NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 2 HRS 5 MINS

Plastics Aplenty

We use plastics every day, but do we really know what it is? In this activity, students develop a definition of plastic—or more properly, plastics. They perform a plastics audit of classroom materials to understand how ubiquitous and useful plastics are in modern life. This new appreciation provides a sense of scale to the shocking facts about plastic pollution presented in the concluding jigsaw activity.

GRADES

6 - 8

SUBJECTS

Chemistry, Earth Science, Oceanography, Experiential Learning

CONTENTS

6 PDFs

OVERVIEW

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For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/plastics-aplenty/

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DIRECTIONS

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

***Plastics, Plastics Everywhere* lesson driving question:** *How do plastics get into and move around the ocean?*

1. Activate students' prior knowledge by posing a deceptively simple question: What is plastic, and where does it come from?

- Instruct publishing teams to work together to brainstorm a list of everyday items made of plastics. Have teams share their lists with the whole class, highlighting points of agreement, disagreement, and uncertainty.
- Once the class list is complete, instruct teams to write their own definition of plastics. Emphasize that this definition can and should change as they learn new information.
- After teams share their definitions, ask a final question to activate students' prior knowledge about the topic of the video they will watch in Step two: Where do all the plastics come from? (Student answers will vary; take care not to correct inaccurate responses, as the upcoming video will provide information.)

2. Deepen students' understanding of plastics with an explanatory video.

- Prepare students to watch the video Science 101: Plastics (5:45) by introducing key vocabulary they will hear in the video. Briefly introduce the following words and add them to the word wall.

    - synthetic
    - polymer
    - fossil fuel
    - extraction
    - detrimental
    - biodegradable
    - sustainable

- Show the video and address any questions raised by students.
- Prompt teams to update their definitions of plastics and then share their new definitions with the class.

3. Conduct a plastics audit in the classroom in order to understand the extent to which the modern world relies on plastics.

- Distribute the *Classroom Plastics Audit* handout. Make sure each team selects a certain area of the classroom in which to search for plastics, as described on the handout.
- Caution students that they may not always be able to tell if a material is a type of plastic or not. Plastics can often look and feel similar to rubber, fabric, foam, glass, wood, or metal. Some materials (including treated paper products) that don't look or feel like plastic may have a plastic coating or lining. Students can share their uncertainties with the class and discuss whether they think questionable materials should be classified as plastics or not.
- Explain the difference between single-use and durable plastics: single-use, or disposable, plastics are designed to be used once and then thrown in the trash, whereas durable plastics are designed to be used many times.
- After students have completed a comprehensive list of the plastics in their designated area, ask:

    - *Did the amount of plastics in our classroom surprise you?*
    - *Were there any materials that sparked debate in your team about whether they were made of plastic or not?*
    - *What do you think will happen to all of this plastic? Where will it be 10 years from now, or 100 years from now?*
    - *If you collected all of your plastic trash for a day, how much space would it take up? What if you did this for a week, a month, or a year?*

- In conclusion, remind students that their magazine will contain an explanation of what plastics are, how they are made, and how they are used.

4. Facilitate a jigsaw reading activity about sources and impacts of ocean plastic.

- Divide the class into new jigsaw groups. Jigsaw groups should contain four students, each from a different publishing team.

    - Prior to assigning these jigsaw groups, familiarize yourself with the four resources and their reading guides. The four resources are not all equal in terms of their reading levels and visual complexity:

        - Resource A: What Happens to the Plastic We Throw Out
        - Resource B: 10 Shocking Facts About Plastic Pollution
        - Resource C:Ocean Trash: 5.25 Trillion Pieces and Counting

    - Resource D: Sailing Seas of Plastic

- To each of these new jigsaw groups, assign one of the four resources. (If you have more than four groups, two jigsaw groups may be assigned the same resource.)
- Tell each group that their job is to become experts on this particular resource.
- Caution groups that these resources are not all typical articles; for instance, Resources A and D contain several interactive maps, and Resource B is mostly made up of photographs and numbers. Resource C is available in multiple reading levels from third to 12th. Later, when they return to their publishing teams, they will be responsible for sharing new information from their jigsaw resource to incorporate into their publishing team's updated *Ocean Plastics Movement Model,* which they began in the previous activity, *Autopsy of an Albatross*.
- Distribute appropriate Reading Guides to each jigsaw group:

