



Smithsonian

**SCIENCE**  
*for Global Goals*

# OCEAN!

Part 1: Ocean Introduction



**SUSTAINABLE  
DEVELOPMENT GOALS**

developed by



Smithsonian  
*Science Education Center*

in collaboration with

**iap** **SCIENCE  
HEALTH  
POLICY**  
the interacademy partnership

## Copyright Notice

© 2024 Smithsonian Institution  
All rights reserved. First Edition 2024.

## Copyright Notice

No part of this module, or derivative works of this module, may be used or reproduced for any purpose except fair use without permission in writing from the Smithsonian Science Education Center.

Smithsonian Science Education Center greatly appreciates the efforts of all the individuals listed below in the development of *Ocean! How can we create a sustainable future for the ocean?* Part 1. Each contributed his or her expertise to ensure this project is of the highest quality. For a full list of acknowledgments please refer to the acknowledgments section at the beginning of this guide.

Smithsonian Science Education Center Module Development Staff

Executive Director - Dr. Carol O'Donnell

Division Director for Curriculum, Digital Media, and  
Communications - Dr. Brian Mandell

Science Curriculum Developer - Heidi Gibson

Contributing Interns  
Alexandra Barrington  
Nikki Kanakis

Technical Reviewers  
Dr. Stella Tsani

The contributions of the Smithsonian Science Education Center staff, Project Advisors, Research Mentors, and Technical Reviewers are found in the acknowledgments section.

## Image Credits

Cover - AshleyWiley/iStock/Getty Images Plus  
Figure 1.1 - Smithsonian Science Education Center  
Figure 1.2 - Smithsonian Science Education Center  
Figure 1.3 - Smithsonian Science Education Center  
Figure 1.4 - Smithsonian Institution  
Figure 1.5 - vichuda/iStock/Getty Images Plus  
Figure 1.6 - Smithsonian Science Education Center  
Figure 1.7 - Smithsonian Science Education Center  
Figure 1.8 - andipantz/iStock/Getty Images Plus  
Figure 1.9 - Mike Henley, Smithsonian  
Figure 1.10 - okimo//iStock/Getty Images Plus  
Figure 1.11 - MarineGEO, Smithsonian Institution  
Figure 1.12 - Smithsonian Science Education Center  
Figure 1.13 - United Nations



## PART 1: OCEAN INTRODUCTION

Planner	4
<b>Task 1:</b> What are our connections to the ocean?	6
<b>Discover:</b> Who am I and how do I relate to the ocean?	6
<b>Understand:</b> What is the relationship between the ocean and my local community?	9
<b>Act:</b> How can we help our community connect to the ocean?	15
<b>Task 2:</b> What are ocean systems and why are they important?	19
<b>Discover:</b> What is a system?	19
<b>Understand:</b> What systems are part of the ocean?	24
<b>Act:</b> What can we do to encourage a positive future for the ocean?	28
Glossary	34

### **Find out More!**

For additional resources and activities, please visit the *Ocean!* StoryMap at <https://bit.ly/OCEAN2030>.



## Planner

<b>Activity</b>	<b>Description</b>	<b>Materials and Technology</b>	<b>Additional Materials</b>	<b>Approximate Timing</b>	<b>Page Number</b>
<b>Task 1: What are our connections to the ocean?</b>					
<b>Discover</b>	Develop a personal identity map showing the different parts of who you are and explore your connections to the ocean.	<ul style="list-style-type: none"> <li>• Paper</li> <li>• Pens or pencils</li> </ul>		45 minutes	6
<b>Understand</b>	Create an ocean identity map and gather oral histories about the ocean from your community.	<ul style="list-style-type: none"> <li>• Class board or poster paper</li> <li>• Paper</li> <li>• Pens or pencils</li> <li>• Art and craft materials (optional)</li> </ul>	<u>Personal Identity Map</u>	25 minutes + Oral history gathering time	9
<b>Act</b>	Design a museum exhibit to help others better understand the ocean and their connection to it.	<ul style="list-style-type: none"> <li>• Paper</li> <li>• Markers, pens, or pencils</li> <li>• Art and craft materials (optional)</li> </ul>	<u>Personal Identity Map</u> <u>Ocean Identity Map</u>	25 minutes	15
<b>Task 2: What are ocean systems and why are they important?</b>					
<b>Discover</b>	Use a system you are familiar with to create a system diagram.	<ul style="list-style-type: none"> <li>• Paper</li> <li>• Pens or pencils</li> </ul>		20 minutes	19
<b>Understand</b>	Investigate ocean systems from small to global, using pictures as a tool.	<ul style="list-style-type: none"> <li>• Paper</li> <li>• Pens or pencils</li> </ul>		25 minutes	24
<b>Act</b>	Consider different perspectives and create team goals for the future of the ocean. Use these goals to decide which guide parts you will use.	<ul style="list-style-type: none"> <li>• Paper</li> <li>• Pens or pencils</li> </ul>	<u>Ocean Identity Map</u>	25 minutes	28



## Ocean! How can we create a sustainable future for the ocean?

In many ways, the **ocean** defines our planet. In this guide you will explore your connections to the ocean and how the ocean connects to you and your community.

While using the guide you will become an **action researcher** to identify and help solve problems in your community. Action researchers first **discover** their own existing knowledge, then they investigate to **understand** problems, and finally they **act** on what they have learned to make local and global communities better.

