

CLASSROOM ACTIVITY

Reducing the Pacific Garbage Patch

Key Learning Topics

- Biodegradable
- Ocean Pollution

Overview

Off the coast of California is the Great Pacific Garbage Patch. It is full of plastic and is about three times the size of France. Students will investigate the impact different types of plastics have on our ecosystem. They will choose one source of plastic in their lives and design a new version using biodegradable materials. Students will then present their idea and explain how their design allows us to dispose of consumable materials more sustainably.

Target Audience

Grades 5–9

Engineering, Biology, Chemistry

Activity Duration

45–60 minutes class period(s)

Essential Questions

Why is it essential to remove floating plastic in the ocean?

How can we reduce our dependency on plastics?

What are the possible solutions to the problem of plastics breaking down in our oceans?

Materials (samples of each)

- Reducing the Pacific Garbage Patch, one per student
- Gallery Walk Feedback Form, one per display
- Display Information, one per display
- Large leaves
- Cotton
- Bark or wood pieces
- Natural paper
- Cork

- Bamboo
- Other biodegradable samples, if available
- Construction paper
- Scissors
- Glue or tape

Background Information

The Great Pacific Garbage Patch covers 1.6 million square kilometers, which is an area twice the size of Texas and three times the size of France. It weighs approximately 80,000 metric tons¹. Researchers estimated that the .6 to 1.2 metric tons of plastic entering the ocean each year from rivers is less dense than the water². The density difference means the less dense plastic will float when it enters the sea. But why is it essential to deal with floating plastic in the ocean? In a landfill, plastic bottles can take up to 450 years to break down³. In the sea the plastic is exposed to UV rays and can break down into microplastics in as little as a year⁴. This process called photodegradation breaks the bonds in the long molecular chains of the plastic releasing toxic bits such as bisphenol A(BPA) and PS oligomer⁵. Also, the bottles made of PET (polyethylene terephthalate) may break down to harmful toxins. However, the research is not conclusive on that yet⁶. These toxic chemicals then enter our food chain when fish eat them, or the toxic chemicals approach the shorelines, and we come into direct contact with them.

Procedure

Introduction— 10 min

- Introduce students to the Great Pacific Garbage Patch using the video <https://www.sea.edu/plastics/gallery>. The video features educators and students that studied the effects of plastic marine debris in the Pacific Ocean. As they watch, ask students to identify what the problem is and what humans are doing to solve it. Who is being helped?
- Now ask students to compare the larger plastics to microplastics. <https://oceanservice.noaa.gov/facts/microplastics.html> After viewing the video, ask students to consider the impact the different types of

¹ Laurent C. M. Lebreton, et al., "Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic," Scientific Reports 8, no. 4666 (March 2018), on the Internet <https://www.nature.com/articles/s41598-018-22939-w> (August 21, 2019)

² Qiqing Chen, et al., "Pollutants in Plastics within the North Pacific Subtropical Gyre," Environmental Science and Technology 52, no. 2 (November 2017): 446-456, on the Internet <https://pubs.acs.org/doi/10.1021/acs.est.7b04682> (August 21, 2019)

³ Postconsumers, How Long Does It Take a Plastic Bottle to Biodegrade?, On the internet <https://www.postconsumers.com/2011/10/31/how-long-does-it-take-a-plastic-bottle-to-biodegrade/> (August 21, 2019)

⁴ ACS Chemistry for Life, Plastics in oceans decompose, release hazardous chemicals, surprising new study says (August 2009), on the internet <https://www.acs.org/content/acs/en/pressroom/newsreleases/2009/august/plastics-in-oceans-decompose-release-hazardous-chemicals-surprising-new-study-says.html> (August 21, 2019)

⁵ How stuff works, How long does it take for plastics to biodegrade?, on the internet <https://science.howstuffworks.com/science-vs-myth/everyday-myths/how-long-does-it-take-for-plastics-to-biodegrade.htm> (August 21, 2019)

⁶ ABC science, PET bottles potential health hazard, Emily Sohn (April 2009), On the internet <https://www.abc.net.au/science/articles/2009/04/29/2555698.htm> (August 21, 2019)

plastics have on our ecosystem. Anticipated answers include students identifying that larger plastic could trap animals, cover the surface of the ocean, be eaten by different aquatic organisms, and pollute the water.

- Pass out the Reducing the Pacific Garbage Patch Student Activity Sheet. Provide the following prompts for students to discuss with a partner.
 - What items do you use during the day that are made of plastic?
 - Have you seen or used any containers that are not made of plastic?

Classroom Activity—20 min

- Divide the students into groups of 3–4 students.
- Explain to students that they will select an item that they currently use that comes in a disposable plastic container. This may include things like plastic bags or plastic packaging. They will then create an alternative packaging solution that uses a more biodegradable resource. This action could reduce the amount of plastic that ends up in our oceans.
- Review the activity procedure with the students and ask if there are any clarifying questions before they begin.
- Move about the room and monitor the student activity as they are working.

Evaluation—10 min

- Instruct students to place one Gallery Walk Feedback Form in front of each project. The feedback sheet should remain at the display area.
- Explain the three levels of comments on the sheet (red, yellow, and green). Clarify with students that they must fill in all three levels of comments for each project they visit.
- Invite students to walk around and visit at least three other projects. They should read the description at each station and view the model before making comments on the Gallery Walk Feedback sheet.

Lesson Summary—5 min

- Have students read the feedback and respond in a prompt stating if they agreed or disagreed with the critique. They should explain specific feedback points and if and how they would incorporate them.

Reducing the Pacific Garbage Patch

Prompts:

What items do you use during the day that are made of plastic?

Have you seen or used any containers that are not made of plastic?

Materials**Activity procedure:**

1. Look back at some of the items you use and select an item that comes in a plastic disposable container. This could include makeup, packaging around electronics, or food containers from a restaurant.
2. Discuss with your group and come to a consensus on which product you will redesign.
3. Brainstorm with your group to list three possible alternative biodegradable containers for the product using the sample materials as inspiration. Then, narrow your final solution down to one by creating a sketch.
4. Construct a model of the product container using construction paper, scissors, and glue/tape. This design does not have to be able to work, or use the inspiration materials, but should mimic the shape and behavior or your new packaging design.
5. Write a descriptive paragraph that goes with your design stating the actual materials that an engineer can use in creating your container. You should also suggest what will be in the container, and what you believe is the best way to dispose of the empty container.
6. Place your model and description at your desk or designated place in the classroom.

Description

What materials can an engineer use in creating your container? What is the intended use of the container?
What do you believe is the best way to dispose of the empty container?

FEEDBACK FOR:
PROJECT TITLE:

FEEDBACK BY	What is something that doesn't work or could be improved?	What is something that is confusing or could be done differently?	What is something that works well, or you really like about the project?

National Standards

Next Generation Science Standards

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Standards for Technological Literacy

CH4 S5 The effects of technology on the environment

CH7 S15 Agricultural and related biotechnologies.

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.L.4.3.C

Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion).

CCSS.ELA-LITERACY.L.(5,6,7,8,9).6

Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships