will use your senses and other tools to find soil organisms in your research area. Learn about how Christine and her team use their senses and tools to help them observe soil organisms.

Christine says:



We use our sense of sight to first look at where the soil is. Is it in a forest? A farm? A prairie system? All of those soils are going to look really different. The soil on a farm that has a lot of planting and **tilling** going on might have fewer nutrients and less organic matter because they constantly get used up.

You can also look at the soil itself. People sometimes laugh at this, but when you line up different soils it can actually be really beautiful because there can be so many different shades. There are soils that are really red, soils that are dark and rich because the area has a history of burning, and you have light brown sandier soils that are from a desert.



Figure 6.3: Soils can have all different colors.



Touch is the next biggest sense we use. Even though we can see the different colors of soil it's still really important to understand what the soil is made up of by touching it. Scientists, farmers, and students can do the ribbon test. You basically squeeze a handful of moist soil through your thumb and fingers to make a ribbon of soil. How long the ribbon is can tell you about the health of the soil and an **estimate** of the things that are living in it.

Smell is also really important, especially in crop fields. You can tell if manure has been added or if the soil has been recently tilled.

We also use tools. The most important tool would be a shovel. We also use soil probes. They are these metal rods that help us get soil from deep places.

We use the cameras on our phones to take pictures of where we get our soil samples. We also have a tool made of clear tubes that go into the ground near plant roots. We stick a long probe with a camera at the end down the tubes so we can take pictures of the roots.

6. Think about how Christine and her team use their senses and other tools to find soil organisms in their research area. Discuss the following questions as a team:
 - a. Could you use any of the same senses or tools that Christine and her team used?
 - b. What other senses or tools do you want to use?
7. Your team will plan and carry out an investigation in the next activity. You will use your senses and other tools to find soil organisms in your research area.



Understand: How can we investigate our research area?

In the last activity you thought about how you can use your senses or other tools to find soil organisms in your research area. Now your team will use this information to plan and carry out an investigation to observe the soil organisms in your research area. Just like in Part 3, don't worry about trying to find all of the soil organisms in your research area in this activity. Just do the best you can.



1. Gather your team and take out the *My Research Area* map you made in Part 1, Task 4, Act. Recall where your research area is.
2. Read *Investigation Instructions* for more information about how to observe soil organisms in your research area.

Investigation Instructions

Where to investigate:

1. Review the tips from the Part 3, Task 1, Understand activity.
2. You can go back and make observations in the same parts of your research area that you did in Part 3. Or you can make observations in a new part of your research area.
3. Soil can be found almost everywhere. Look for soil in cracks between sidewalks or bricks, next to buildings, along a road, a public park, a raised garden bed, or a container garden. Even small amounts of soil can be the home to living things.
4. Remember to look for soil underwater, too. Look in puddles, ponds, streams, rivers, marshes, wetlands, tidepools, and oceans for the layer of soil, sand, or sediment at the bottom.
5. You can also look for soil organisms in something called **litter**. Litter is the layer of dead and decomposing plants that sit on top of the soil. For example, after the growing season is over there might be a layer of dead leaves and twigs on the ground. Some soil organisms spend part of their lives in that layer of litter.
6. Turn over objects that are sitting on top of the soil to look for organisms that are underneath. For example, you could look under fallen branches and logs, small rocks, cinder blocks, bins, or boxes.





Figure 6.4: This photo shows over 200 kinds of arthropods that were found in leaf litter by a scientist in North Carolina.

Tools you can use:

1. Review the tips from the Part 3, Task 1, Understand activity that describe how to use your senses and other tools, such as a magnifying glass, a camera, or paper and a writing tool. Remember that you also thought about how you could use your senses in the Discover activity.

Emotional Safety Tip

Remember to be an inclusive team member. Every person on your team brings different skills and perspectives. Some members of your team may not want to or be able to use all of their senses. That is fine. Work with your teammates to find a way for everyone to participate and feel comfortable

2. Some soil organisms are very small. It can be hard to see details of the soil organisms. A camera that can zoom or a hand lens can help you see small soil organisms. If you do not have either tool you can make a simple hand lens out of a plastic bottle:
 - a. Find a clear plastic bottle with a curved top.
 - b. Cut a small circle out of the curved part of the bottle.



- c. Pour a small amount of water into the curved part of the bottle.
 - d. Hold the curved part of the bottle over the soil organism you are trying to see. The curve of the bottle and the water will magnify it.
3. Always use digging tools to help you see under the soil. There are many kinds of tools that can help you dig, such as a shovel, a **trowel**, a spoon, a file, a sharpened stick or rock, or a metal spatula. Do not dig with your bare hands.
 4. Wear sturdy gloves to protect your hands when handling the soil. You can use gardening gloves or rubber gloves. It is important to protect your hands from harmful objects that may be in soil such as glass, metal, rocks, or other sharp surfaces.

Tips for doing this investigation:

1. Review the tips from the Part 3, Task 1, Understand activity.
2. Try to conduct your investigations during the growing season when soil biodiversity will be highest.
3. Soil can be easier to explore when it is damp. It can be very difficult to dig into dry soil.
4. If the soil is cold or frozen there may not be many soil organisms that are active. It will also be difficult to dig into the soil.
5. Remember that there are three major types of soil organisms that you might observe: bacteria, fungi, and animals. Some animals and fungi might be large enough for you to observe easily. For example, some fungi have large parts that grow above the soil or litter. But some fungi are very small and can only be found underground, at the tip of plant roots. They are much harder to see. Bacteria are also too small for you to see without using a microscope. Read the *Types of Soil Investigations* section for tips on how to find evidence of all kinds of soil organisms.
6. Because many soil organisms are decomposers, look for them in places where organic material is breaking down. For example, you may find fungi near a rotting log. You may also be more likely to find certain soil organisms in parts of your research area that are damp. Earthworms and certain mushrooms are examples of soil organisms that like to live in damp environments.





Figure 6.5: Part of this tree has fallen down and started to decompose. This would be a good place to start your search for soil organisms.

Safety Tips for observing outside:

Ask your teacher first for guidelines. They will know what is safest in your community.

Physical Safety Tip

Do not observe a research area by yourself. Always work with at least one other person, which could be an adult or a teammate. Notice if your teammates are uncomfortable or if they feel unsafe. Offer to pause the investigation or move to another part of the research area.

Do not use your sense of taste to try to observe soil organisms. Do not touch soil organisms that you are unsure are safe to touch. For example, some soil organisms may bite or sting.

Always wash your hands before and after handling soil and soil organisms. Wear sturdy gloves to protect your hands when handling soil.

Make sure it is safe to dig in your research area before doing any investigations that involve digging. Some countries have phone numbers you can call to find out if an area has buried electric or cable lines or other harmful materials. Be sure to ask an adult for help before digging.



 **Emotional Safety Tip**

You may not want to touch the organisms that you find. Or you might be nervous or scared around certain soil organisms, such as insects, spiders, and worms. It is okay to find another way to help the team.

Do not be discouraged if it is difficult to find soil organisms. Every research area is different. Some areas may have many soil organisms and some may have very few. It is not your fault if you have trouble finding soil organisms. Just practice using your senses and other tools to do your investigation. If you feel sad or wish there were more soil organisms in your research area, remember that you will take action to make this possible!

Types of Soil Investigations

Growth Plate

In this investigation you will make **growth plates**. A growth plate is a surface that is covered in gelatin and nutrients. Bacteria and fungi are able to grow on the surface.

1. Ask an adult to help you boil a cup of water.
2. Add a teaspoon of unflavored gelatin, a teaspoon of sugar, and teaspoon of beef stock powder or a beef bouillon cube to the boiling water.
3. Stir until all the ingredients are dissolved. This should take about 1 minute.
4. Turn off the heat and let the mixture cool for about 10 minutes.
5. Pour the mixture into individual containers such as clear, round plastic containers with lids, plastic cups with lids, or foil muffin tins. Fill each container about 1/3rd of the way with the mixture.
6. Place a cover loosely on the containers and allow the mixture to cool all the way. You can store the containers in a cool, dry place such as a refrigerator, food cellar, or basement until you are ready to use them.
7. Get a piece of litter from your research area, such as a leaf, twig, and piece of bark. Or get an object from on or under the soil such as a rock or stone.



8. Press the object gently onto the surface of a growth plate. Do not push it down into the mixture. Place the cover back onto the growth plate immediately after. Repeat with a new object and new plate as often as you would like.
9. Place the growth plates in a warm place and leave them alone for 3 to 5 days.
10. Check the plates after 3 to 5 days. Notice if they have anything growing in them. Fungi will often look like fuzzy, thread-like material. Bacteria will often look like circular spots. The growth plate can show you if those kinds of soil organisms are growing in your research area.

Berlese Funnel

In this investigation you will make a **Berlese funnel** to observe the animals living in the soil and litter of your research area. If you would like more instructions or to see an example of a Berlese funnel, you can view a setup video in the *Biodiversity!* StoryMap.

1. Ask an adult for help in cutting a plastic drinking bottle in half. A 1-liter bottle is a good size to use.
2. If you would like, you can pour a few centimeters of soapy water or rubbing alcohol in the bottom half of the bottle. This liquid will kill and preserve any animals that fall down the funnel. If you would prefer not to do that, you can leave the liquid out and return all the animals to their habitat once the experiment is over.
3. Flip the top of the bottle so the mouth of the bottle faces down. Place it into the bottom of the bottle and tape the parts of the bottle together to form a seal.
4. Line the inside of the top part of the bottle with thin mesh. The mesh can be wire or plastic. It should have openings of about $\frac{1}{4}$ inch. Make sure the mesh sits over the mouth opening in the bottle. This will allow animals to move to the bottom of the Berlese funnel.
5. Collect some leaf litter and soil from your research area. Place it in the top part of the bottle over the mesh.
6. Cover the outside of the bottom part of the bottle with dark paper or fabric (like a t-shirt).



7. Place the Berlese funnel under a light. The light will cause the animals to move downward to the dark part of the funnel.
8. Leave the funnel alone for 3 to 5 days.
9. Open the funnel. If you used liquid, pour the liquid into a wide, flat container with raised sides like a cooking dish. If you did not use liquid, you can still use a wide flat container with raised sides to observe any animals. But do your observation outdoors in case the animals in your sample begin to move away from the container.
10. You will learn more about how to classify the animals you found in the Act activity.

Aquatic Animals

In this investigation you will use mesh bags and dried leaves to trap and observe any organisms living in the leaf litter underwater. The instructions in this section will help you do a very simple version of this activity. If you would like to do a more detailed version of this activity you can go to the Stroud Water Research Network Leaf Pack Activity website. The website is listed in the *Biodiversity!* StoryMap. The Leaf Pack activity is available in English and Spanish.

