

Plastics Use Audit

Topic

Plastics

Grades

6-12

Site

Indoors, Outdoors

Duration

One hour plus

Materials

See page 3

Vocabulary

audit, plastic, recycling, waste

Next Generation Science Standards

Practices

Planning and carrying out investigations

Core Ideas

ESS3.C Human impacts on Earth systems

Crosscutting Concepts

Cause and Effect

Performance Expectations

See page 5



Focus Question

What types of plastics do we use the most? How can we reduce our use of single-use plastics?

Overview

How much plastic do we consume? In this activity, students design an investigation and conduct an audit of waste (trash and recycling) at home or in their schools to discover the types and quantities of plastics that are consumed. They use their findings to raise awareness about which items show up most frequently. Then they conduct a follow-up audit and provide information on whether increased awareness influenced people's behaviors with regard to plastic use.

Objectives

Students will be able to:

- Conduct an investigation to determine the types and quantities of plastic waste generated in the classroom, home and/or school-wide.
- Gather and make sense of information that plastics, which are made from natural resources, can have positive and negative effects on the environment.
- Design, evaluate and refine a solution for reducing the amount of plastic waste generated.

Background

Nearly all plastic ever produced, whether disposed of responsibly or not, still exists today (www.sustainablecommunications.org). In 2011 alone, Americans discarded approximately 32 million tons of plastic waste with only 8% of that recovered for recycling (Environmental Protection Agency). The remainder ends up in landfills or the environment, especially the ocean. Plastic pollution has become a global dilemma requiring resolution.

What is Plastic?

Plastic is an easily shaped substance, composed of polymers typically made from fossil fuels. Plastics can be malleable or rigid, flimsy or nearly indestructible. It is



VOCABULARY

Audit: an unbiased examination and evaluation of something like finances or, in this case, waste

Plastic: a readily-molded substance made from fossils fuels through chemical reactions

Recycling: processing an existing material or product into a different material or product, uses energy and additional raw materials

Waste: unwanted and discarded materials

also relatively economically inexpensive to produce. Due to this versatility, plastics are everywhere, used in electronic devices, tools and food packaging. While some uses of plastic are both practical and beneficial, an estimated 50% of plastics used daily are single-use disposable items. This is problematic as plastic is too valuable and long-lasting a material to be used once and discarded.

Plastic Problems

Producing plastics is energy intensive. According to the U.S. Energy Information Administration, in the U.S. production of plastics required an estimated 191 million barrels of liquid petroleum gases and natural gas liquids in 2010 (about 2.7% of total U.S. petroleum consumption) (<http://www.eia.gov/tools/faqs/faq.cfm?id=34&t=6>). Made from nonrenewable resources and chemicals, plastics are not biodegradable. They are photodegradable, breaking into smaller fragments when exposed to the sun's UV rays. Plastic objects or small plastic fragments can contaminate soil and water and are easily ingested by many organisms. This is particularly concerning in the ocean, where millions of tons of plastic debris is accumulating. The majority of this debris consists of small plastic particles resulting from the break down of larger plastic items over time by wind, wave and UV action.

These tiny plastic particles can pack a toxic punch. Most plastics are composed of many types of toxic chemicals, while persistent organic pollutants (POPs) found in ocean waters adsorb to certain plastics, increasing their toxicity. Due to their small size and abundance, these toxic plastic pieces are mixed with the plankton at the very base of the marine food web. Evidence is accumulating that these toxic chemicals work their way up the food chain, potentially affecting the top consumer in the ocean food web, humans. Removing this plastic debris is not practical, so preventing the continuous flow of plastic waste from land to sea is the way to resolve this problem.

Action

Fortunately, there are many ways to reduce plastic waste and help maintain healthy ocean animals and ecosystems. First, increase awareness of your own plastic waste by tracking the amount of disposable plastics you use. Then attempt to reduce disposable plastics whenever possible. You can also refuse to use plastic utensils and instead carry a personal set of reusable utensils when you go out to eat. You can also buy foods like crackers, pretzels and other snacks in bulk and store them in reusable containers, rather than purchasing smaller, individually wrapped portions. You can also use reusable containers to store classroom tools like paper clips, markers, pencils, pens, etc. Recycling plastic waste is important but requires additional energy and materials. Reducing the amount of plastic waste generated is the most effective way to reduce plastics in the waste stream. While plastic pollution, especially in the ocean, is a global threat, increasing awareness of this problem at individual and community levels is the first step in reducing its proliferation.

Materials

- Large tabletop or floor space
- Tarps
- Buckets for liquids
- Rubber gloves
- Bathroom or digital scale(s)
- Access to soap and water or disinfectant hand wipes
- Recycling/waste bin contents
- Copies of the **Plastics Audit Data sheet** and **Plastics Audit Analysis sheet** (pages 6-9)
- Graphing program or paper

Teacher Preparation

Gather the materials for each student group to conduct an audit on an ongoing basis. See materials first and read over procedure to determine amount of materials you will need. Make desired number of student sheets.

Procedure

1. INTRODUCE THE ISSUE OF PLASTIC POLLUTION AND FOCUS QUESTION TO STUDENTS.

Use the Gyre in a Bottle activity (on the Aquarium website) or show a movie like *Bag it!* (see **Resources**) to introduce the issue of plastic pollution and illustrate its scale. Ask students to respond to this focus question as a quick write in their notebooks: *What types of plastics do we use the most? How can we reduce our use of single-use plastics?*

2. AS A CLASS, DETERMINE A QUESTION OR PROBLEM TO INVESTIGATE WITH A PLASTICS AUDIT.

Discuss what an audit is (an unbiased observation using data) and what you want to investigate (e.g., How big is our plastics problem? How much plastic waste will we find in the cafeteria?) The class may want to reduce plastic school-wide, take a census of their household's plastics use or just assess how much plastic they use in various settings. Pass out the **Plastics Audit Analysis** student sheet. Have students write in the investigation question and a prediction for that question.

3. DESIGN THE INVESTIGATION AS A CLASS.

Depending on the class question, discuss the plastic audit procedure. How will you measure plastic consumption? Will you measure plastics found in trash bins and/or recycling bins? Will you compare plastics to other trash and/or recycling? Consider things like the duration of the audit, location of recycling/trash bins to examine (i.e., if you want to see how much plastic the school cafeteria uses, then include all bins where lunch waste may be discarded) and the number of people who use the bins. To start small, you may choose to begin with an audit of your classroom. Students will need to gather information on variables that can affect the data, such as regular collection time (when is waste collected in your locations?), special events happening, etc. Collecting data more than once will give you more accurate results. After gathering this information, have students decide when and where they will collect the recycling/trash. Have students use the **Plastics Audit Analysis** sheet to record the procedure and revise their initial prediction.

**THE MISSION OF THE
MONTEREY BAY
AQUARIUM
IS TO INSPIRE
CONSERVATION OF THE
OCEANS.**

4. CONDUCT THE AUDIT.

For the actual audit, see **Materials** for what to have on hand. Generally, for each bin, spread a tarp on a large floor or outdoor space. Small student groups (three to six is ideal) should choose roles. Roles may include sorters to differentiate plastics from nonplastics, researchers to look up unknown materials, measurers to count quantity of plastic items and assess weight or volume and data recorders. Pass out the **Plastics Audit Data Sheet** for ideas. Students should wear gloves and avoid sharp objects, biological hazards such as blood, or anything else that may cause injury. (Avoid bathroom waste bins and exercise caution if auditing kitchen waste bins.) Return all nonplastics to waste or recycling bins.

NOTE: Repeat the audit more than once to generate multiple samples (for methodological precision) and to collect an accurate representation of the type of waste being generated.

