

RESOURCE LIBRARY

ACTIVITY : 1 HR 40 MINS

Seaworthy Solutions

As a class, students learn about one proposed solution to the ocean plastics crisis. Jigsaw groups explore four additional solutions, analyzing the strengths and weaknesses of each. Next, publishing teams compare the solutions and develop a rubric to evaluate different solutions and select a winner for their unit project.

GRADES

6 - 8

SUBJECTS

Chemistry, Conservation, Earth Science, Oceanography, Engineering, Geography, Human Geography, Social Studies, Civics, Economics

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4 PDFs

OVERVIEW

As a class, students learn about one proposed solution to the ocean plastics crisis. Jigsaw groups explore four additional solutions, analyzing the strengths and weaknesses of each. Next, publishing teams compare the solutions and develop a rubric to evaluate different solutions and select a winner for their unit project.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/seaworthy-solutions/>

In collaboration with

DIRECTIONS

Plastics: From Pollution to Solutions unit driving question: *How can humans solve our plastic problem in the ocean?*

Pollution Solutions lesson driving question: *Which solutions to the plastic problem are the most promising?*

1. Reassure students that there is hope for solving the ocean plastics crisis.

- Ask: *Now that we are halfway through our unit on ocean plastics, how do you feel about the plastics problem?*

- Possible responses:

- Scared, because it seems very dangerous and it's getting worse.
- Hopeless, because plastic is ubiquitous and it lasts a very long time in the environment.
- Angry, because humans are hurting animals and the ecosystem.
- I don't care, because I don't believe this problem affects me.
- Energized, because I want to do something to address this problem.

- Point out that plastics are a problem created by humans, and humans have the ability to solve this problem. Tell students that humans have faced big challenges before, and by working together, we can create solutions.

- Ask: *What other big problems have humans solved, and how?*

- Possible responses:

- We have developed vaccines to eradicate diseases such as polio and smallpox.
- We found out that chlorofluorocarbons (CFCs) were causing a hole in the ozone layer, so we banned CFCs and the hole is getting smaller.
- We learned that DDT was killing birds, so we banned DDT and bald eagle populations have rebounded.
- We have expanded civil rights for women and people of color in many countries around the world.

- Tell students that it's normal and natural to feel negative emotions like sadness, hopelessness, and anger when you first learn about global problems like these. However, to reach a solution, people must move from negativity to positivity by realizing that hope is possible and solutions do exist.
- Ask: *Does anyone know of a way that people are working to solve the plastic crisis?*
 - Possible responses may include beach cleanups, bans on plastic straws and bags.
- Explain that many scientists, designers, activists, and communities around the world are working on different solutions, and that the next part of the unit will focus on the many different types of solutions, with the goal of inspiring students and helping them feel hopeful and empowered to be a part of the global solution to this global problem.

2. Model the process of evaluating a proposed solution.

- Distribute the [Seaworthy Solutions](#) handout to each student.
- Project the [Take 3 for the Sea](#) website and guide students through the process of filling out the first row of the table with a think-aloud. Use the [Seaworthy Solutions Answer Key](#) to narrate your think-aloud.
 - Navigate through the website, especially the *About* and *Programs* pages, to find answers to the questions.
 - Explain that students will use the same process for the next four rows of the table, and they must read carefully and strategically because questions may not be directly answered.

3. Assign students to jigsaw groups to investigate other solutions.

- Divide students into jigsaw groups and assign each group one of the four solutions listed in the table in the *Seaworthy Solutions* handout. Remind jigsaw groups that their job is to become an expert on their topic so they can share the information with their publishing team.
- Distribute computers to jigsaw groups and prompt each group to access the video introduction to their assigned solution.
- After each group watches their initial video, have them research their solutions independently to learn more, paying careful attention to the possible disadvantages as you demonstrated in the think-aloud.
 - [Compostable Plastics](#) (4:54)

- *Bye Bye Plastic Bags* (8:11)
 - *Net-Works* (5:18)
 - *The Ocean Cleanup* (5:37)
- Circulate around the room to ensure jigsaw groups are finding answers to their questions; the table in the *Seaworthy Solutions* handout should be a good indicator of their progress.
 - Using bullet points in the tables is fine, as long as the meaning of each answer is still intelligible to another student who knows nothing about that solution.
 - If some jigsaw groups finish early, prompt them to research other solutions to the plastics crisis.