1. Find a source of shallow water in your research area, such as a stream. Make sure you have permission to place something in this water.
2. Collect dried leaves from your research site. If you only have fresh leaves during this time of the year, pick some fresh leaves and allow them to dry for several weeks. You want dried leaves that snap in half when you bend them. If the dried leaves crumble when you bend them they are too dry.
3. Collect a mesh bag. You can usually find these bags at the grocery store. They are usually used to hold onions or fruits.
4. Place dried leaves inside the mesh bag until it is loosely full. Make sure the bag has a knot at one end before placing the leaves inside.
5. Close the mesh bag by tying a knot at the other end.
6. Thread a long string through the mesh bag. This string will allow you to keep the bag in one place in the stream.
7. Find a place in the stream where leaves and other material are collecting in the current, such as against a rock. Place the mesh bag in that part of the stream. Use the string to secure it to a heavy rock in the stream so it will not float away.



8. Write down where you placed your mesh bag. You can also make a mark on the side of the stream to help you find the mesh bag again, such as planting a bright flag in the ground.
9. Leave the mesh bag for 3 to 4 weeks.
10. Come back to the stream. Fill a bucket or other container with water from the stream.
11. Collect the mesh bag from the stream and place it in a bucket or other container filled with stream water.
12. Untie the knot in the bag and pour all the leaves into the bucket. Pour more stream water over the mesh to fully rinse all the leaves and organisms from the bag.
13. If you can, pour the bucket of leaves through a sieve with very small openings. This can help trap the leaves and organisms while allowing the stream sediment to pass through. If you can do this step, dump the contents of the sieve into a flat, wide container filled with a few inches of stream water.
14. If you cannot do step 13, pour the contents of the bucket into a flat, wide container.
15. Observe the organisms in the container.
16. Feel the leaves in the container. Do they feel slimy or like they have a thin film on them? That is likely bacteria and fungi. Bacteria and fungi grow on dead material and help decompose it.
17. Observe the animals in the container. You will likely see many kinds of arthropods. These are animals with jointed bodies, pairs of limbs, and hard exoskeletons. Spiders and insects are some examples of arthropods.
18. You will learn more about how to classify the organisms you found in the Act activity.
19. When you get to the Task 2, Understand activity be sure to review the kinds of organisms you found in your Leaf Pack. They can help you understand if the water is healthy or polluted. More information can be found on the Leaf Pack website.





Figure 6.6: Search for soil and sediment organisms in water like this small stream. Notice the pack of leaves that have naturally formed near some rocks in the stream. That would be a good place to start your search.

3. If finding soil organisms outside doesn't sound like the right investigation for your team, that's okay! You can pick another way to collect information about your research area.
 - a. You can use online tools, such as iNaturalist, to find out what soil organisms have already been found in your research area. More information about these tools is in the *Biodiversity!* StoryMap.
 - b. You can use books, lists, websites, videos, artwork, photos, stories, or other records of soil organisms in your research area. Try to use records that have been made recently to make sure you are only observing soil organisms that still live in your research area.



- c. You can write, call, or talk to local gardeners, farmers, scientists, researchers, older people who have lived in the community a long time, or other experts on soil organisms in your research area. Ask them to describe what soil organisms they have observed in your research area.
4. Decide as a team how you will investigate.
5. Remember, including everyone on your team is important. Try to pick a way to investigate that allows everyone to participate. Don't forget to think about the timing, comfort, location, and format of your investigation to make sure everyone on the team feels included. You can reread Part 2, Task 2, Understand if you need more information about making your investigation inclusive.
6. Next, work with your team to plan how you will do your investigation. For example, if you decide to do an observation, decide which teammates will observe which parts of the research area. Decide how long you will spend finding soil organisms. Decide how you will record the soil organisms you find and who will do the recording.
7. Finally, do your investigation with your team.



Act: *How can we classify the soil organisms in our research area?*

Your team has just completed a very important step in helping to balance the needs of people and soil organisms in your community. You observed the kinds of soil organisms in your research area. Now you will classify these soil organisms. This information will help you complete the rest of this Part and get ready to take action in Part 7 to create a balanced community.

1. Your team is going to **classify** the soil organisms you just found in your research area. Classify means to name or identify something and to sort it into a group. Classifying living things can help you understand more about the biodiversity in your research area. Remember that biodiversity is a measurement of how many different types of living things are in an area. To measure biodiversity in your research area, you need to know how many different kinds of soil organisms you observed.
2. Read *Tools to Help Classify Soil Organisms* for more information about how to classify soil organisms in your research area.



Tools to Help Classify Soil Organisms

1. A **field guide** is a tool that has the names, images, and descriptions of soil organisms in an area. Field guides may be printed (such as books) or online. Because there are so many different kinds of living things in soil, you may need to look at a key for one kind of living thing at a time. For example, you could find a field guide just for insects.
2. You can also use a **dichotomous key**. This is a tool that asks you questions about the parts of a soil organism to help you classify it. Try finding a dichotomous key for soil organisms in your area of the world. Because there are so many different kinds of living things in soil, you may need to look at a key for one kind of living thing at a time. For example, you could find a dichotomous key just for fungi.
3. A ruler can help you measure the soil organisms you find. Measurements can help you tell animals apart.
4. You can use an online tool such as the iNaturalist website, which is also known as a community science tool. People in a community take photos or describe what soil organisms they have noticed in their area. They send the photos and descriptions to scientists through the website. The scientists help identify what the soil organisms are. This helps scientists and community members keep a record of what kinds of soil organisms are in an area. More information for iNaturalist is in the *Biodiversity!* StoryMap.
5. Communicate with a person who is respected in your community because of their knowledge of the environment and soil organisms. This might be a gardener, a farmer, a soil scientist, someone who has lived in the community for a long time, someone with traditional knowledge, or someone who works or volunteers in the outdoors.
6. If you do not have a field guide, your team can come up with your own names for soil organisms in your research area. Review the case study in Part 3, Task 1, Act for more information.

Tips to Help Classify Soil Organisms

1. If you don't have access to any tools to help you classify, just try to notice if the soil organisms you observed in your research area are different from each



other. For example, you might observe that one animal in your research area has a long, dry body with many legs and antennae, and another soil organism has a smooth, long, moist body with no legs or antennae. Even though you don't know the names of these soil organisms, you can tell that they are not the same. Record that you observed two different soil organisms in your research area.

3. Remember from the case study in Part 3, Task 1, Act that there are many ways to classify a living thing. No matter which way you choose to classify the soil organisms in your area, remember that your way is valuable because it came from you.
4. Work with your team. Title a sheet of paper or a digital document *Part 6 Organizer*. Make three columns just like you did for your *Part 3 Organizer*. Write the words "Know", "Think," and "Wonder" at the top of the columns.
5. Create a list in the *Know* column of the soil organisms that your team found in the research area.
 - a. Record the name of each soil organism you found. If you were not able to find or create a name you can write a description, use a symbol, or make a drawing.
 - b. List how many of that soil organism you found.
 - c. If several team members found the same soil organism, combine those numbers and record the total. For example, if one person found 10 carpenter ants in their part of the research area and another person found 12 carpenter ants in their part of the research area, record "twenty-two carpenter ants."
 - d. You may have found evidence of soil organisms even if you could not see the actual organism. For example, you may have found slimy leaves. This tells you the leaves probably have bacteria on them even if you aren't able to see the bacteria. You can record this in the *Know* column.
6. Consider your *Know* column. Discuss the following questions as a team:
 - a. Did your research area have many different kinds of soil organisms?
 - b. Did it have the same kind of soil organisms over and over?
 - c. Did it have very few soil organisms?
 - d. Do you think there might be soil organisms living there that you weren't able to observe?



7. Answer the following questions in the *Think* column:
 - a. How does your team feel about the kinds of soil organisms in your research area? Are there soil organisms you like more than others?
 - b. Do you wish you had more kinds of soil organisms in your research area?
 - c. Which soil organisms did you notice most easily? Why do you think that is?
 - d. Are any soil organisms more important to you than others? Why or why not?
 - e. Why do you think some soils have more organisms than others?
8. Is there anything else you would like to investigate about the soil organisms in your research area? Or anything else you would like to know? Record your answers in the *Wonder* column.
9. Keep the Part 6 Organizer in a safe place.



Task 2: What do the soil organisms in our research area need to survive?

In Task 1 your team observed as many soil organisms as you could in your research area. Now it is time to figure out how those soil organisms are meeting their needs. First, you will **discover** how your experiences are related to soil organisms. Then, you will use an investigation to **understand** how the soil organisms in your research area meet their needs. Finally, you will **act** on this information to record those needs and think about how well your research area is able to meet them.



Discover: *How are soil organisms important to me and my community?*

In this activity you are going to think about how your experiences relate to how soil organisms meet their needs.

1. Think about the following questions by yourself:
 - a. Imagine you needed to get rid of a piece of waste, such as uneaten food, plastic packaging, or paper?
 - b. How does it help you to get the waste out of your home?
 - c. What would happen if you could not get rid of waste?
 - d. What do you do with items in your household that can be recycled, such as glass, paper, and certain kinds of plastic?
 - e. How can recycling help you, your local community, and the global community?
2. Now, share your answers with your team.
3. Read *Decomposers*. Then answer the questions that follow.

Decomposers

Many soil organisms meet their needs for energy by decomposing organisms that have died. Decomposition breaks down the dead organism into very, very small parts. This makes space in the environment for living things to grow and live.



When bacteria, fungi, and animals decompose an organism some of the nutrients in that organism are returned to the soil. Those nutrients become available for another organism to use for energy.

4. Using the information from *Decomposers*, answer these questions with your team:
- How are the actions of soil organisms similar to the actions you described in step 1?
 - What would happen in your community if soil organisms did not decompose organisms that died?



Understand: *How can we investigate what soil organisms need to survive?*

In the Part 3, Task 2, Understand activity your team did an investigation of how the living things in your research area meet their needs. That investigation may have already included some of the soil organisms from your research area. Now you are going to add to that investigation by finding out more about the soil organisms you observed in the Part 6, Task 1, Understand activity.

- Gather your team together and take out your *Part 3 Organizer* and your *Part 6 Organizer*.
- Read through the list of soil organisms in the *Know* columns. Remind yourself of what soil organisms are in your research area.
- Now your team will plan an investigation into how the soil organisms in your area meet their needs. Read *What Do Soil Organisms Need?* to find out more about the basic needs of soil organisms.

What Do Soil Organisms Need?

Soil organisms need a source of energy, water, and space.

Many soil organisms rely on organic matter as a source of energy. Some examples of organic matter are dead plants and animals. When these living things die, they decompose and return nutrients to the soil.



Soil organisms need water. Water must be able to absorb down into the soil to reach soil organisms below the surface. The water should be clean and free of pollution.

Soil organisms need space to live in the soil. It is also helpful if that space is not disturbed very often. This means that the soil is not dug up, moved, or tilled.

4. Before you begin your investigation, read the following information from your research mentor, Christine. She explains what the soil organisms in her research area need.

Christine says . . .



Nematodes can live in fresh water, salt water, and land **ecosystems**. Nematodes don't require that much space as they are on average 1/500th of an inch!

The awesome thing about nematodes is that they really depend on other parts of the food web for survival. Nematodes are specialists, so certain nematodes are fungivores and only feed on fungi. Other nematodes are bacterivores and only feed on bacteria. Some feed on other nematodes (they are predators!). The last group are parasitic nematodes that feed on plant roots. So nematodes will thrive based on if their chosen food source is plentiful.