You will create and keep several sheets of paper or digital documents to help you record and remember information. You may want to use a notebook or folder to help organize the sheets you will use in the guide.

**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 are our connections to the ocean?

Who we are affects the way we think about and view the world around us. In this task you will first **discover** more about your own identity and how it has changed over time. You will then explore how your personal history connects you to the ocean. You will gather information from your community to **understand** more about the links between your community and the ocean. Finally, you will **act** by beginning to map out the ocean's identity.



### **Discover:** *Who am I and how do I relate to the ocean?*

In this guide you will be exploring your connection to the ocean with the rest of your team. The ocean is the large body of saltwater that covers 71% of Earth's surface.

Before you can start to think about what the ocean is and how it connects to you, it is important to think about who you are. Our different experiences, backgrounds, and ideas give each of us a unique **identity**. Your identity is what makes you you. Each of us has a unique identity and a unique personal history. The ocean also has an identity and a history. Your personal relationship with the ocean is an important place to start this guide.

1. Take out a piece of paper or open a digital document and title it "Personal Identity Map."
2. Write your name in the center of the page or draw a small picture of yourself.
3. Think about your answer to the question, "Who am I?" The list below can give you some ideas to consider, but you choose what you think is an important part of your identity. You can also include things that are not on the list.
  - Age
  - School or class
  - Race and/or ethnicity
  - Gender
  - Country or place where you live
  - Country or place that is important to you or your family
  - Values or beliefs that are important to you
  - Goals that are important to you



- Topics or subjects that interest you
  - Hobbies or things you like to do for fun
  - Physical traits (such as tall, black hair, blue eyes, wears glasses)
  - Personality traits (such as loud, funny, quiet, kind)
  - Roles you have in your household (such as big sister, helper, cousin)
  - Groups you belong to
4. Write or draw something on the page around your name to show the important parts of your identity.
  5. Then draw a circle around all the things you listed as part of your identity.
- Figure 1.1 shows an example.

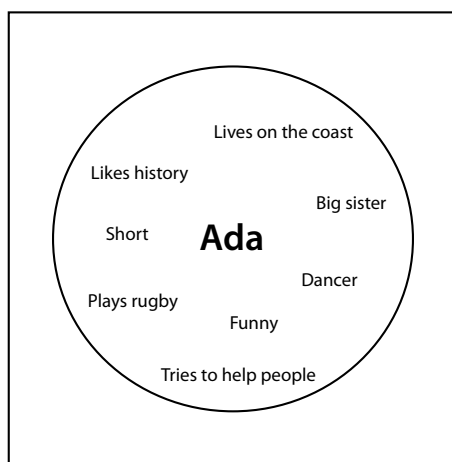


Figure 1.1: *Personal Identity Map* example.

6. Draw a circle around your *Personal Identity Map* and label the circle “Ocean Connections.” Figure 1.2 shows an example. You will use this circle to help you think about your personal connections to the ocean.

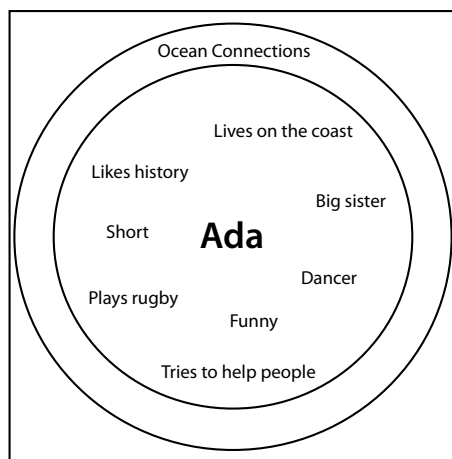


Figure 1.2: Example of a *Personal Identity Map* with the *Ocean Connections* circle added.



7. Examine the things you listed as part of your identity. Are there parts you think connect you to the ocean? For example, if you like to surf or you like to cook and your favorite food comes from the ocean, that could be a connection. Draw or write each connection in the *Ocean Connections* circle.
8. Think quietly to yourself about the feelings or beliefs that are part of your personal relationship with the ocean. Even if you have never physically been to the ocean, you still have a relationship with it. You may want to consider:
  - a. How do you feel about the ocean?
  - b. If you have been near the ocean, how would you describe that experience?
  - c. What are your personal or cultural beliefs or stories about the ocean and the way people should relate to it?
  - d. Are there specific words or language you or others in your community use to describe the ocean or parts of the ocean?
9. Write or draw each part of your relationship with the ocean in the *Ocean Connections* circle.
10. Think of an ocean-related memory and add it to your *Ocean Connections* circle. For example:
  - a. Do you have a memory of being near, on, or in the ocean?
  - b. Do you have a memory of experiencing the ocean through visual art, music, books, television shows, or movies?
  - c. Is there a connection between your personal history and the ocean?
11. Turn to a partner.
12. Take turns telling your partner the story of your ocean-related memory, and listening to your partner's story.
  - a. For the storyteller: Try to share details about your story and why you picked it.
  - b. For the listener: Pay close attention and think carefully. Why is this story important and what does it tell you about how someone else thinks and feels about the ocean?





 **Emotional Safety Tip**

Sharing memories can be very personal. Remember that your partner is trusting you to respect them and their memory. Make sure you listen carefully and stay open to the story, even if it feels unfamiliar or strange to you. If you are not comfortable sharing one memory, pick a different one to share.