5. ANALYZE AUDIT DATA.

Ask each group to create a graph of their results to display. As a class discuss: *What is the total number of items and their weight/volume? What patterns did you notice? Were there any surprises? What more do you want to know? What other questions do you have? How much plastic is used each week? Each month? Per year?* You may want to compare the amount of plastic or other waste items discarded at your site to the national average or to other countries around the world. See the EPA's website for recent statistics: http://www.epa.gov/osw/nonhaz/municipal/pubs/MSWcharacterization_508_053113_fs.pdf



6. STUDENTS FORMULATE A CONCLUSION.

Students can write conclusions on the **Plastics Audit Analysis** sheet. They should include evidence to show whether their prediction is accurate or not. Have them go back and add to their original answer to the question: *What kinds of plastic do we use the most? How can we reduce our use of single-use plastics?*

7. PROPOSE AN AWARENESS CAMPAIGN OR MESSAGE ABOUT PLASTIC CONSUMPTION FOR YOUR SCHOOL, CLASSROOM OR STUDENT HOUSEHOLDS.

See the **Use Less Plastic: Inspiring Conservation Behavior** activity (on the Aquarium website) for more information about targeting specific plastic consumption behaviors. Share your audit data with the school and other classes. Come up with a few specific actions for people to take to reduce the amount of plastics used. For example, encourage students to come up with more creative solutions than a reusable water bottle and a bag. Have them think about things like individual packaging, straw use, disposable dinnerware.

8. CONDUCT A FOLLOW-UP AUDIT AND COMPARE RESULTS WITH INITIAL AUDIT.

Have students follow the same investigation procedure (collect, record and analyze data). Then have your students analyze the effectiveness of their awareness campaign or message by comparing the initial and follow-up audit. *How did the data change or stay the same? What was surprising? What seems to be the most effective strategy for using less plastic? How are you going to continue these actions after this class is over?*

9. RETURN TO THE FOCUS QUESTION.

Now that students have collected data about their plastic use and discussed their results, have them again revisit the question: *What kinds of plastic s do we use the most? How can we reduce our use of plastics?* Students may think on their own or discuss with a partner. Then in their science notebook, you may have them draw a line of learning and under it add to their original thoughts about the question.

Resources

Websites

Environmental Protection Agency (EPA) www.epa.gov/osw/

Learn about different kinds of waste and how you can take action to reduce waste.

Monterey Bay Aquarium www.montereybayaquarium.com

Find curriculum about conservation issues like plastic pollution and many other themes.

Plastic Oceans <http://www.plasticoceans.net/the-facts/what-a-waste/>

The Plastics Ocean Foundation is a nonprofit based in the United Kingdom dedicated to research, policy and fundraising regarding plastic pollution in the oceans.

5Gyres http://5gyres.org/what_is_the_issue/the_problem/

This organization's mission is to conduct research and communicate about the global impact of plastic pollution in the world's oceans and employ strategies to eliminate the accumulation of plastic pollution in the 5 subtropical gyres.

Videos

Bag it! Is Your Life Too Plastic?

<http://www.bagitmovie.com/>

Standards

Next Generation Science Standards www.nextgenscience.org

Performance Expectations

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

**PLASTICS: MADE TO
LAST FOREVER,
DESIGNED TO
THROW AWAY.**

5 GYRES

Plastics Audit Data Sheet

Name(s): _____

Location of waste bins (specify if recycling or trash):	
Description of location (e.g., classroom, cafeteria, close to high use areas? etc.):	
Frequency of collection (when are the bin contents collected?):	

Type of Plastic	Number		Weight	
Date & Day of Week:	My Data	Class Data	My Data	Class Data
Bottles				
Food packaging				
Non-food Packaging				
Other				
Total				
Date & Day of Week:				
Bottles				
Food packaging				
Non-food Packaging				
Other				
Total				
Date & Day of Week:				
Bottles				
Food packaging				
Non-food Packaging				
Other				
Total				
Average of all audit totals:				
<i>Average # bottles</i>				
<i>Average # food packaging</i>				
<i>Average # non-food packaging</i>				
<i>Average # other items</i>				

Plastics Audit Analysis

Name(s):

QUESTION/PROBLEM

What do you want to investigate about plastic use? Where? (home/school/community)



PREDICTION

What do you think you'll find?



PROCEDURE

How are you going to conduct your investigation? What evidence will you collect?