5. Discuss how you will investigate the needs of soil organisms in your research area. There are many ways to investigate. You could:
- Plan an observation like you did in the Part 3, Task 2, Understand activity. You could observe the spaces that have soil in your research area. Just like in Part 3, be aware that some needs may be more difficult to observe than others. Use the following questions as a guide:
 - Where does the organic matter on or in the soil come from?
 - Where does water come from in your research area? Rain? Waterways such as streams, rivers, or ponds?
 - How much space in the research area has soil?



- b. Interview an expert in your community on the phone, online, or in person. An interview is similar to the oral history you collected in Part 2, Task 2, Understand. But instead of asking about the past you will ask people about what they know now. Go back to Part 2, Task 2, Understand if you need help with this kind of investigation. You could interview:
- Older people who have lived in the community a long time and know about local soil organisms
 - A person who is respected in your community because of their knowledge of the environment and soil organisms
 - Someone with traditional knowledge of soil organisms or how to manage soil
 - Farmers, gardeners, landscapers, or other people who work in the soil
 - A scientist that studies soil organisms
 - A volunteer at a local nature preserve or wildlife refuge
- c. Use books, websites, videos, artwork, audio recordings, or other records of what the soil organisms in your research area need. Try to use records that have been made recently to make sure you are only learning about the soil organisms that still live in your research area.
- d. Think of your own way to collect information.
6. It might be difficult to get all of the information you need from just one kind of investigation. You may need to combine more than one kind.
7. Decide what kind of information you want from this investigation.
- a. Soil organisms have three basic needs: a source of energy, water, and space. You will need to find out how the soil organisms in your research area are meeting these needs. You can also begin to notice if the soil organisms in your research area are having trouble meeting their needs. Use the following questions as a guide:
- Organic Matter:
 1. Is there organic matter in your research area?
 2. When plants and animals die, do people remove them or can they decompose in the soil? For example, when a tree dies or falls over, is it cut up and taken away?



- Water:
 1. When it rains does the water quickly run off the surface of the soil without absorbing? Or does some of it absorb into the soil?
 2. Is there any pollution in your research area that could absorb into the soil?
 - Space:
 1. How much of your research area has soil?
 2. Are there any spaces in your research area where something is covering the soil, such as pavement or a building?
 3. Does the soil look like it has been disturbed? If so, who or what is disturbing it?
 4. Are there any soil organisms in your research area that people do not like or are trying to get rid of? What do they do or use to try to get rid of those organisms?
8. Plan your investigation. Decide what needs to be done and who will do each part. You can:
- a. Split up the list of soil organisms from the *Know* columns among your team members.
 - b. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.
 - c. Decide who will lead the investigation and who will record the information from those investigations.
9. Work with your team to do your investigation.



Figure 6.7: A group of mushrooms has started growing after a heavy rainstorm. This species of mushroom needs lots of water to grow and meet its needs.





Act: *How can we share what we learned about what soil organisms need?*

Your team has investigated the needs of soil organisms in your research area. Now, your team will share what you observed and use that information to decide how well your community is meeting those needs.

1. Take out the information you recorded from the Understand activity. Take out your Part 6 Organizer.
2. Have the team leader record what they found out in the Understand activity. They should put their answers in the *Know* column. For example, the team leader may have learned from an observation that the soil organisms in your research area get their water from rain.
3. Let the team leader know if they describe a need that you also found in the investigation. Circle that need or make some other mark next to it. This will help you record that this is something that more than one soil organism needs or wants.
4. Next, share any needs you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
5. You should now have a list of what the soil organisms in your research area need.
6. Discuss what you learned about in the investigation as a team. Record your thoughts in the *Think* column.
 - a. What needs are shared by many different kinds of soil organisms in your research area?
 - b. Are any soil organisms in the research area having trouble meeting their needs?
7. Take out your Part 2 Organizer or the information from your investigation in Part 2, Task 2, Act. Remember that you investigated how your community changed over time. Information from this investigation can help your team discuss how well your community is meeting the needs of soil organisms. Discuss:
 - a. In the past did your community have a resource that helped meet the needs of soil organisms, such as a forest that produced a lot of organic matter when leaves and branches fell?
 - b. What happened to that resource?
 - c. Why did it change over time?



Task 3: What are the conflicts between people and soil organisms in my community?

Your team found out information about the needs of soil organisms in your research area. Now, you will **discover** how you feel about conflicts between people and soil. You will use an investigation to **understand** if there is evidence of conflict between soil organisms and people in your research area. You will **act** on the information from the investigation to identify the problems in your community and start thinking about how to solve them.



Discover: *How do I feel about the soil organisms in my community?*

In the Task 1, Understand activity you discovered the variety of soil organisms in your research area. Remember that the living things in soil help break down organic matter and return those nutrients to the ecosystem. Many other organisms depend on the living things in soil to survive.

But people also use the land and water where soil organisms live. In this activity you will learn how you feel about conflicts between soil organisms and people. In the Understand activity you will investigate some of these conflicts.

1. You are going to read a few statements and decide how you feel about them.
2. Choose whether you agree, are not sure, or disagree.
3. Share that information with your teammates. You could say it, write it, draw it, share it online, or move to different places in a classroom or learning space. For example, the corners of a classroom could have signs that read, "I agree," "I disagree," or "I'm not sure," and you could move to the corner that matches what you think.
4. Read the following statements and decide how you feel:
 - a. Some soil organisms are pests and it is okay to kill them with chemicals.
 - b. It is okay to build a sidewalk over soil so people can safely move around their space.
 - c. All dead plants and animals should be cleared out of parks that people use.
 - d. It is okay if chemicals get into a stream because they will just wash away.



5. Read the following information from your research mentor, Christine. She explains some of the conflicts between people and soil organisms.

Christine says . . .



There is this huge conflict of, “We need to grow food to feed people,” and we know that food security is a really important issue around the world. There are a lot of places where they aren’t able to produce enough food to feed their population. But food production is really intensive and it actually degrades the soil a lot of times. It can release greenhouse gases back into the atmosphere which can cause climate change, which we know is probably the most pressing issue of our time.

Agriculture has a role in contributing to climate change, but it also has a role in mitigating climate change. We are trying to understand how soil organisms are processing soil carbon. Are they helping to keep it in the soil instead of being released into the atmosphere? What kind of management practices would help the soil organisms keep carbon in the soil?

Pollution is a problem. Especially in urban soils. I live in Ohio, so a lot of people in Cleveland are working to use different urban spaces for gardens. But a lot of that soil is contaminated with lead. They have to do a lot more testing than we do to make sure the soil is safe to plant food that people are going to eat. As more people live in cities, thinking about how our soils might be polluted is really important.



Understand: *How can we find out more about the conflicts in our research area?*

When soil organisms can’t meet their needs, they may get stressed and some may die. The organisms that can move may leave. All of this lowers the biodiversity in an area. Remember that biodiversity is the measure of different living things in an area. Many living things depend on soil organisms to survive, so a decrease in soil organism biodiversity can cause huge problems in the rest of an ecosystem.



Your team is trying to figure out how to solve problems related to biodiversity in your research area. But it can be hard to observe these conflicts between soil organisms and people because many of these living things are small or hidden under the soil. In this activity, you and your team will learn how to observe evidence that soil organisms are stressed, have moved, or have died.

1. As a team, think back to what you observed in the Task 2, Understand activity. Discuss the following question as a team:
 - a. Did you notice that any soil organisms had trouble meeting their needs?
2. Gather your team together and take out your *Part 3 Organizer* and your *Part 6 Organizer*.
3. Read through the list of soil organisms in the *Know* columns. Remind yourself of what soil organisms are in your research area.
4. Now your team will do an investigation of your research area. You will find out if there is any evidence of conflict between people and soil organisms.
5. Use the following investigations to help you observe evidence of conflicts in the research area.

Physical Safety Tip

Do not observe a research area by yourself. Always work with at least one other person, which could be an adult or a teammate. Notice if your teammates are uncomfortable or if they feel unsafe. Offer to pause the investigation or move to another part of the research area.

Always wash your hands before and after handling soil and soil organisms.

Make sure it is safe to dig in your research area before doing any investigations that involve digging. Some countries have phone numbers you can call to find out if an area has buried electric or cable lines or other harmful materials. Be sure to ask an adult for help before digging.

Wear sturdy gloves to protect your hands when handling the soil. You can use gardening gloves or rubber gloves. It is important to protect your hands from objects in the soil that you cannot see like glass, metal, rocks, or other sharp surfaces.



Soil Tests

Soil Health Test

This investigation will help you observe if the soil organisms in your research area are healthy or if they are having trouble meeting their needs. If you find an area that seems to have unhealthy soil, observe how humans are using that area. Is there anything about the way humans are using it that might make it harder for soil organisms to meet their needs?

1. Get a piece of white cotton clothing, such as a cotton rag or t-shirt. The item must not be dyed.
2. Find a place in your research area where it is okay to bury the clothing.
3. Dig a hole at least 8 cm deep.
4. Place the clothing in the hole.
5. Completely cover the clothing with soil and refill the hole.
6. Mark the place with a stick, a rock, a landscape flag, or another marker.
7. Dig up the clothing 8 weeks later. You can check the clothing more often if you would like in that 8-week period, but it is best to leave the soil alone.
8. Check to see if the clothing has broken down. If it has, then you have a healthy community of soil animals, fungi, and bacteria. The soil organisms have decomposed the organic matter in the clothing.
9. You can expand this investigation by burying clothing in several different spots in your research area and comparing the results. This will tell you about the soil health in each location.
 - a. Compare a spot that is heavily used by humans, like a path, to a spot that is left alone.
 - b. Compare a spot that gets more rainfall to one that is more sheltered.
 - c. Compare an area that only has one kind of plant, such as a lawn, to an area with many different kinds of native plants.
10. If you do not have clothing you can use, you can also do this investigation with teabags. Learn more about how to do this investigation in the *Biodiversity!* StoryMap.



Smell Test

1. Dig up a handful of soil from several places in your research area.
2. Place each handful in its own container.
3. Smell each container of soil.
4. Does any of the soil smell sour or rotten? This can mean the soil lacks oxygen. A lack of oxygen can make it hard for some soil organisms to survive and meet their needs.
5. If the soil smells sour or rotten, notice how the soil in that area is being used. Is this a space that people are also using? If so, how are they using it?

Soil Compaction Test

In this investigation you will find out if the soil in your research area is **compacted**. Compacted means packed tightly or pressed down. Compacted soil does not have space for air or water. It is harder for soil organisms to meet their needs in compacted soil. Soil can be compacted when humans use an area of soil over and over again. For example, the soil on a walking path or a garden can become compacted.

1. Find a place in your research area that has soil that is used often by humans. Find another place that has soil that is left alone.
2. Ask an adult to help you find a wire to use in the test. This wire should be a few feet long. You want the wire to be rigid but bendable. You should be able to bend it using your hands. But the wire should not bend itself when you shake or wiggle it. A wire hanger or a wire landscape flag can work. Or, if you are able, you can purchase 10-gauge high-tensile wire.
3. Bend one end of the wire to make a handle.
4. Get a ruler or tape measure.
5. Go to the first place you want to test.
6. Using the handle, try to press the wire into the soil until it cannot go any further. The wire may start to bend. That is a sign to stop pushing.
7. Use your finger to mark the place where the wire meets the soil.
8. Pull the wire out while keeping your finger in place.
9. Measure the distance from the end of the wire to your finger. This will tell you how far into the soil the wire went.