12. Keep your *Personal Identity Map*. You will need it later.



**Understand:** *What is the relationship between the ocean and my local community?*

A **community** is a group of people who share something in common, for example, your family, your classmates, your teachers, or your neighbors. A community can share space, like a local, national, or global community. Or a community can share an identity, like a religion, ethnicity, or common interest. Some communities include many people and some have fewer people. If you think back to your identity map and your relationships, you will probably realize you are part of many communities.

Some local communities are located near the ocean and some are located farther away. But no matter where a community is located, the people in it still have a relationship with the ocean. In this activity you will find out more about some of those relationships.

1. Form a team. Your team may be your whole class, or it may be a smaller group. Either is fine. As action researchers, you will work together with your team, made up of your classmates, for the rest of this guide. You will work together to understand your local area and make it better.
2. Take out a very large piece of paper or use a class board or another shared space. Plan to leave this document or board on display while you are using this guide.
3. With your team, write or draw the word "Ocean" in the center of the paper, board, or area. Draw a circle around *Ocean* that takes up about half the space available. This is now your *Ocean Identity Map*.



4. Give each team member a marker, pen, or another way to write or draw their ideas on the *Ocean Identity Map*.
5. Within the *Ocean* circle, list anything you think is important to know or understand about the ocean. Add as many words or drawings as you want within the circle. For example you might want to list information about:
  - a. The location of the ocean
  - b. What the ocean is made of
  - c. Parts of the ocean
  - d. Types of things that happen in and around the ocean
  - e. Living things in the ocean
  - f. Ways the ocean is changing
6. Read *One Ocean*. If this information makes you want to add anything to your *Ocean Identity Map*, do so now.

### *One Ocean*

You may have noticed the name of this guide is *Ocean*, not *Oceans*. But you also may know the names of different oceans, such as Pacific, Atlantic, and Indian. So why only one ocean?

Think of a map of the world. Is there any separation between the oceans you may be familiar with? No! Although we call different areas of the ocean different names, the water and living things in the ocean move and mix between these areas. Sometimes it can be helpful to think about different areas of the ocean, or **ocean basins**, by naming them separately. But it is important to remember that the ocean is all one connected whole.

7. Draw another circle around the *Ocean* circle on your *Ocean Identity Map* and label it "Connections." Figure 1.3 shows an example.



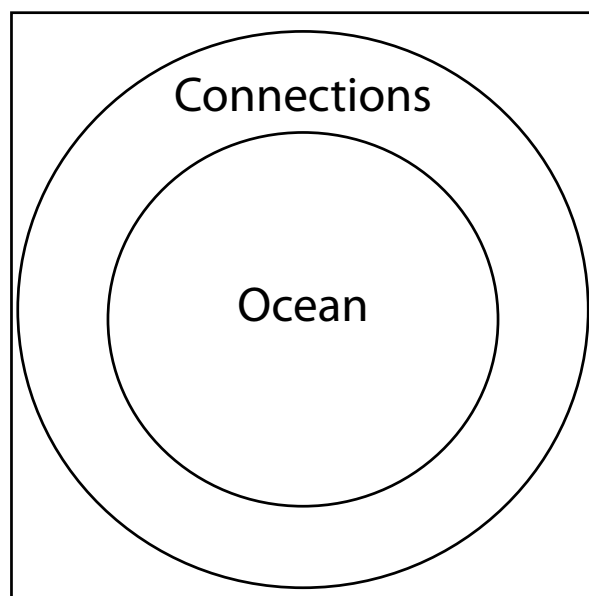


Figure 1.3: Example of an *Ocean Identity Map* with *Ocean* and *Connections* circles.

8. Have each team member add at least one ocean connection from their *Personal Identity Map* to the *Connections* circle in the team *Ocean Identity Map*.
9. Examine all the connections listed by the members of your team. Are there any that surprise you? Are there any that are similar to yours?
10. Discuss with your team:
  - a. Why might it be useful to think about many different types of connections to the ocean when learning more about it?
  - b. How can having different experiences with the ocean help your team as you do research?
11. With your team, decide which local community you will focus on and learn from as you research connections between your local community and the ocean. For example, you could choose the community of your town or your neighborhood or your school. Make sure it is a community your whole team is part of and a community you will be able to interact with. Choose a community that feels important and personal to you and your team.
12. Read the *Oral History Instructions*.



## Oral History Instructions

When you talk to people and record information about their past, it is called an **oral history**. An oral history lets people share stories from their past. You can use these stories to gather information about the history of your community's relationship with the ocean.

You have already done this in a smaller way when you shared your ocean memory with your partner. Now each team member will gather an oral history of an ocean memory from your local community. Oral histories can have a lot of information. They can show changes over time, relationships, and what is important to a group.

### **Choosing People to Talk to**

- a. Think about who might know the most about the relationship of your community with the ocean. For example, it might be older people who have lived in the community a long time, a local historian, environmental activists, leaders who make decisions, or people who are part of a local **Indigenous** group. Indigenous means a group of people who lived in an area before any other groups arrived. Indigenous peoples are sometimes referred to as First People or First Nations, Aboriginal, or Native Peoples.
- b. If you can, include people with many different identities when gathering community oral histories. As a team, try to talk to people with a variety of ages, genders, jobs, incomes, religions, ethnicities, roles in the community, or other identities. However, if this is too difficult, you can collect oral histories from communities that you are closer to, such as people in your school.
- c. Think about the many ways people can share information and try not to leave people out.
- d. 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 talks to at least one person, you will have enough information to complete the activity.