    - Reading Guide A:What Happens to the Plastic We Throw Out
    - Reading Guide B:10 Shocking Facts About Plastic Pollution
    - Reading Guide C:Ocean Trash: 5.25 Trillion Pieces and Counting
    - Reading Guide D:Sailing Seas of Plastic

- Ensure each group has online access, then instruct students to begin reading and answering the questions.

- Prior to the conclusion of the jigsaw activity, remind students that they are responsible for sharing information about their jigsaw resource with their publishing team. This information should help their publishing team refine their *Ocean Plastics Movement Model*.
- If some groups finish their Reading Guides before others, those groups can begin updating their Ocean Plastics Movement Model with the new information they have learned.
- When the *Reading Guides* are complete, use the *Reading Guides Answer Key* to assess students' understanding.
- After assessment, Reading Guides should be placed in each publishing team's folder, where they can be consulted when publishing teams are working on other elements of their magazines.

5. Guide students to update their Ocean Plastics Movement Models.

- Bring students back into their publishing teams. Instruct them to take out their *Ocean Plastics Movement Models*. Remind students that the final version of this model will be a central part of their unit project, but it is still under development. They have now

learned a lot of new information, from many different resources, which they can use to update their models.

- Instruct students to take turns in their publishing teams sharing information from their jigsaw resources that will improve their *Ocean Plastics Movement Models*. While one student is sharing information about their jigsaw resource, another student in their publishing team should add drawings to the model, while a third student writes a verbal explanation.

    - Because they will continue to revise their *Ocean Plastics Movement Models* over the course of this unit, remind students to use pencils. In addition, having different colored pencils for successive layers of revisions and additions may prove helpful.

Tip

Step Four: To read more about facilitating successful jigsaw activities, visit The Jigsaw Classroom.

Modification

- **Step Two:** To support linguistically diverse learners, consider providing tangible examples of different types of plastics, including not only bottles and bags but also some less familiar examples.
- **Step Four:** The jigsaw resources have varying levels of complexity. Take some time to familiarize yourself with these resources, as well as the Reading Guides, before assigning students to jigsaw groups.

    - Resource A is densely packed with information, including text, world maps, and infographics. Also note that for this resource, the visual infographic shows that the vast majority of mismanaged plastics come from South, East, and Southeast Asia.
    - Resource B consists of 10 photographs with associated statistics. The questions on the reading guide are largely mathematical and visual in nature.
    - Resource C offers multiple reading levels and hyperlinked vocabulary words. The questions on the reading guide correspond with the sixth-grade version of the article.
    - Resource D is a fully interactive world map showing a detailed view of ocean plastic pollution. The amount of information contained is substantial, and navigating the site while answering the questions will require good time-management skills.

Informal Assessment

Students' participation in discussions, their changing definition of plastics, their plastic audit handouts, and their *Reading Guides* responses all provide insights into students' current understanding about plastics as synthetic materials that come from natural resources, with impacts on society.

Extending the Learning

A school wide plastic waste audit is ambitious, messy, and incredibly informative! Often, an audit is used as a first step in creating a school wide plan for reducing waste. It requires time, space, materials, and significant planning and communication with students, families, administration, and custodial staff. In spite of these challenges, many schools have successfully completed school wide plastic waste audits—and your school can, too. Here are some resources that can help in your planning process.