10. You may feel the wire hit a rock or other object in the soil. If that happens you can stop the test. Repeat the test in soil a few centimeters away to try to avoid that object.
11. Record the results from the first place you tested.
12. Then, repeat the soil compaction test in the second place in your research area.
13. Record the results from the second place you tested.
14. Compare the results. Where did the wire go further into the soil? That area is less compacted.
15. If the wire went less than 20 cm into the soil, your soil is likely compacted. If the wire went between 20 and 30 cm, the soil might be slightly compacted. If the wire went more than 30 cm into the soil, the soil is likely not compacted.
16. If the soil is compacted, notice how the soil in that area is being used. Is this a space that people are also using? If so, how are they using it?

Soil Stability Test

This investigation will help you test how well the soil in your area sticks together. Soil that sticks together is called **stable** soil.

Why is it important for soil to be stable? Soil is exposed to many different kinds of forces. Rainwater, wind, and human activity are all forces that try to move soil. Stable soil stays in place. That makes it a good habitat for bacteria, fungi, plants, and animals.

What makes stable soil? Stable soils usually have lots of organic matter. They also have healthy communities of bacteria, fungi, and animals.

1. Get a clear container that is at least 10–15 cm tall. The opening to the container should be large enough to find your hand.
2. Get some wire mesh with large openings. Chicken wire is a good example.
3. Use a tool to dig up some soil in your research area.
4. Gently separate the soil. Allow it to fall apart into clumps.
5. Choose a clump of soil about 3–5 cm across.
6. Let the soil dry for 48 hours in a warm place.
7. Fill your clear container with water.



8. Bend a piece of wire mesh so that it forms a basket inside the clear container. Place the basket so that it sits under the water.
9. Gently place your soil in the mesh basket.
10. Start a timer.
11. Watch to see how long it takes the soil to break up and fall apart through the wire mesh.
12. Soil that falls apart in less than 1 minute is not stable. Soil that falls apart between 1 and 5 minutes is stable. Soil that falls apart after 5 minutes is very stable.
13. If the soil is not stable, notice how the soil in that area is being used. Is this a space that people are also using? If so, how are they using it?

6. Some tests are more complicated. For example, you might want to know if your soil is polluted. That information needs a special test. You can send a sample of your soil to be tested by a professional. This usually costs money. These tests are usually done by the local government, a university, or a private laboratory. You can also purchase some kinds of tests to do yourself. They use special chemicals that you can't find on your own.
7. Remember the questions from the Task 2, Understand activity. Work with your team to try to answer these questions if you have not already:
 - i. Organic Matter:
 1. Is there organic matter in your research area?
 2. When plants and animals die, do people remove them or can they decompose in the soil? For example, when a tree dies or falls over, is it cut up and taken away?
 - ii. Water:
 1. When it rains does the water quickly run off the surface of the soil without absorbing? Or does some of it absorb into the soil?
 2. Is there any pollution in your research area that could absorb into the soil?



iii. Space:

1. How much of your research area has soil?
 2. Are there any spaces in your research area where something is covering the soil, such as pavement or a building?
 3. Does the soil look like it has been disturbed? If so, who or what is disturbing it?
 4. Are there any soil organisms in your research area that people do not like or are trying to get rid of? What do they do or use to try to get rid of those organisms?
8. Decide how you want to record the information from your investigations. You can write it down, draw pictures, record your voice, or find another way.
9. Work by yourself to conduct your investigation.
10. Read what Christine says about investigating conflicts in her research area.

Christine says . . .

My research group is interested in the way we use the land and how land management affects soil organisms. We are also interested in how climate change impacts soil organisms.

In terms of land use, we study all the different ways that farmers manage their crops and their land. One of my students is looking at a tilled system, where the farmer uses a plow, and a system where there is no tillage. What we have found is that the soil food web drastically changes based on tillage, which we know disturbs the soil. And when you till, you release a lot of carbon dioxide back into the atmosphere, which then contributes to global climate change.

In terms of global climate change, we want to understand how things like longer droughts and heavy rainfall events influence soil organisms. In the following picture we are under a rainout shelter. The rainout shelter is keeping all the rain out for an entire growing season so we can study how drought impacts a field of crops. We are studying how nematodes respond to this stress.





Figure 6.8: Christine and a member of her team collect data under a rainout shelter.



Act: What do we think about the conflicts in our research area?

Your team has investigated how soil organisms in your research area might have problems meeting their needs. Now, your team will share what you observed and think about how people may be involved in these conflicts.

1. Take out the observations you recorded from the Understand activity.
2. Take out your *Part 6 Organizer*.
3. Have the team leader record what they found out in the Understand activity. They should put their answer in the *Know* column. For example, the team leader may have observed walking paths in your research area that help people get from one place to another. But the soil under this path is compacted. The soil also has low biodiversity.
4. If the team leader shares any conflicts that you also found in your investigation, let them know. Circle that need or make some other mark. This will help you record that this is something that is a conflict for more than one soil organism.



5. Next, share the conflicts you learned about in the investigation that haven't already been listed. Have the team leader record your observations or add them yourself if you are working with a digital or shared document.
6. You should now have a list of the conflicts in your research area.
7. Take out your Part 3 Organizer. The *Know* column has information about what the people in your community need.
8. As a team, compare the information in the *Know* column of your Part 3 Organizer to the information in the *Know* column of your Part 6 Organizer.
9. Discuss the following question as a team:
 - a. Consider the needs of the people in your community. Remember that you recorded this information in your Part 3 Organizer. Do you think any of these needs are causing the conflicts between people and soil organisms?
10. Record your answers in the *Think* column of your Part 6 Organizer.



Task 4: What are people already doing to balance the needs of people and soil organisms?

In this task you will **discover** how you think and feel about conflicts between people and soil organisms in your research area. Then you will use information from your community and your research mentor to **understand** how people are already working to solve these conflicts. You will **act** to think about what you would do about the conflicts in your community.



Discover: *What is my perspective on the conflicts in my research area?*

In Task 3 your team identified the conflicts between people and soil organisms in your community. There can be many perspectives on conflicts. You probably have your own thoughts and feelings. Other people might have other ideas and perspectives.

1. Consider what your team wrote in the *Know* column of the Part 6 Organizer.
2. Think quietly to yourself about the following questions:
 - a. How do the conflicts between people and soil organisms in your research area make you feel?
 - b. Which conflicts are most important to you?
 - c. Think back to your answer from Task 1 about whether or not soil is important to you. Did your opinion change?
 - d. Which conflicts do you think will be the hardest to solve?
 - e. Which conflicts do you think you are able to take action on?
3. Take out or remember your identity map from Part 1. How do you think your identity affects how you think and feel about the conflicts in your research area?
4. Pair with a teammate.
5. Ask your teammate the same questions from Step 2.
6. Think quietly to yourself about the following questions:
 - a. How are your answers similar to your teammate's answers?
 - b. How are they different?
 - c. Have you changed your mind about any of your answers?



7. Remember the four perspectives you learned about in Part 1, Task 3. The following situations involve at least one of those perspectives. Read each situation and identify the conflict in each one. Then, discuss with a teammate how each conflict makes you feel. Which perspective is most important to you? What do you think you would choose to do about each conflict?

- a. Economic and environmental: A storm knocks down several large trees in a community. The trees can be cut up and sold by the community as fuel or building materials. But the dead trees will also provide important habitat for fungi, bacteria, and animals such as insects. It will also provide organic matter to the organisms living in the soil.
- b. Social, ethical, and environmental: A community hires a developer to add paths to a community park. The new paths will allow people to move to parts of the park they couldn't get to before. The developers say that the cheapest and safest option is to make the paths out of concrete. The paths will be wide and flat, which will allow people to walk, run, ride bikes, use strollers, and any other mobility tools such as wheelchairs, walkers, and canes. A group of people ask the developer to use gravel instead. Gravel will allow rainwater and organic material to filter down into the soil. This will help keep the soil organisms in the park healthy. But gravel pathways cannot be used by everyone.

 **Emotional Safety Tip**

You may have a strong opinion about some of these statements. Remember to be respectful in how you share your thoughts and how you listen to others. It is okay to disagree but remember to disagree with ideas and not people.

8. Read what Christine says about considering perspectives.

Christine says . . .

We live in a global environment where everyone has different needs. We all rely on the soil for food. But some people rely on it for income as well. I work a lot with farmers who rely on soil to grow food and foresters who rely on soil to grow trees for timber. There is tension and conflict when it comes to finding



that balance. How do we take enough from the land to support families and a business and have an income, but also think about the environment and do this in a sustainable way?

There are social and ethical components to this. Who decides what people can do with their own land? We can't all be selfish, especially with global climate change.

It's important to think about all of these perspectives. It is important to have conversations with people. I interview farmers as part of my research. Farmers always tell me, "I get my water from Lake Erie just like you do. I want to make sure that I manage my farm properly so it doesn't pollute the lake." I think when we see what we have in common and understand that we all share these natural resources, we can find some common ground. We can find the best management that helps people earn money but also protects the environment.



Understand: How can we find out more about solving conflicts?

As you learned in Part 3, there are some people who think about the conflicts between people and other living things because it is important to their way of life or it is their job. These people think about and try to solve the same kinds of problems you are trying to solve in this guide. These can be difficult problems to solve!

In this activity, you will think about just one conflict in your research area. You will try to find out what people in your community are already doing about this problem. You will learn more from your research mentor. This will help you create solutions that are sustainable and inclusive.

1. You can work on this activity by yourself or with the teammate you worked with in the Discover activity.
2. Remember which conflicts felt most important to you in the Discover activity.
3. Choose one of those conflicts to learn more about.
4. By yourself, record what the soil organism(s) in that conflict need. Remember that you can find that information in your *Part 6 Organizer*.



5. Next, record what the people in that conflict need. Remember that you can find that information in your *Part 3 Organizer* or your *Part 6 Organizer*.
6. Finally, record how the needs of soil organisms and people cause or contribute to this conflict.
7. For example, maybe your research area has a garden or a farm. This farm grows the same kinds of plants every year. When it is not the growing season all the dead plants are cleared away. The soil is tilled. This causes a conflict between people and soil organisms. You would record:
 - a. What the soil organisms need: The soil organisms need a source of energy from organic matter. They need space in the soil to live. They need that space to be undisturbed.
 - b. What the people need: The people depend on the plants for food. They also sell some of the plants to make money.
 - c. What causes the conflict: The garden helps people meet their needs but it is harming soil organisms. The tilling disturbs the soil organisms. The organic matter is cleared away after the growing season which means the soil organisms do not have a source of energy.
8. Decide if you need more information about this conflict from your research area or community. You can do another investigation in your research area or community to find out more about what the soil organisms or people in this conflict need. If you feel you need more information, gather it now.