## Possible Ways to Record an Oral History

- a. You can use audio or video to record an oral history.
- b. You can 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 Collecting an Oral History

- a. Make sure you ask permission to record a person's answers to your questions.
- b. Ask permission to share the oral history with the rest of your team, class, or other people in the community.
- c. People might be more willing to talk if their oral history is **anonymous**.
- d. 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.
- e. If it feels like someone didn't answer your question, don't be afraid to ask the question again in a different way.
- f. 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.

## Choosing Your Questions

Make a list of questions you would like to ask to help understand your community's relationship with the ocean. For example:

- a. You might want to ask about ocean memories, like the ones you shared with your partner.
- b. You might want to ask how people in your community think and feel about the ocean and if this has changed over time.
- c. You might want to ask whether there are any community stories or strong beliefs about the ocean and its history or its living things.
- d. You also might have other questions you want to ask.

## Safety Tips for Talking to People

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



 **Physical Safety Tip**

When gathering oral histories, always make sure you feel safe. You can always include a trusted adult or classmate when recording. 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 okay! 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.

13. If an oral history doesn't sound like the right investigation for your team, you can pick another way to collect information about the relationship between your community and the ocean. For example, you could investigate using books, videos, maps, artwork, audio recordings, stories, or other records of the history of your community. Or you could gather information digitally, such as through a social media post.
14. 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.

 **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 a conversation if you are uncomfortable or upset.





15. Remember, including everyone is important. If you are working with a team, you may need to adjust the way you gather your oral histories so that everyone feels safe, comfortable, and able to help. Those changes are okay! They are part of including everyone. Make sure to consider:
  - 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 gather your oral history, make sure everyone on your team feels safe and able to do this. If not, what is another way team members could help?
  - 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?
16. Work with your team to gather the oral histories or investigate your community's relationship with the ocean in a different way.
17. Come back together with your team.
18. Listen to the histories gathered by your team.
19. Discuss with your teammates:
  - a. What are the new things we have learned about the relationship between our community and the ocean?
  - b. What are the most important parts of our community's relationship with the ocean?
20. Add words or drawings to represent the stories and ideas you learned about from your investigation to the *Connections* circle of your *Ocean Identity Map*.



**Act:** *How can we help our community connect to the ocean?*

You have learned that you have a lot of different parts that make up you and your identity. The ocean also has many parts that make up its identity. You have already begun mapping that ocean identity and its relationship to you and your community. Now you will use your senses and your knowledge to add to and share your ideas about the ocean's identity.



1. Imagine you were creating a museum exhibit to show people about the ocean and their connections with it. Use your *Personal Identity Map* and your *Ocean Identity Map* to help you think. By yourself, consider:
  - a. What would you include? Are there certain objects or physical items that might help people realize their connection to the ocean?
  - b. Are there certain parts of the ocean's identity that would be important to include?
2. Close your eyes and consider ways the ocean relates to your senses. How does it sound, feel, smell, taste, and look? You may have been to the ocean and be using your personal experience, or you may be using ideas you have gathered about the ocean from art, videos, games, music, or other sources. Either is fine.

 **Emotional Safety Tip**

Some members of your team may not want to or be able to use all of their senses. This is not a problem. There are many ways to think about the ocean.

3. If you were creating a museum exhibit, how would you help visitors understand through their senses the experience of being at the ocean? For example:
  - a. Sound: How does the ocean sound? Is there a way you could create the experience of the sounds of the ocean, such as a playlist of sounds?
  - b. Feel: How do different parts of the ocean feel? Could you create an opportunity for someone to explore different ocean-related textures, like sand or seashells?
  - c. Smell: What are the smells of the ocean? Do different parts of the ocean have different smells? How could you create that experience or describe it to someone else?
  - d. Taste: What are the tastes of the ocean? Could you use words, pictures, or drawings to represent these tastes?
  - e. Sight: What are the different sights or colors of the ocean? Think carefully about what the ocean might look like in different parts. How could you share that?



4. Read *At the Smithsonian* to learn more about museum exhibit design at the Smithsonian.



### ***At the Smithsonian***

Sant Ocean Hall is a large permanent exhibit at the Smithsonian’s National Museum of Natural History. Why is it important to have a museum exhibit about the ocean? Ocean Hall exhibit developer Jill Johnson explains, “The ocean covers the majority of our planet, so it is the largest environment we have on Earth. There are a lot of human connections we have with the ocean. These connections can be very positive but can also be harmful. The health of the ocean is in danger.”

Museum exhibits help communicate ideas. Jill says, “Sant Ocean Hall is a place where we can share information about the ocean itself, how important it is to our planet, and to our existence. We think the more people learn about the ocean, the more they are going to care about it. We want to give them the resources to be part of the changes that are needed.”

Designing a museum exhibit takes careful thought. Developers learn about their audience and what they would like to know. Then they consider how to use objects to tell the story they want to share. Different people might find different things interesting, so exhibit designers try to create a variety of opportunities to have a personal connection to the exhibit.





Figure 1.4: Sant Ocean Hall at the Smithsonian National Museum of Natural History.

During this process, exhibit developers always keep in mind the big message. According to Jill, for Sant Ocean Hall that message is “The ocean is a global system essential to all life, including yours.”

Think to yourself:

- What is the big message you would want to share through your museum exhibit?
- What objects could you use to help tell that story?

Visit the *Ocean!* StoryMap for more information on designing Sant Ocean Hall.

- If you have time, work with your team to create your museum exhibit and share it with others in your community.
- If you do not have time, use a piece of paper to draw or plan out your museum exhibit and share that paper with a friend, family member, or another person or group.
- Ask the people you share your museum exhibit with, are there other connections they have to the ocean that are not part of the exhibit? If so, add those connections to the *Connections* circle on your *Ocean Identity Map*.
- Keep your *Ocean Identity Map* safe. You will continue to add to it throughout this guide.



## Task 2: What are ocean systems and why are they important?

The ocean is vast and complex. The ocean has many parts that affect one another. One of the best ways to understand the relationships between these parts of the ocean is to think about them as a **system**. A system is a group of individual items, living things, forces, or ideas that relate to one another. The parts of a systems often depend on one another and can be considered as an interconnected whole. The ocean is part of the systems of the Earth, and the ocean itself has many systems within it.

In this task you will first **discover** what you already know about systems and how they work. Then you will explore to **understand** different parts of the ocean system. Finally, you will **act** by deciding which parts of the ocean system are most important for you to understand so you can help protect the ocean in the future.



### **Discover:** *What is a system?*

You are probably familiar with different systems. Some systems describe physical interactions or relationships between things. For example, you may know about systems in your body, such as your digestive system, in which many different body parts digest the food you eat. Or you may have heard of a system where living things and non-living things all interact in an area, such as an **ecosystem**. You might even know about large systems that span the entire planet, such as the water cycle. Systems have different parts that relate to and depend on one another.

In this activity you will think about how systems work. Understanding the idea of systems and their interactions will be very important to help you build your understanding about the ocean.

1. Read *Linking a System*.



## Linking a System

You will start thinking about systems using what you know about relationships between a few items that might be familiar to you.

- Take out a piece of paper and title it "Cooking Rice System Diagram." If you aren't familiar with how to cook rice, you can substitute pasta or potatoes for rice.



Figure 1.5: Picture of a system that might contain rice, water, salt, a pot, and heat.

- Write the words "rice," "water," "salt," "pot," and "heat" around a page. Figure 1.5 shows an example. Remember if you prefer, you can substitute "pasta" or "potatoes" for rice.
- Draw a box around each word. The boxed words represent **elements** or parts of a system. People, places, things, and ideas can all be elements in a system. The elements in the system you are considering are *rice*, *water*, *salt*, *pot*, and *heat*.
- Examine your five elements. Are there ways you think these elements could be linked to create a specific **result** or outcome connected to the process of cooking rice?
- For each link you noticed in the system, draw an arrow to show the **relationship** between the two elements. A relationship is how two or more elements in a system are connected to or affect one another. Sometimes there is only one relationship or arrow connected to an element. Sometimes there





are several. If the relationship goes both ways, you can draw two arrows, one pointing in each direction. The arrows in Figure 1.6 are just examples. The relationships you identify might be different.

- f. Write words to label each arrow to explain the connections around the process of cooking rice. For example maybe between rice and pot you might write “the rice goes in the pot.”

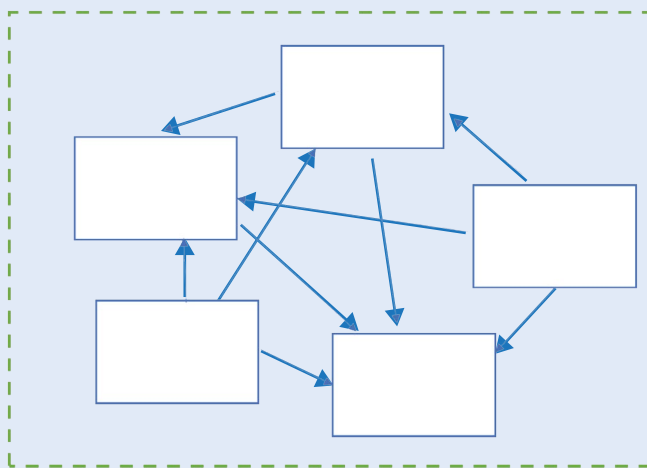


Figure 1.6: Example of a *Cooking Rice System Diagram*.

Congratulations! You just created a **system diagram**. A system diagram is a way of showing the elements and relationships in a system so you can understand how the system works. It can also help you understand what is happening when a system changes. In this guide you will be creating system diagrams about ocean systems. You will use these diagrams to learn more about problems or changes to these systems.

Do not worry if your system diagrams seem complicated or messy. Systems in the real world are often quite complex!

2. Turn to a partner and show them your system diagram.
3. Examine your two system diagrams together. Did you both show the same relationships between the elements? Don't worry if you listed different relationships; there can be multiple relationships between elements of a system.
4. Read *Bounding a System*.



## **Bounding a System**

Think about the system you just drew. Does it connect to other things around it? Of course! Each element of the system connects to other systems. For example, the water may have come from a tap that connects to a pipe that connects to a larger system of pipes. The system of cooking rice is also contained within other systems, such as the system of someone cooking dinner in a kitchen.