4. Reassemble publishing teams to share and compare information.

- Have students return to their publishing teams and take turns presenting information about the solution they investigated with their jigsaw group.
- Discuss the following questions in a whole-class debrief:
 - *What similarities do you see among these solutions?*
 - Compostable plastics and Net-Works create a marketable product; they can make money for people.
 - Bye Bye Plastic Bags and Net-Works involve the local community in being part of the solution.
 - Compostable plastics and the Ocean Cleanup are both new technologies that are promising, but still in the early phases of development with hurdles to overcome.
 - Net-Works and the Ocean Cleanup focus on recovering mismanaged plastic waste from the environment.
 - Bye Bye Plastic Bags and compostable plastics focus on source reduction, decreasing the overall amount of plastic waste.
 - *What differences do you see among these solutions?*
 - Bye Bye Plastic Bags is the only solution (out of these four) that encourages people to use less plastic.
 - Net-Works™ is the only solution (out of these four) that directly targets fishing nets, which make up almost 50 percent of ocean macroplastics, according to some studies.
 - The Ocean Cleanup is the only solution (out of these four) that directly targets microplastics.

- *Do you think any one of these solutions can solve the plastics crisis on their own?*
 - Answers will vary, but should indicate that the problem is very big and requires a lot of different kinds of solutions, each of which have disadvantages and possible unintended consequences.

5. Launch the Ocean Plastics Pollution Solutions Contest.

- Tell students that one element of their magazines will be to announce their chosen winner of the Ocean Plastics Pollution Solutions Contest. They must compare five different solutions, separate from the five included in this activity, and decide which one is the most promising. Emphasize that no solution is perfect, but some can still be better than others.
- Ask: *What might make one solution better than another?*
 - Possible responses:
 - A solution could be better if it includes a larger geographic area or a greater number of people.
 - A solution could be better if it creates jobs for more people.
 - A solution could be better if it stops plastics from being made, used, or thrown away in the first place, rather than simply cleaning them up from the ocean.
- Distribute the handout *Ocean Plastics Pollution Solutions Contest Criteria*.
- Tell publishing teams they will use this document to create their own contest rubric, with three different criteria and clear descriptions to measure the success of each solution.
 - Each team's criteria and descriptions will be different, but every team should be able to use their document as a rubric to evaluate the five finalist solutions they choose.
- Have teams discuss which three criteria they think are most important first, before writing descriptions for any. This part of the assignment is very open-ended, and different teams will likely come up with very different rubrics.
 - To guide teams in brainstorming good criteria for their rubrics, use the class' responses about what might make one solution better than another.
 - If students thought addressing a larger geographic area or involving a greater number of people could make one solution better than another, a criterion corresponding to this could be "Area of Impact" or "Total Population Affected."

- If students thought creating jobs for people could make one solution better than another, a criterion corresponding to this could be “Economic Benefits.”
- If students thought reducing the amount of plastics produced or disposed of could make one solution better than another that only targets plastics after they have already been produced and thrown away, a criterion corresponding to this could be “Waste Source Reduction.”
- After a team has selected three reasonable criteria for evaluation, guide them to use the *Final Project Checklist and Rubric* to help create descriptions of what would demonstrate high impact, moderate impact, and low impact in each criterion.
- Conclude by having teams test out their rubrics on one of the five solutions they learned about in this activity. Remind teams that they will have to find five other solutions in the next activity as contest entrants, so this is just a trial of their rubric to ensure that the team knows how to use it.
- All handouts from this activity should be stored in the publishing team’s project folder for use in upcoming activities.

Tip

Step 3: It may be useful to provide headphones to students when they are working in jigsaw groups so that they can listen to the video without disrupting other groups.