Act: *How can I take action on conflicts in my community?*

Now that you have learned more about the conflict you chose, you are going to think about what you would need in order to take action. This information will help your team complete Task 5.

1. You can work on this activity by yourself or with the teammate you worked with in the Discover and Understand activities.
2. Think about the conflict that you learned more about in the Understand activity.



3. Answer the following questions by yourself or with your teammate:
 - a. What would you do to try to solve this conflict?
 - b. Who would your solution help? People? Soil organisms? Both?
 - c. Which group's needs are most important to you? Why?
4. Take out your *Part 2 Organizer*.
5. Consider the information in the *Know* column.
6. Answer the following questions by yourself or with your teammate:
 - d. Who makes decisions in your community?
 - e. Who are the people in your community who don't usually get to share their ideas or help with decisions?
 - f. How can we make sure those people are included?
 - g. How can we find out what people are already doing to solve conflicts between people and soil organisms in our community?
7. Read what Christine says about how people can take action to keep soils healthy.

Christine says . . .



Rather than growing corn over and over on a farm, you could rotate crops. And it's important to have something covering the soil all year. Have plants that cover the ground in the winter. They may not be a crop that you can eat, but they will stop the soil from being blown or washed away. Some kinds of crops can also help return nutrients to the soil.

It's really important to think about what you are "feeding" the soil and how you are treating the soil. Rather than tilling, you use a practice that disturbs the soil less. Reduce the amount that you are tilling or stop tilling altogether.

Most of our agriculture is annual plants that grow and die within 1 year, like corn. Think about planting other crops that help put nutrients back into the soil.

8. Read what Christine says about why it's important to include the community when taking action.



Christine says . . .



It is important to work with the community, especially when working with soils and producing food. Food is a very personal part of our lives. For so long there have been communities that have either been stopped from being able to grow their own food or have not had access to land.

That's what I love about the urban garden and local food movement. It empowers people to grow food in areas where they've never been able to have a garden before. Producing food is such a basic component of everyday life. Everyone should be able to have access to food. If you can grow it safely on your own, that's really important. Healthy soil is an environmental justice issue.



Figure 6.9: This group of people has changed an empty lot into a community garden, which allows the people to grow their own food.



Task 5: How can I take action to balance needs in my community?

Change happens on different levels. There are things you can change about your own behavior. There are also changes that happen within the whole community. In this task you will **discover** what you know about changes needed for your community. Your team will use this information to decide on your community action plan in Part 7. You will also **understand** some ways you can personally change your behavior to help your community. Then you will **act** on those ideas.



Discover: *How is our community meeting the needs of people and soil organisms?*

In any community there are people and other soil organisms trying to meet their needs. Sometimes these needs cause conflict. Now you will use what you have learned in this Part to think about ways you could make those conflicts better.

1. Take out your *Part 6 Organizer*.
2. Your team has already listed information you found out from your investigations in the *Know* column. Add any additional information you want to remember.
3. Now you will list or draw everything your team thinks about your community under the *Think* column. Consider:
 - a. Think about the work you did in Task 4. What do we think are the most important conflicts to solve between people and soil organisms in our community?
 - b. What do we think are some good ways to try to solve those conflicts?
 - c. Do we think our community could do better at meeting the needs of soil organisms?
4. Take out your Balanced Community Goals. Compare them to the things you *Know* and *Think*. Your Balanced Community Goals show you how your team wants your community to be. What you *Know* and *Think* shows you how your community is. When your community is not the way you want it to be, that is a problem.



5. As a team discuss:
 - a. How well do you think your community is meeting the needs of the soil organisms in your research area?
 - b. Are there goals in the *Balanced Community Goals* that would help your community meet the needs of soil organisms? If not, think about adding those goals now.
 - c. Do you think it is important to meet the needs of soil organisms? Why or why not?
 - d. Record these thoughts in your *Think* column.
6. Think back to the investigations you did in Part 2, Task 3, Understand about who makes decisions in your community. Think about how people your age are involved in making decisions.
 - a. Which conflicts do you think you could take action on?
 - b. Which conflicts would you need help with?
 - c. Record those now in your *Think* column.
7. List or draw everything your team still wonders about your community under the *Wonder* column. Consider:
 - a. Are there questions you still have about how your community meets the needs of people and soil organisms?
 - b. Are there actions you could take that might help your community balance the needs of people and soil organisms?
8. Keep the *Part 6 Organizer* safe. You will need it again.



Understand: How can I solve conflicts?

In this Part you investigated how the soil organisms in your research area meet their needs. You also learned how the people in your community meet their needs and wants. You noticed how those needs might cause conflicts. You thought about ways that your community could better balance the needs of people and soil organisms. You will have a chance to put some of these ideas into action in Part 7. However, there are always ways that you could make things in your community better through your own individual actions.



1. Consider the *Think* and *Wonder* sections of your *Part 6 Organizer*. Are there any problems that you could help to change all on your own? Are there any actions you could take on your own?
2. Discuss your ideas with your team. For example:
 - a. Suggest any of your ideas about reducing conflict from Task 4.
 - b. Help people in your community become more aware of soil and the soil organisms around them. You could do an art project by painting with soils. Or you could do one of the investigations from this Part as a community activity.
 - c. You could make choices about the things that you buy or do that reduce the amount of plastic waste or pollution coming from your household.
 - d. You could think of ways to add more organic matter to the soil in your community. You could compost your food waste and add it to the soil near your household. Or you could ask people to let dead plants break down on their property so those nutrients go back to the soil.
 - e. You could work with the people in your household to make a list of your needs and wants. Then, you all could think about which needs and wants might make it difficult for soil organisms to meet their needs. Are there any things that you need or want that you could use less of?
 - f. Come up with your own ideas.



Figure 6.10: This sign at the Smithsonian's Mary Livingston Ripley Garden encourages visitors to leave their yards, gardens, and green spaces messy. Leaf litter, piles of sticks, and other kinds of organic matter can help insects survive cold weather and gives birds materials to build their nests. The Smithsonian Gardens team has left plenty of this material in the large structure in the background.



3. Read some examples of action from your research mentor Christine.

Christine says . . .



Talk to the older generation about climate change. A lot of times climate change seems so abstract, and people say, “Oh, it’s only impacting people in that other place, it’s not affecting me here.” But scientists are observing that climate change is impacting everyone, all ecosystems, all regions. We all have an individual responsibility to do something about it. A great step is just talking to people about it and explaining even little things they can do to help. For example, if you convert a lawn into a pollinator garden you can help increase insect biodiversity. But a side benefit is that you are keeping carbon in the soil instead of the atmosphere, and you are making the soil healthier.

Plastic waste is also a huge problem for soil, so can you take reusable bags to the grocery store? Can you compost instead of throwing away your food waste? Composting is a great way to immerse yourself in the process of soil and making soil. You can watch your food waste turn into soil. That’s a really fun and active way for people to get involved in soils.

You can even grow your own food in a tiny little garden. Even if it’s just a couple of tomatoes and carrots, that’s less food that had to be transported from a farm.

4. Think quietly to yourself about a change you want to make in the way you act. Why do you think this change is important?



Act: *How can we take action and reflect?*

Changing our own behavior is often the first step. Now that you have decided what you will do to improve your community, you need to put that idea into action.

1. Make a plan for how you will put your idea into action. If you need to share information, where, when, and with whom will you share it. If you need to do something, what do you need to do it.



2. Put your plan into action.
3. Quietly reflect on your action by yourself:
 - a. What seemed to go well?
 - b. What was hard?
 - c. Were you able to make the changes you thought you would be able to make?
 - d. Will you keep going with your change or are there things you would do differently in the future?

Congratulations!

You have finished Part 6.

Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Glossary

This glossary can help you understand words you may not know. Feel free to add drawings, your own definition, or anything else that will help. Add other words to the glossary if you would like.

Arthropod: A kind of animal without a backbone that has a segmented body, exoskeleton and paired appendages

Berlese funnel: A tool that captures the animals living in soil and leaf litter

Classify: To find the name of something or put it in a category

Climate change: Changes in the patterns of temperature and precipitation on Earth

Compacted: Closely packed together

Decomposing: The process of breaking down or breaking apart

Dichotomous key: A tool that helps identify living things by choosing between two characteristics

Ecosystem: A community made of living things and nonliving things

Estimate: A guess at the size or number of something

Field guide: A collection of descriptions and images that help the user identify living things

Growth plate: A plate filled with nutrients on which bacteria and fungi can grow



Litter: The layer of organic matter that sits above soil

Nematode: A small worm that lives in soil

Organic matter: The living, dead, and decomposing material in the soil

Sediment: The soil-like material that lines the bottom of a body of water

Soil: The mix of minerals, air, water, and living things that sits on Earth's surface

Soil health: The ability of soil to support the growth of plants, animals, and bacteria.

Stable: Not likely to move or change

Till: To dig into soil and turn that layer over on itself

Trowel: A tool with a flat blade that can be used to dig into soil

Other words:



BIODIVERSITY!



Part 7:

How will we
act to help create
a balanced
community?

SUSTAINABLE DEVELOPMENT GOALS

developed by



Smithsonian
Science Education Center

in collaboration with

iap **SCIENCE**
HEALTH
POLICY
the interacademy partnership

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Find out More!

For additional resources and activities, please visit the *Biodiversity!* StoryMap at <https://bit.ly/3zvJ2Qh>.



Planner

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: What is the problem we want to take action on in our community?					
Discover	Explore ways in which your community is doing well and ways in which it could be doing better.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 2, 3, 4, 5, 6 Organizers</u> (from Task 1 in each Part)	30 minutes	314
Understand	Report on problems in your community and consider the connections between the root causes of these problems.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Connected Problems</u> (Task 1)	25 minutes	316
Act	Come to a team consensus about which community problem you want to take action on.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3) <u>Connected Problems</u> (Task 1)	25 minutes	319
Task 2: How will we try to solve our problem?					
Discover	Imagine different actions you could take to help address your team problem.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Part 2, 3, 4, 5, 6 Organizers</u> (from Task 1 in each Part)	25 minutes	322
Understand	Explore ways your possible actions could be more sustainable.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Team Action Plan</u> (Task 2) <u>Community Identity Map</u> (Part 2, Task 1)	20 minutes + investigation time	324
Act	Come to a team consensus on which action you will take.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Balanced Community Goals</u> (Part 1, Task 3)	20 minutes	326



Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 3: How will our team take action in our community?					
Discover	List the steps needed for your action.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Community Communication</u> (Part 2, Task 5)	20 minutes	328
Understand	Organize the action steps.	<ul style="list-style-type: none"> • Paper • Pens or pencils 		20 minutes	329
Act	Create an inclusive team action plan.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>Team Action Plan</u> (Task 2)	25 minutes	330
Task 4: Putting your plan into action					
Task 4	Put your plan into action!	<ul style="list-style-type: none"> • Varies, depends on action plan 		Varies, depends on action plan	332
Task 5: What did I learn?					
Task 5	Reflect on your action and your feelings.	<ul style="list-style-type: none"> • Paper • Pens or pencils 	<u>My Feelings</u> (Part 1, Task 5) <u>Team Identity Map</u> (Part 1, Task 2)	15 minutes	333

*StoryMap extension found at <https://bit.ly/3zvJ2Qh>



Part 7: How will we act to help create a balanced community?