If you added all the possible elements and relationships together at once, the system becomes very complex. This can make it difficult to understand and identify problems. That is why people often use boundaries when thinking about systems. A **boundary** is just a way of defining exactly what is part of the particular system you are thinking about. This can help you identify problems within the system.

- a. Draw a dashed rectangle or circle that surrounds your system diagram. This dashed shape represents the boundary of your system. The dashed line in Figure 1.6 shows an example of a system boundary.

### **Problem-Solving Using Boundaries**

Now you will put the power of system boundaries into action to help solve a problem. Imagine if your cooked rice (or pasta or potato) is too hard. What could have gone wrong?

- b. Examine your system diagram. For each relationship, think about whether a problem in that relationship could have led to the result of hard rice. For example, could hard rice be the result of a problem between the rice and the water? The pot and the heat? Two other elements?
- c. Identify and circle each arrow that shows a relationship that might be a problem.
- d. Share your answers with a partner. Did they notice any potential problems with relationships that you didn't?
- e. If you are trying to solve a problem, why might it be useful to use a system with a set boundary?



5. With your partner or team, discuss what would happen if you drew a bigger boundary around your system.
  - a. What things might be included within that bigger boundary?
  - b. Imagine you were trying you were trying to solve the problem of hard rice and you realized there was no water. Would you need to draw a bigger boundary to understand the problem of no water to cook rice with?
6. Read *System Removals and Additions*.

### *System Removals and Additions*

Most systems are open, meaning that elements can enter or exit the system. Those entries and exits can change the system.

#### **Removals**

In this guide we will call elements that are removed from or leave the system **removals**.

- a. Examine your *Cooking Rice System Diagram* and imagine you removed one of the elements. What would change about the system if that element was not there?
- b. One at a time, think about the removal each of the other four elements. How would the system change?
- c. Discuss with a partner:
  - Which elements would completely change the system if they were missing?
  - Are there some elements that would change the system less?

#### **Additions**

Elements that are added to or enter a system are called **additions**.

- a. Examine your *Cooking Rice System Diagram* and think of one additional element that could be added to that system. For example, could something else be added to the pot?
- b. Think to yourself, what would change about the system with the new addition?



c. Discuss with a partner:

- What are some new additions you can think of for this system?
- Additions can be an entirely new element or they can be more of an existing element. For example, if the addition was twice the amount of water, how do you think that might change the system?

System additions and removals can be added to system diagrams. Figure 1.7 shows an example of how to diagram additions and removals. Add one of the additions and one of the removals you just considered to your *Cooking Rice System Diagram*.

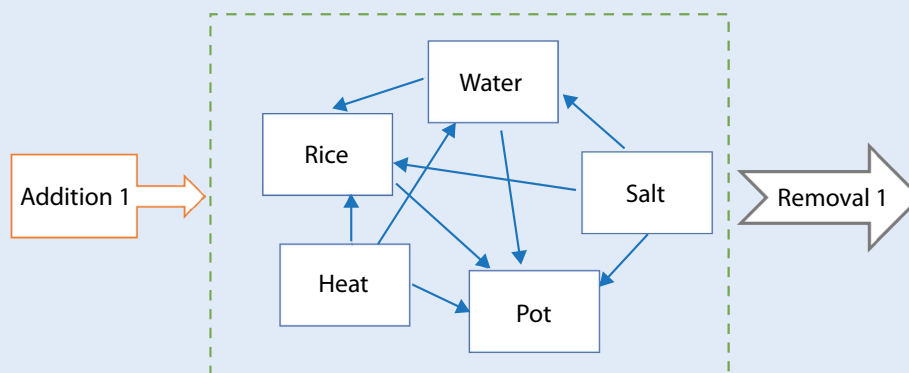


Figure 1.7: Example of a system diagram showing additions and removals.

7. Remember how to make a system diagram. You will have a chance to make and use more diagrams about ocean systems in the next activity and as you continue through this guide.



### **Understand:** What systems are part of the ocean?

The ocean system is complex and always changing. It has many systems within it and is part of many systems of our planet. There are some ocean systems that are **localized**, or only found in a specific place in the ocean, and there are some systems that span the whole ocean. In this activity you will analyze different types of ocean systems.

1. Have each team member take out a piece of paper.
2. Fold your paper into thirds.



3. Examine Figure 1.8, the close-up picture of a **rock pool**, a small area next to the ocean. A rock pool can also be called a tide pool. Some of the time a rock pool is underwater. However, when the tide goes out, the water and the organisms in the rock pool are separated from the ocean.
4. In the first third of your paper create a rock pool system diagram. You can use Figure 1.6 to help you remember how to draw a system diagram.
  - a. First, add the elements. Pick up to five elements you notice in the rock pool system. Keep in mind that some elements can be easy to forget, like water, rocks, air, or sunlight. Draw a box around each element.
  - b. Second, add arrows to show the relationships. How do the elements connect to or affect one another? Label each arrow to show the relationship. Do not worry if you don't know all the relationships, just do your best.
  - c. Third, add the boundary. What is the boundary of the system you are examining. Add and label a dashed line to show the boundary.



Figure 1.8: Close-up of a rock pool by the ocean's edge.