Informal Assessment

Students’ analysis of the five different solutions, especially the advantages and disadvantages of each, should draw on what they have learned about the sources of the plastic pollution problem and provide insights into their current understanding and ideas about evaluating competing design solutions. The ability of teams to agree on three meaningful criteria for their rubric demonstrates their higher-level thinking and collaborative group work skills.

OBJECTIVES

Subjects & Disciplines

- Chemistry
- Conservation
- Earth Science**
 - Oceanography

- Engineering
- **Geography**
 - Human Geography
- **Social Studies**
 - Civics
 - Economics

Learning Objectives

Students will:

- Investigate solutions to the ocean plastic waste crisis.

Teaching Approach

- Project-based learning

Teaching Methods

- Jigsaw
- Modeling
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Learning and Innovation Skills
 - Communication and Collaboration
 - Critical Thinking and Problem Solving
- 21st Century Themes
 - Environmental Literacy
 - Global Awareness
- Critical Thinking Skills

- Analyzing
- Applying
- Evaluating
- Science and Engineering Practices
 - Asking questions (for science) and defining problems (for engineering)
 - Engaging in argument from evidence
 - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

- **Standard 14:**

How human actions modify the physical environment

NEXT GENERATION SCIENCE STANDARDS

- **ETS1.B: Developing Possible Solutions:**

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

- **Science and Engineering Practice 7:**

Engaging in argument from evidence

Preparation

What You'll Need

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per pair

PHYSICAL SPACE

- Classroom

GROUPING

- Jigsaw grouping

- Large-group instruction
- Small-group learning
- Small-group work

BACKGROUND & VOCABULARY

Background Information

Many solutions are taking aim at the plastics crisis, but none of them are a silver bullet. All sectors of society must collaborate to solve a problem that involves every aspect of modern life and touches every corner of our planet. Solutions may come from consumers, activists, engineers, artists, governments, corporations, educational institutions, and even nature itself.

Plastic bag bans, anti-straw campaigns, compostable plastics, and reusable water bottles are gaining momentum globally. However, they are not without opponents, whether selfish or sincere. Some consumers prefer the convenience of disposable goods, and the plastics industry is large, profitable, and influential. On the other hand, people with disabilities may depend on plastic straws to be able to drink. Small businesses fear they may lose revenue if they charge customers for plastic bags. Some studies suggest that reusable coffee mugs may have a greater environmental impact than single-use cups, depending on how many times the mug is actually reused. Indeed, reusable products still require mining or harvesting raw materials and must be cleaned, both of which impact the environment.

As history demonstrates, all actions have consequences, many of them unintended. Remember that plastics were invented to halt the harvest of ivory from endangered elephants. Solutions that seem ingenious can become problematic when scaled up. For example, many so-called compostable plastics require an industrial composting facility to biodegrade, and will not break down in a landfill, a backyard compost pile, or the ocean. Highly publicized engineering feats such as the Ocean Cleanup have encountered technical difficulties, such as breaking apart in the middle of the Pacific Ocean and impacting marine food webs. Meanwhile, feel-good stories about the end of plastic straws seldom mention that straws comprise only about 1 percent of marine plastics. Hope and optimism must be balanced with a critical lens toward proposed solutions.

Prior Knowledge

Recommended Prior Activities

- [Autopsy of an Albatross](#)
- [Follow the Friendly Floatees](#)
- [Magazine Design Workshop I](#)
- [Magazine Design Workshop II](#)
- [Plastics Aplenty](#)
- [The Life Cycle of Plastics](#)

Vocabulary

Term	Part of Speech	Definition
compostable	adjective	capable of disintegrating and biodegrading in a compost pile or commercial composting facility.
constraint	noun	limitation or obstacle.
criteria	plural noun	set of standards or rules.
economic	adjective	having to do with money.
systematic	adjective	following an orderly method or plan.

For Further Exploration

Articles & Profiles

- [National Geographic: How Do Plastic Straw Bans Work?](#)
- [National Geographic: Plastic Bag Bans Are Spreading. But Are They Truly Effective?](#)
- [National Geographic: What You Need to Know About Plant-Based Plastic](#)
- [National Geographic: Biodegradable Bags Buried for Three Years Still Work](#)