As **action researchers** you now have a lot of information about your **community**. You discovered what is important to you and your team. You understand the science of biodiversity. You understand the way decisions are made. You understand the values of people in your community. And you understand the relationships among the living things in your community. Now you will put those ideas together. In this part you will decide how your team will act to create a balanced community. Then you will put those plans into action.

Remember: *In this guide you and your team are in charge. You can always change the instructions in the steps to make them work better for you and your team.*

Your Research Mentor

Sharing your experiences with others and learning from others' experiences are parts of being a good action researcher. In Part 2, you will have a research **mentor** to help you understand some issues about making decisions in your community. A mentor is someone who has experience and can help guide you.

Meet Fred Tutman, Your Part 7 Research Mentor



Meet Fred Tutman (Frehd). Fred is the Riverkeeper for the Patuxent River. The Patuxent River is in the United States. A Riverkeeper is a person or an organization that protects a waterway, such as a river, stream, or **estuary**. If the waterway is polluted or harmed in some way the Riverkeeper does whatever they can to solve the problem. They may involve people from the community, try to get the government to take action, or even file a lawsuit. As Fred describes it, "Riverkeepers are the voice of the waterway if the waterway had a voice of its own."



Fred used to work in television and radio for 25 years but decided to become a Riverkeeper. He shares, "Riverkeeping has taken every skill I've had and pushed me to the edge. It is challenging work. I am **incrementally** making a difference. I know I'm not going to single-handedly clean the Patuxent in my lifetime. But I have to develop a lasting movement, so another Riverkeeper will take over when I'm gone."

Fred has knowledge and **perspectives** that came from his **identity**. Since Fred is now working with you, it is important to understand who he is. To help you Fred filled out an identity map, just like you did in Part 1. Fred's identity map includes the following things:

- I am 63 years old
- I started working part time in radio stations and on media projects when I was a teenager
- I am African-American with some Irish, Scottish and Native-American ancestry. One of my Virginia ancestors was reputedly the first African-American State Senator in Virginia's history during civil war reconstruction. I was named after abolitionist Frederick Douglass.
- I realized recently that while I have always been African-American, my **grassroots** work has shown me that I have not always been all that well connected to Black communities. It is an embarrassment at times and I am trying to relink, reconnect and rediscover my family history in Baltimore (on my father's side) and Southern Maryland (on my mother's side).
- I am very much at home in my skin as a male. My father trained me to be "manly" in the sense of firm handshakes, but I try not to be stuck in those roles. I try to keep an open mind and not judge others.
- I am an American citizen at a time when I feel Americans are being redefined in the world
- I am much more at home in the country rather than in cityscapes. I make my primary home in Maryland on a family farm that was settled by my great grandparents. The farm is an extraordinary gift of fields, streams, forests and various other natural treasures. They endlessly fascinate me and challenge my body as age makes my joints stiff and my muscles ache from farm duties.



- I am interested in race relations, conflict resolution, the environment, law, public policy, natural history, **metallurgy**, world history and many other areas of study and knowledge
- I am considered to be “large” with broad shoulders, very gray hair, glasses, moustache. My hair went very suddenly gray while attending the first semester of law school in my early forties.
- I think I am pretty gentle, funny, silly, compassionate, curious, and observant. I am passionate about injustice and the need for self-determination among all people.
- I like backpacking, photography, blacksmithing, creative writing, inventing and tinkering, books, road trips, and hiking
- I am a problem solver in most of what I do. I am the manager of the family farm and the CEO of a small non-profit organization. As I have gotten older, I have also been a mentor to younger people who have sought my help, advice and assistance.
- I get along well with outdoorsy folks. And I am learning there are many environmentalists and activists who are people of color. I am amazed and fascinated to meet and learn about people thinking out of the box and traveling roads less traveled.
- I also fit in well with metal workers and art craftsman from various walks and specialties

Throughout Part 7, you will notice Fred sharing ideas and experiences with you. He will share some of the work that he has done and help you find ways to take action in your community.



Task 1: What is the problem we want to take action on in our community?

In this task you will decide what problem you want to solve. Start with information from the investigations you did and questions you asked. Now you will **discover** connections between problems in your community. You will use these connections to help you **understand** the causes of problems you identified. Then you will decide what problem you will **act** to help solve.



Discover: *What is my community doing well and what could we be doing better?*

Each community has some things that it is doing well and some things it can be doing better. You probably noticed many of these things as you created your Part Organizer sheets ask you worked through each Part. Now, your team will work together to make a list of what your community is doing well and what it can be doing better. Then you will look at connections between the things that could be better in your community. These connections will help your team make a list of problems you could take action on.

1. Get out all your team's Part Organizer sheets for Parts 2–6. If you did not do all the Parts that is okay, you can just use the information you have.
2. As a team, use the information from your Part Organizer sheets to make a new list of what your community is doing well and what your community could do better. You can write this list, draw it or record your voices. You will need this list later, so be sure to record it in a way that works for your team. Look at the information you listed in all three columns, *Know*, *Think*, and *Wonder*. Your new list should have two categories: *Doing Well* and *Need to Do Better*.
 - a. For example, maybe your team knows that your community planted a new pollinator garden. Your team would list that under *Doing Well*.
 - b. Or maybe your team thinks that many trees in your community don't have enough space to grow. Your team would list that under *Need to Do Better*.





Figure 7.1: This tree does not have enough space to grow. Its roots have pushed through the street.

3. Consider the list of things in the *Doing Well* category. These things might be going well because people in your community took action to solve problems. Someday, the action your team takes could be on this list, too!
4. Now your team is going to find connections between the things in the *Need to Do Better* category. The things in this category are problems in your community. Connecting these problems will help you figure out which are most important to solve. Now you will make those connections.
5. First a team member will share a piece of information from the *Need to Do Better* category. Then a different team member will share another piece of information that connects to the first one and explain how it relates. For example, someone might say:
 - a. "I think that problem is connected to this problem because..."
 - b. "I would put these problems together in one group because..."
 - c. "I notice this problem happens over and over again in different ways..."
6. You can share ideas in several ways. You could talk out loud or sign to each other. You could pass an object from teammate to teammate to show who is talking. You could roll or pass a string between people to show that ideas are connected. Pick the best way for your team.



7. Show the connections you identified in your Need to Do Better category. For example, maybe you noticed a problem about how far some people in your community need to travel to get to green spaces. You also noticed that this same group of people needs to travel a long way to get to public transportation. If you wrote or drew your list, you might want to draw a line between those two problems to show the connection.
8. You now have a list of connected problems you could take action on in your community. You can label this list Connected Problems.



Understand: *What are the causes of problems in my community?*

In the last activity you and your team made a list of things your community could be doing better. Helping to make things better is your team's important job as action researchers. Before you decide how you will make things better, you need to think about the causes of the problems you found. Listing these causes will help you take action in your community.

1. First, read Fred's ideas about how he defines a problem. Consider his ideas as you start to think about problems in your community.

Fred says . . .



Sometimes people assume that “problems” and “issues” are the same thing. I think problems are very particular, local, and personal to us. I think of an issue as several similar problems lumped together. If an issue is a forest, the problems are the trees.

If you want to organize a community, it helps to break an issue down into the actual problems. Those problems will get your audience passionate and interested.



2. Move into a circle with the rest of your team. You are going to report on problems in your community. This will help you to start thinking about what is causing these problems.
3. Choose one team member to record your ideas.
4. Pick one team member to go first.
5. Imagine you are giving a news report to someone who knows nothing about your community. You can imagine using some of the tools shown in Figure 7.2. The first team member will say, "We are reporting from (put the name of your community in here), where there is a problem. The problem is (state your problem in here)." Examine your *Connected Problems* list to help you remember the problems you found.



Figure 7.2: Tools that can be used for news reports.

6. Then the second person in the circle continues the report, "Some people in the community think this problem is caused by..." and says one thing that might be causing the problem. The second person should use information from their investigations and knowledge of their community to figure out what they think the cause is.
7. The third person in the circle can add another cause by saying, "Yes, and other people think this problem is caused by..."
8. The team continues going around the circle and reporting on causes of the problem until your team shares all your ideas. You and your team are almost done with your reporting. There is one more important step.



9. Discuss with your team what you think is the **root cause** for the problem you are reporting about. What is a root cause? Like roots that are under a tree, root causes are all the way under each problem. The best news reports help people understand the root cause underneath a problem. For example,
- Imagine that the problem in your community is that animals keep getting hit by cars.
 - Your team reported that one cause might be people are driving down the road too fast to avoid animals that are crossing. Another cause might be that animals have to cross this road to reach a pond on the other side.
 - What could be the root cause? It might be that people value being able to use the roads to get around quickly and easily. They don't think about slowing down for animals.



Figure 7.3: A turtle crossing a paved road.

10. Record the root cause or root causes next to the problem your team is reporting on. How will it help your team to know the root cause? It can help you take action that is **sustainable**. Remember that **sustainable action** lasts for a long time.
- If the root cause of problems in your community is that people want to use the road the way they want to, you might decide to take action on that cause. You might try to find a way that people can keep using the road at the same time as animals. You might try to get people to slow down on the part of the road near the pond. You might ask your town to build a tunnel under the road to help animals cross safely.



11. When the team has decided the root cause of each problem, move on to doing a news report for the next problem.
12. After you finish with your news reports, discuss whether any of the root causes are the same. For example, maybe you noticed that people in your community have built roads, buildings, and other things that take space away from the other living things in your area. Perhaps the root cause for these problems is that people feel like it is more important to use the space for what they need than what other living things in their area need.
13. If you notice any root causes that are the same, be sure to record that information. Keep this information, because you will need it in the Act activity.



Act: *What problem will we take action on?*

Now you will decide what problem your team will act on. You will pick a problem that is important to you, your team, and your community.

1. Take out your Balanced Community Goals and your community, team, and individual identity maps.
2. Examine the goals and identities and remind yourself of what you and your team value.
3. Now you will use that information to pick a problem you will take action on. Before you do, read about Fred's thoughts about why it is so important for people who live in a community to choose which problems they want to solve. Explore his experience with groups that tell communities what problems they need to fix, instead of listening to the community. Consider this as you are choosing which problem to solve.

Fred says . . .



While we, Riverkeepers, want to **empower** communities, there are some conservation groups that don't follow that **paradigm** at all. Those conservation groups don't want to empower the community. They want to get the community working on the issue that the conservation group cares about. That kind of



activism will not last because it ignores the community's vision. It takes effort away from a local problem. The solution to community problems is a solution that fits the circumstances, needs, wishes, and hopes held by the community itself.

Activism owned by and controlled by the community tends to be more long lived and much more energetic. Activism should use local creativity, knowledge, and passion. Activism should involve the affected community.

We think that work that lasts a long time is better work in the long haul.

Communities with a tradition helping themselves and mentoring leadership from within are better and healthier communities.