5. Examine Figure 1.9, the close-up picture of a **coral reef**, an ecosystem that includes individual corals, fish, and many other species all living together in the same area.
6. In the next third of your paper, create a coral reef system diagram. Just as with your rock pool system diagram, add the elements, the relationships, and the boundary. Remember people can be part of systems. You can use the directions in step 4 or Figure 1.6 to help you.







Figure 1.9: Coral reef ecosystem.

7. Examine the **coast** of an ocean shown in Figure 1.10.
8. Use the final third of your paper to create a coast system diagram. Just as before, add your elements, relationships, and boundary.



Figure 1.10: A coast where the ocean and land meet.

10. Examine the three system diagrams you created and discuss with a partner:
  - a. Are there any elements that are part of more than one system?
  - b. Can you think of any connections between the elements of the different systems?
  - c. Are there other boundaries you could use that would pull together elements from more than one system?
  - d. When thinking about a system, are there some relationships that might be easy to miss, depending on where you place your boundary?





11. Read *At the Smithsonian* to learn more about how Smithsonian scientists are **collaborating** or working together to explore ocean systems around the world. Why do you think it might be useful to compare data collected about ocean systems with different system boundaries?



### *At the Smithsonian*

Smithsonian scientists know that understanding ocean systems takes a lot of collaboration. That is one reason for the Smithsonian's Marine Global Earth Observatory (MarineGEO) Network. Through this network, partners at research stations around the world's coastlines work together using the same methods to collect the same types of data about important coastal marine life and ecosystems, such as seagrasses, coral reefs, and oyster reefs. They focus on these coastal places because most marine species and most people live near the coasts. Coastal ecosystems are important to the health and survival of both humans and marine life. MarineGEO partners share and analyze their data to track changes to coastal marine ecosystems and the benefits they provide to people.



*Figure 1.11: A MarineGEO researcher observes a coral reef.*



Monitoring coastal life and ecosystems helps MarineGEO researchers discover the ways the ocean is changing. MarineGEO researchers also work together to understand the reasons for those changes. For example, MarineGEO recently teamed up with researchers from other Smithsonian museums and institutes, and colleagues from across North and South America, to investigate how warming sea temperatures and the declining numbers of fish in the ocean affect other marine organisms. They are conducting an experiment at sites from near the Arctic in the north all the way to the tip of South America. The team concluded that at higher temperatures, taking fish away has a bigger impact on the sea-bottom ecosystems.

Bringing data together from places all around the ocean helps researchers understand the whole system of the ocean and how and why it is changing, in ways that no one could do alone.



**Act:** *What can we do to encourage a positive future for the ocean?*

People have an important relationship to the ocean and its systems. People affect the ocean and the ocean affects people. This relationship can be considered from many different **perspectives**, or ways of thinking about the world around us. In this activity, you will think about what might make a **sustainable** relationship between people and the ocean. Sustainable means an approach that balances different perspectives and can keep working for a long time.

1. Choose a three-dimensional object around you, such as a chair or table.
2. Have different team members examine the object from different angles and share with the team exactly what they notice. For example, maybe one person examines the object from below, one from the side, and one from the top.
3. Have different team members touch different parts of the object and describe to the team what they feel. For example, maybe one touches a metal table leg and another touches the edge of the table and another the tabletop.



4. Discuss with your team:
  - a. What different information did the different team members share about the object?
  - b. What would you be missing if you only used one perspective?
  - c. How does this activity show why thinking about different perspectives is important?
5. Read *Different Perspectives*.

### *Different Perspectives*

Just as there can be different perspectives that come together to understand an object, it is also important to consider different perspectives to understand a situation.

For a situation to be sustainable, it needs to be balanced. This means it cannot just satisfy one person or group; it needs to balance the needs of people, other living things, and our planet. When thinking about sustainability, it is important to consider at least four types of perspectives: social, economic, environmental, and ethical.

- **Social** is about the interaction of people in a community. The health, education, cultural and community ties, and well-being of people are the most important things from this perspective.
- **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 from this perspective.
- **Environmental** is about the natural world. Protecting living things, natural systems, and Earth itself are the most important things from this perspective.
- **Ethical** means that something is fair. Doing what is right and having a just community where everyone and everything is treated fairly are the most important things from this perspective.

6. With your team, take out a piece of paper and divide it into four sections. Label these sections "Social," "Economic," "Environmental," and "Ethical."



7. Examine your *Ocean Identity Map* carefully. What **themes** or main ideas do you notice about important parts of or connections with the ocean from each perspective? For example, maybe you notice that many people use the ocean as a source of peace or a place to have fun. That theme would be part of a social perspective.
8. Write the themes you notice in the section of the perspective they represent.
9. Take out your *Ocean Identity Map* and add two more circles. Label them “Concerns” and “Hopes.” Figure 1.12 shows an example.

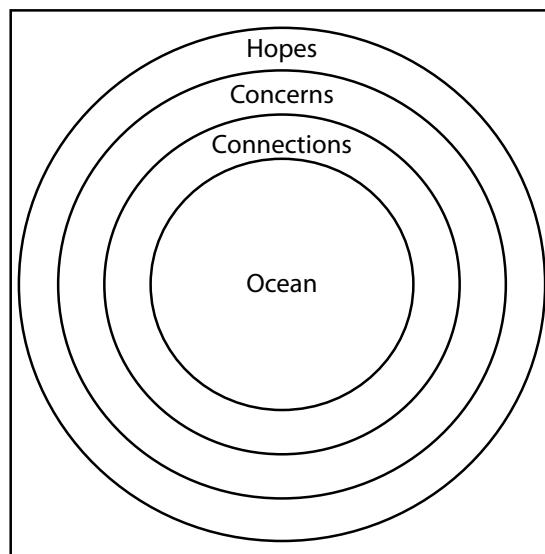


Figure 1.12: Example of an *Ocean Identity Map* with all four circles added.