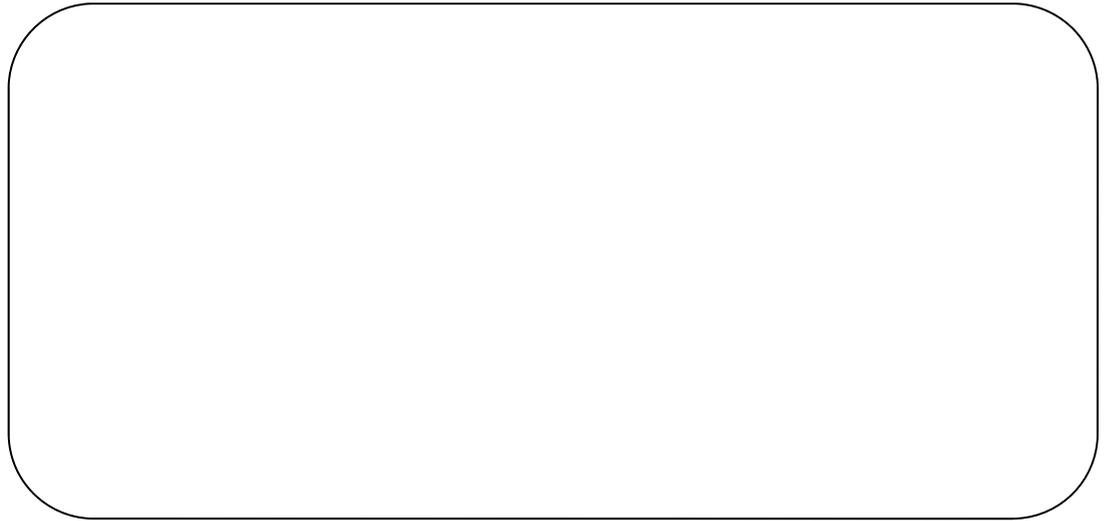
ANALYZE RESULTS

Graph and discuss your data (e.g., The data show...)

Plastics Audit Analysis

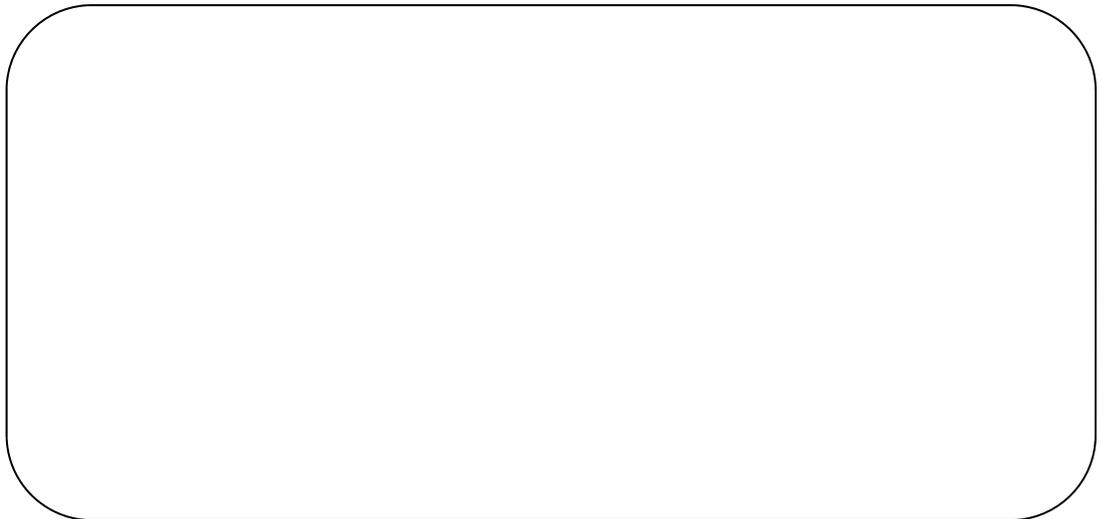
CONCLUSION

Was your prediction accurate? What is the evidence? Do you need more information? What other questions do you want to investigate?



SOLUTION

What actions can you take to address the issue/problem? How might you communicate your findings and solution?



NEXT STEPS

Repeat the audit after implementing your solution and graph that data here. Did your actions have an effect?