4. Examine your *Connected Problems*. If there are problems you found that had the same root cause, you can examine those together.
5. As a team discuss what problems would be most important to take action on if you want to reach your *Balanced Community Goals*.
6. Make a mark next to any problems that everyone thinks are important.
7. There are many problems, but some are very hard for young people to change. Think about what problems you think your team would be able to act on and really make a difference.
8. Make a mark next to problems that you think your team could help to change.
9. As a team discuss who you help when you solve each problem. Think about who you would most like to help. For example, you could choose:
 - a. Helping the most people
 - b. Helping people who have often been left out in the past
 - c. Helping people who need the most help
10. Make a mark next to problems that affect the people you chose.
11. You now have a list of problems with marks next to them. One by one, for each problem, ask the team, "Is this the most important problem to take action on?" You and your teammates can say:
 - a. Yes
 - b. Maybe, if you are not sure
 - c. No



12. If everyone agrees on the same problem, record the problem. Then you can move on to Task 2.
13. If some people disagree, you need to come to **consensus** as a team. Remember the skills you used to come to consensus in Part 1? You can use those skills again. Here are some ideas. You can choose whatever works best for your team.
 - a. List the good things and bad things about taking action on each problem. Discuss as a team.
 - b. Try to find the same values. Are there some problems that have the similar root causes? Is there a way to combine those problems?
 - c. Build a sense of the group opinion. Each person can mark one problem to solve. This can help you understand which problems are most important to your team. You can discard any problems no one picked.
 - d. Find a slow consensus. Find a partner and as a pair find consensus on which problem is most important. Then in a group of two pairs (four team members) you can find consensus. Then in a group of four pairs (eight team members) you find consensus. Keep adding together groups until you have found a team consensus.
 - e. Consider your goals. Examine your *Balanced Community Goals*. Do some problems relate to many of the goals? If so, those might be more important to solve.
 - f. Consider your **impact**. Think about who benefits. Which group are you most interested in helping?
14. Keep discussing your ideas until you come to consensus about the best problem to try to help solve as a team. Record that problem.



Task 2: How will we try to solve our problem?

Action researchers and scientists seek problems, try to understand them, and then solve them. You have thought about problems in your community. You have **investigated** to understand these problems. Now you will have a chance to decide how to try and solve the problem you chose in Task 1. You will **discover** possible actions. Then you will **understand** how different actions might help solve your problem from different perspectives. Finally, you will decide how you will **act** to help solve that problem.



Discover: *What are some actions we could take?*

You have decided what problem your team will take action on to improve your community. Now you need to decide what type of action you want to take.

1. As a team take out a piece of paper or create a digital document. Title it Team Action Plan. On the first line write or draw the problem your team is going to work to make better. You can label this part "Problem."
2. On the next line write or draw the causes and root cause of the problem which you identified during your problem news report in the Task 1, Understand activity. You can label this part "Causes."
3. Next record your ideas about who is affected by your problem. Think about if it is mostly people of a specific age, or people who live in a specific place, or people who have another thing in common. You can label this part "Who is Affected."
4. Now look at some of the ideas you had under your *Wonder* columns of your Part Organizer sheets. Are there any ideas there that might help you take action to help solve your problem? If so, record those ideas. You can label this part "Actions."
5. If you can think of any other actions, then record those under Actions.
6. If you are having trouble thinking of actions you can take, here are some ideas:
 - a. Personal change: Change something in your daily life or home. For example, learning more about an endangered living thing in your area and find out if you can change your own behavior to help protect it.



- b. Change at home: Make changes with the people who live in your home. For example, finding another way to get rid of pests in your home instead of using chemicals.
- c. Class or school change: Encourage changes at your school. For example, creating a school garden with plants that are native to your area.
- d. Communicate with your community: Help the community understand the problem or change their behavior by designing posters, composing songs, recording podcasts, making public service announcements, setting up a social media campaign, or using other ways to communicate.
- e. Government change: Try to change what your local or national government is doing. For example, write letters to officials or speak at local government meetings to share your concerns about your problem.
- f. Global change: Collaborate with others around the world who are worried about the same problem. For example, join a group that works together to stop poaching of living things.
- g. Come up with your own ideas!

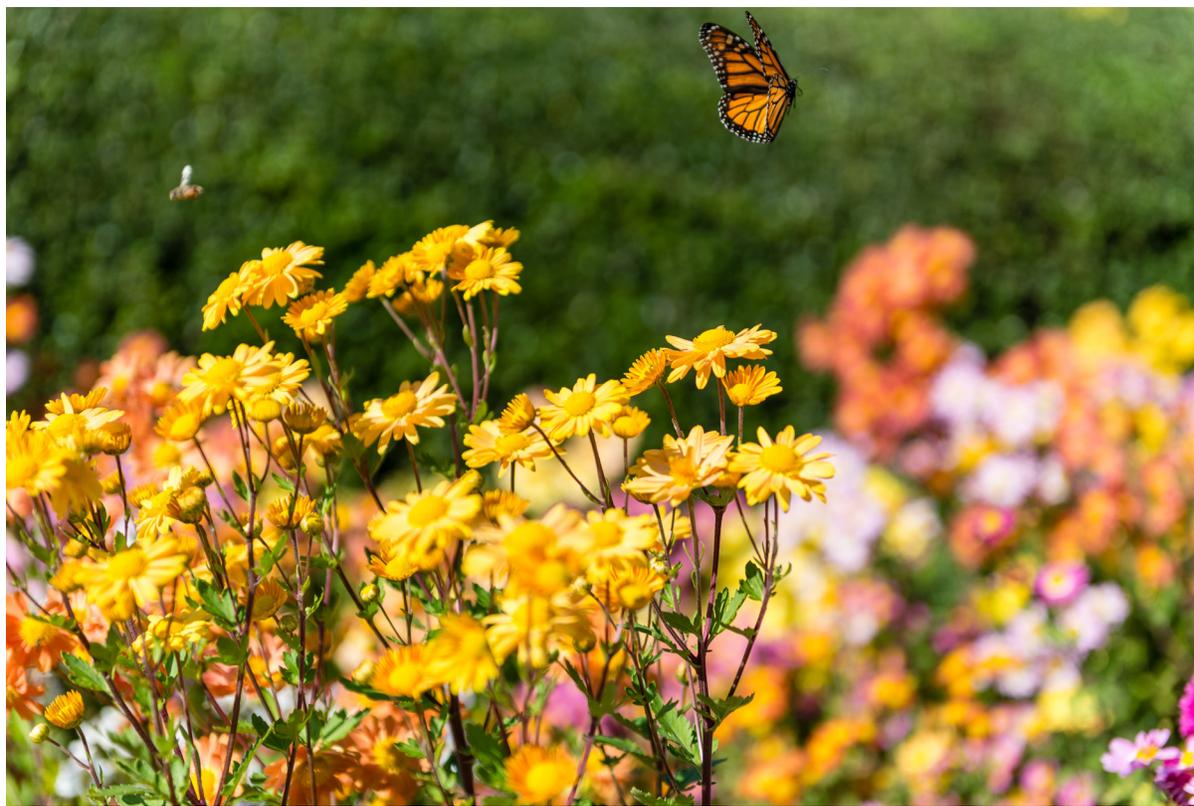


Figure 7.4: This garden creates food and habitat for several different living things that pollinate plants.





Understand: *How will we make our action sustainable?*

Remember there are different perspectives or ways of thinking about problems in your community. Actions may help solve a problem from one perspective, but not from another. Sustainable actions need to consider **social, environmental, economic,** and **ethical** perspectives. Considering the needs of as many people and perspectives as possible makes the actions you take more sustainable.

1. Take out your Team Action Plan.
2. Consider the actions you listed. Would each action help solve your problem from:
 - a. A social perspective? For example, helping to build relationships between people.
 - b. An environmental perspective? For example, helping to make the air cleaner.
 - c. An economic perspective? For example, making it easier for people to earn money.
 - d. An ethical perspective? For example, making your community fairer.
3. Make a mark next to each action that shows from which perspectives it helps. You can use abbreviations, symbols, or whatever works best for your team. An action may help solve the problem from one perspective or more than one perspective.
4. Think about the actions and perspectives you have written down. What can you change about your actions so they help solve the problem from more than one perspective? Make those changes now.
 - a. For example, maybe your action is picking up plastic bottles that are polluting a nearby river, like the one shown in Figure 7.5. This action mainly helps from an environmental perspective.





Figure 7.5: A polluted river.

- b. Could you add in a social perspective by encouraging community members to work together to pick up the bottles so that the shared space around the river becomes better for socializing?
 - c. Could you add in an economic perspective by clearing bottles near a tourist area so it looks nicer and people will go to the restaurants there?
 - d. Could you add in an ethical perspective by making sure that your action is fair? Maybe you pick up bottles all along the river, not just in some places.
 - e. In a perfect world each action would help from all four perspectives. That might not be possible. Just do your best.
5. Take out your Community Identity Map. Use it to remember all the different people in your community.
 6. Think about how your community members might feel about your action ideas. As a team discuss for each action:
 - a. Who does this action help?
 - b. Are there people who are left out? If so, what could you change about the action so it does not leave them out?
 - c. Does this action hurt anyone? If so, what could you change about the action so that it does not hurt them?
 - d. Are there things that might happen when we take this action that we do not want to happen? If so, what could you change about the action so they don't happen?



- e. Are there other ways you want to change any action so it will work better?
- f. Make any changes you feel are needed.

7. Read what Fred has to say about involving the community in taking action.

Fred says . . .



How do you get people working local on a global issue but to do so in ways that increase the community’s power over the issue? Be careful it doesn’t empower the campaign but not the people. People tend to work on causes and issue where they can make a difference. People want to empower their own voice. People want to tell their own stories.

Conservation work is often fueled by money. Sometimes people assume that the issues that have money are the most important. But a person working on an issue because they are being paid may behave and act differently than a person who is defending their community and upholding their own values.

8. In a perfect world each action would make your whole community better. Sometimes that is not possible. Just do your best.



Act: How will we take action?

Your team is ready to decide what action you will take.

1. Think quietly to yourself about the actions you have listed. Ask yourself:
 - a. Does the action help fix the root cause of your problem?
 - b. Is this an action that your team can take? Think about your time, any costs involved, and whether everyone can participate.
 - c. Would you be excited to take this action?
2. As a team, discuss the actions you have listed. Get rid of any actions that would not be helpful or that you cannot do.



3. Take out your *Balanced Community Goals*. Discuss which of the actions will be best for helping your community move toward your goals.
4. Pick the best way to come to consensus for your group. You can use any of the ways you used in Part 1, earlier in Part 7, or come up with a new way.
5. Use your consensus-building skills to decide what action your team will take.



Task 3: How will our team take action in our community?

You and your team have picked an action that will make your community better. As action researchers, your next task is to plan exactly how to take that action. You will **discover** the steps you think are most important. Then you will **understand** the steps your team would like to take. Finally you will **act** as a team to build an action plan to carry out in Task 4.



Discover: *What are the steps needed to take action?*

The first thing to do when planning an action is to figure out the steps that are part of that action. Your action could need permission from someone. Your action could need your team to do some things one day and other things another day. Your action could take place in several areas. All of these ideas could be different steps in your action plan.