10. Examine the themes you have written for each perspective.
  - a. Are there concerns you notice from each perspective? If so, write those down in the *Concerns* circle.
  - b. What would be your hopes for the future of the ocean from each perspective? What would a perfect future for the ocean be from each perspective? Write your ideas in the *Hopes* circle.
11. If there are other hopes or concerns you have about the ocean, add those to the *Hopes* and *Concerns* circles now.
12. With your team, use the hopes and concerns you just listed to think about important goals for a sustainable future for the ocean. These goals might be based on your hopes for something to continue, like “people can continue to rely on the ocean as an important source of food,” or they might be based on changes you would like to see, like “plastic pollution of the ocean is stopped.” These are your *Ocean Goals*.



13. List these *Ocean Goals* in the space outside the *Hopes* circle of your *Ocean Identity Map*.
14. Read *The United Nations and the Sustainable Development Goals*.

### *The United Nations and the Sustainable Development Goals*

Achieving a sustainable future like the one you just thought about is complex. It takes many people working together in many places to create a sustainable future. 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.

As the year 2015 approached, the UN asked countries and people around the world to imagine a better world and a better future. 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 SDGs are the global goals designed by people across the world to last from 2015 and 2030.



Figure 1.13: United Nations Sustainable Development Goals.



15. Examine the different SDGs. Are there SDGs you think are important for a sustainable future for the ocean and for people that your team didn't list in your *Ocean Goals*? Do you think those goals are also important? If so, add these goals to your *Ocean Goals* listed on your *Ocean Identity Map*.
16. Read *Picking a Path*.

### *Picking a Path*

To work toward your *Ocean Goals*, what is it most important to learn about? You have almost completed Part 1 and you will want to complete Part 7 at the end. Parts 2 through 6 of this guide can help you explore sustainability and different ocean systems. Parts 2 through 6 are about:

Part 2: Ocean and Water: Exploring the movement of the water system on Earth and in the ocean and how that relates to ocean pollution.

Part 3: Ocean and Air: Exploring the chemistry of ocean systems involved in the changing acidity of the ocean and how that affects living things in the ocean.

Part 4: Ocean and Heat: Exploring how the ocean system absorbs and redistributes heat on Earth and what a warming ocean means for people and ocean systems.

Part 5: Ocean and Food: Exploring the system of ocean food webs and how to make human activities harvesting and fishing sustainable.

Part 6: Ocean and Coasts: Exploring the meeting of human and ocean systems along the ocean's coasts and how to balance the needs of both people and the ocean.

Part 7 will help you bring together what you have learned so you can plan and implement actions to protect ocean systems.

17. Find out from your teacher or other leader how many parts you have time to do.
18. If you do not have time for all the parts, discuss with your team and pick the parts that are most closely related to your *Hopes, Concerns, and Goals* for the ocean.
19. Work with your team and choose which parts you will do next.





# Congratulations!

## You have finished Part 1.

***Find out More!***

For additional resources and activities, please visit the *Ocean!* StoryMap at <https://bit.ly/OCEAN2030>.



## 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 researcher:** A person who works with their community to discover, understand, and act on local and global problems they learn about

**Additions:** Things that are added to or enter a system

**Anonymous:** People do not list their name

**Boundary:** The edge or border of a system

**Coast:** The area where the ocean and the land meet

**Collaborating:** Working together

**Community:** A group of people who share something in common, such as a space or an identity

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

**Coral reef:** An ecosystem that includes individual corals, fish, and many other species all living together in the same area

**Economic:** About money, income, and the use of wealth

**Ecosystem:** A system where living things and non-living things all interact in an area



**Element:** A part of a larger system

**Environmental:** About the natural world

**Ethical:** Something that is fair

**Identity:** The characteristics that make you you

**Indigenous:** A group of people who lived in an area before any other groups arrived; Indigenous peoples are sometimes referred to as First People or First Nations, Aboriginal, or Native Peoples

**Localized:** Only found in a specific place

**Object:** A physical item

**Ocean:** The large body of saltwater that covers 71% of Earth's surface

**Ocean basins:** Different areas of the ocean

**Oral history:** Recording information from people who are talking about their past

**Perspectives:** The different ways we think about the world around us

**Relationship:** How two or more elements in a system are connected to or affect one another

**Removals:** Things that leave or are removed from a system



**Result:** The outcome

**Rock pool:** A small area that is underwater part of the time on the edge of the ocean; also known as a tide pool

**Social:** Relating to the interaction of people in a community

**Sustainable:** An approach that balances different perspectives and can keep working for a long time

**Sustainable Development Goals (SDGs):** Seventeen goals for a better world created by the countries of the United Nations

**System:** A group of natural things or forces that interact with one another as part of a common network

**System diagram:** A way of showing the elements and relationships in a system so you can understand how the system works

**Themes:** Main ideas