1. Think quietly to yourself about the steps that could be part of the action your team picked.
2. Write, draw, or use another way to record your ideas on small pieces of paper. Each piece of paper should have one step. You will share these pieces of paper in the Understand activity. If you would like, you can also make a list of your ideas on a computer, phone, or other device. Just make sure these ideas can be shared with others.
3. Take out your Community Communication paper from Part 2, Task 5. Use it to remember the best ways to communicate with your community.
4. Think about how you will tell the community about your action. Record the steps involved. Remember if people feel like they are a part of something they may be more likely to help. Telling the community about what you are doing can help make your action better.
5. Read Fred's ideas about why it is important to communicate with the community and help people feel involved in an action. Use these ideas when planning your action.



Fred says . . .

You have to talk to real people. You have to respect what they know or what they think they know. You have to meet people where they are. People have opinions, local knowledge, a sense of commitment and dedication. Their participation is absolutely necessary. It is not optional or an afterthought.

Change happens on a community basis. Movements that have communities on their backs have movement. A project may run out of money in ten months, but movements last on.

Riverkeepers teach these communities about how to fight and how to struggle. We are teaching skills of **advocacy**. For example, the Riverkeeper can help people learn how to file a Freedom of Information request. Or how to get their ideas or messaging on TV or radio. The people in a community may not understand the laws that are related to the particular situation they are trying to amend or change. We give them a whole toolbox of things that they can use to take action.

6. Think about how you will measure the way your action is making your community better? Record the steps involved. For example,
 - a. Could you ask people in the community if they feel like the action helped?
 - b. Could you count how many people or living things you have affected?
7. Write your name next to any steps you would like to help with.

**Understand:** *How can we organize our action steps?*

You have thought about what you think your team needs to take action. But it is also important to find out what the other people on your team are thinking. Then you will need to organize your ideas as a team.

1. Have each team member place their pieces of paper from the Discover activity on a table or another surface. This will help your team share their steps. Your team can also share their steps on a computer or other device using a program like Padlet or Google Classroom.



2. Read through the steps from your teammates.
 - a. Did you notice any steps that were similar to yours?
 - b. Do you think your team is missing any steps?
3. Start to organize your team's steps. You can move the pieces of paper around as you do this. Thinking about your team's steps will help you decide how you will take action:
 - a. Group any similar steps together.
 - b. Remove any steps that you don't think are needed to help your team take action.
 - c. Think about how each team member will help. Put their names with the steps they would like to help with.
 - d. Think about what steps might be missing. Add those steps.
4. Start putting the steps in order.
 - a. For example, what do you think the team needs to do first? Place that piece of paper before all the others.
5. Make a list of things you need to help you take action.
 - a. What materials do you need?
 - b. How much time do you need?
 - c. Do you need an adult to help you get permission?
6. Keep these steps and the list of things you need for the Act activity.



Act: *What will we put in our action plan?*

In this activity you and your team will create your action plan. You will use this plan in Task 4 when you take your action in your community. Think back to the steps you and your team organized in the Understand activity. Now you need to turn those steps into an action plan.

1. You will record your action plan so everyone on the team can use it. You may want to add it to your Team Action Plan document. Your team can record your action plan in whatever way you would like:
 - a. Write
 - b. Draw



- c. Create a storyboard that shows the steps in order
 - d. Type the plan on a computer, phone, or other device
 - e. Record your team saying the steps
2. Remember the steps and materials you chose in the Understand activity. Use that information and this checklist to help you record the following:
 - a. The steps your team would like to take
 - b. The order of those steps
 - c. Who will help with each step (it might be more than one person)
 - d. When and where you will take these steps
 - e. How you will communicate your action plan to the community.
3. Think about what you will do if your plan doesn't work or you run into another problem (for example, an adult in your community says you need permission and you don't have it yet). Record these ideas as part of your action plan.
4. Remember to create an **inclusive** action plan. Being inclusive everyone on your team can participate in some way. You may need to make changes to the plan so that everyone feels safe, comfortable, and able to help. Those changes are okay! They are part of being a good action researcher and a good teammate.



Task 4: Putting your plan into action

You finally have arrived at the most exciting part of action research. You **discovered** your own knowledge and values. You used science and **social science** investigations to **understand** the problems of your community. Now it is time to **act**!

1. Put the plan you created in Task 3 into action.



Task 5: What did I learn?

Great job! You took action to make your community better! In this task you will reflect on the action you took with your team. **Reflecting** means thinking carefully about something. You will also reflect on your role as an action researcher in this Community Research Guide. Why? Reflecting is something all action researchers do. Reflecting helps you figure out what worked and what didn't work about your action. It helps you take even better action in the future.

1. Find a place to rest that is quiet and comfortable. Start by closing your eyes if that feels comfortable for you. Breathe in slowly through your nose. Let your belly and chest expand with air. Breathe out slowly through your mouth. Push out all of the air that was in your belly and chest.
2. This exercise helps your brain get ready to reflect. Repeat it as many times as you would like so you can feel ready.
3. Gather with your team. You are going to reflect on your action together.
4. Get three large pieces of paper. You can also do this activity by talking out loud or sharing ideas online.
5. Label each piece of paper with one of the following questions:
 - a. "What went well?"
 - b. "What could have been better?"
 - c. "How did our action make our community better?"
6. Write your answers on each piece of paper. Let everyone on the team add their answers.
7. Read the answers from your teammates. Notice what you agree with. Notice what surprises you.
8. Talk with your team to answer this next question. Use what you wrote on the three pieces of paper to help you answer.
 - a. What would you do differently if your team planned another action?
9. Now you will take some time to think about how you have grown as an action researcher.
10. Take out the *My Feelings* paper from Part 1, Task 5. Remember, you thought about:
 - a. What worries me about being an action researcher?
 - b. What excites me about being an action researcher?



- c. What do I hope I will learn about my community?
 - d. What do I hope I will learn about the topic of biodiversity?
 - e. How do I think my team will work together?
 - f. Do I feel ready to take action to make my community better?
 - g. How do I hope I will feel at the end?
11. Think about your answers. Then record your thoughts about:
 - a. If I had to answer these questions now, how would my answers change?
 - b. What did I do in this guide that surprised me?
 - c. What was hard for me to do?
 - d. What are the most important things I learned?
 - e. What makes me the proudest?
 - f. How have I changed?
 12. Come back together with your team.
 13. You will create a final identity map. This identity map will help you understand how your team has changed after finishing this guide.
 14. Pick one person on the team to lead the discussion.
 15. Have the team leader write the word “Team” on the board or on a piece of paper. Circle it. You can look at Part 1 for an example.
 16. The team leader will start by sharing one way they changed while doing the *Biodiversity! Community Research Guide*.
 - a. For example, maybe the team leader says, “I feel more able to change my community.”
 17. The team leader will write their item on the team identity map.
 18. Then the team leader will ask other team members to share how they have changed.
 19. Write each item on the team identity map.
 20. Repeat until all members of the team have shared and added one item to the team identity map.
 21. Quietly consider the team identity map. It shows how your whole team has changed since the beginning of this guide. These changes are important. We hope that your changes make it easier for you to take action in the future.



Congratulations!

You finished the Biodiversity Community Research Guide!

All of us should be trying to do what we can to change ourselves and our world for the better. Maybe you took a big action. Maybe you took a smaller action. Maybe it had a big impact. Maybe it had a small impact. The most important thing is that you did something. When you take action to make your community better, you create the world you want to live in by. You and your team are changing the world, one step at a time!

*Never underestimate the power of a small group of committed
people to change the world.*

In fact, it is the only thing that ever has.

—Margaret Mead



Glossary

This glossary can help you understand words you may not know. You can add drawings, your own definitions, or anything else that will help. Add other words to the glossary if you would like.

Action researchers: People who use their own knowledge and information they find out from their community to make decisions and take action on important issues

Activism: Taking action in support of an idea or cause, or taking action against an idea or cause

Advocacy: Supporting an idea or cause

Community: A group of people that have a place or other thing in common

Consensus: A balanced decision that works for everyone in the group

Economic: About money, income, and use of wealth

Empower: To give power to someone or something

Environmental: About the natural world

Estuary: A body of water where one or more rivers meet an ocean

Ethical: The fairness of something

Grassroots: the ordinary people in a community instead of the leadership or people in positions of power



Identity: Characteristics that make up each person or thing

Impact: The effect one thing has on another

Inclusive: Making sure no one is left out

Incrementally: Changing by a small amount at a time

Investigate: Find out more information

Mentor: Someone who has experience and can help guide you

Metallurgy: The science of metals and their properties

Paradigm: A way of thinking about the world

Perspective: A specific way of thinking about the world around us

Reflecting: Thinking carefully about something

Root cause: The reason underlying a problem

Social: About the interaction of people in a community

Social science: Study of human communities and interactions



Sustainable: A balanced, long-term approach to social, environmental, economic, and ethical concerns

Sustainable action: Actions that can continue for a long time and take into account many perspectives

Other words:



Meet Logan Schmidt, Your Biodiversity Guide Developer



Meet Logan Schmidt. Logan (LOH-gan) was the main person writing this guide. She talked with lots of researchers to get information. However, like anyone, she has her own perspective. You have learned it is important to consider the perspectives of your teammates and research mentors.

Perspectives affect what we think and how we think. It is also important to think about the perspective of the writer. This can help you understand why the guide was written the way it was. Considering the source of information is always a good idea.

Logan has degrees in biology and education. However, she also has knowledge and perspectives that come from other parts of her identity. Since you have been reading a lot of what Logan has written, it is important to know who she is. To help you, Logan filled out an identity map, just like you did in Part 1. Logan's identity map includes the following things.

- I am 38 years old
- I identify as female and use she/her pronouns
- I am cisgender
- The only thing I love more than science is talking to other people about science
- My favorite food is mozzarella sticks
- I am from the United States but have also lived in Greece, the Turks and Caicos, and the Falkland Islands
- I am a little sister, an aunt to two nephews, and the mother of one daughter
- In my free time I like to play volleyball and soccer, do needlepoint, volunteer to help military veterans, and fly fish
- My mother is now retired but worked as a teacher, literacy specialist, assistant principal, and principal. She is my hero. She inspired me to work in education.
- My maternal grandfather had a saying, "We do what we value" and I try to live by that saying each day.



Before you finish the guide, think quietly to yourself about Logan's identity map.

- What questions do you have about the way the guide was written?
- What perspectives does Logan have that might have made her write the guide the way it is?
- Are there things you would include that were not included?

Do you want to tell Logan what you would change about the guide? Email her at scienceeducation@si.edu. She'd love to hear from you!



References

1. Dejaviso Pose, C., Mustalish, R. (2017). *Ancestral Lands of the Ese'Eja: The True People* (R. Martinez, J. Cox, R. Mustalish, Ed.) Amazon Center for Environmental Education and Research (ACEER)

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Attempting to empower the next generation of decision-makers capable of making the right choices about the complex socio-scientific issues facing human society, SSfGG blends together previous practices in Inquiry-Based Science Education, Social Studies Education, Global Citizenship Education, Social Emotional Learning, and Education for Sustainable Development.

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