- Eco-Schools USA Consumption and Waste Audit Lesson Plan
- Monterey Bay Aquarium Plastic Use Audit Lesson Plan
- Many video examples are available on the Internet, for example:

    - Pinole Valley High School Waste Audit
    - School Solid Waste Audit

In step four, one of the jigsaw resources, 10 Shocking Facts About Plastic Pollution, refers to incineration of plastic waste. Students reading this resource may be intrigued by incineration as a possible solution to the problem of plastic pollution. Scientists and policymakers have debated for decades whether burning plastics is any better for the environment than sending it to landfill. Meanwhile, advocates of zero waste and a circular economy would argue that our fundamental goal should be reducing the amount of plastic waste as much as possible so that none of it needs to be burned or buried at all. These four articles summarize the debate between burning or burying waste plastics.

- Is burning plastic waste a good idea? (National Geographic)
- What's worse, burning plastic or sending it to a landfill? (Grist.org)
- Should we burn or bury waste plastic? (BBC)
- Incineration versus Recycling: In Europe, a Debate over Trash (Yale Environment 360)

OBJECTIVES

Subjects & Disciplines

- Chemistry

  Earth Science

  - Oceanography
- Experiential Learning

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Experiential learning
- Jigsaw

Skills Summary

This activity targets the following skills:

- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Applying
- Geographic Skills
  - Asking Geographic Questions
- Science and Engineering Practices
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

• **MS-PS1-3:**
Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
• **Standard 11:**
The patterns and networks of economic interdependence on Earth's surface
• **Standard 14:**
How human actions modify the physical environment

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.SL.7.1.A:**
Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
• **CCSS.ELA-LITERACY.SL.7.2:**
Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 4:**
Systems and system models
• **Science and Engineering Practice 6:**
Constructing explanations and designing solutions
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Vinyl or nitrile gloves for plastics audit, if students are going through trash/recycling. You can point out that these gloves are also made of plastic! (If no students have a latex allergy, you can use latex gloves instead.)

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per pair, Projector, Speakers

PHYSICAL SPACE

- Classroom

SETUP

Make sure that the classroom space is prepared for the plastics audit. Students may need to move throughout the room and move objects around to accomplish this activity. Provide time at the end of class for cleanup.

GROUPING

- Jigsaw grouping
- Small-group learning
- Small-group work

ACCESSIBILITY NOTES

The video Science 101: Plastics contains a lot of high-level vocabulary. Consider introducing key terms before starting the video, and make sure that closed captioning is turned on.

For students who would benefit from leveled text options, be sure to point them toward Jigsaw Resource C: Ocean Trash: 5.25 Trillion Pieces and Counting.

BACKGROUND & VOCABULARY

Background Information

Before “plastic” became a noun, it was an adjective referring to a material’s ability to deform without breaking. The first plastic was invented in 1869, when John Wesley Hyatt combined plant-based materials to manufacture billiard balls. Hyatt developed more than 200 patents for plastics, with applications from dentistry to photography and beyond.

Plastic is not one material, but a family of materials, including the seven classes of recyclable plastics. What do all plastics have in common? All are synthetic: Although made from natural materials, notably the vast majority from crude oil and natural gas, plastics do not occur in nature. And they are all polymers: long chains of atoms, mostly carbon. (Silk and DNA are two naturally occurring polymers.)

The unique properties of synthetic carbon polymers make plastics both useful and harmful. Because carbon atoms bond to each other, they can form strings of nearly any length. And because carbon also bonds to many other atoms, these strings take on properties of other elements, too. Plastics (specifically thermoplastics) are moldable and recyclable because polymer chains bond to each other at low temperatures. At higher temperatures, the chains remain intact, but the weaker forces between chains break down, allowing the material to reform without losing its properties.

But these long, strong, synthetic bonds make plastics hard to break down. So the polymers that were designed to last a long time on the supermarket shelf continue to last a very long time in the ocean!

Prior Knowledge

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Recommended Prior Activities

- Autopsy of an Albatross

Vocabulary

Term	Part of Speech	Definition
biodegradable	*adjective*	able to decompose naturally.
detrimental	*adjective*	harmful.
entrenched	*adjective*	firmly established

Term	Part of Speech	Definition
extraction	*noun*	process by which natural resources are extracted and removed from the earth.
fossil fuel	*noun*	coal, oil, or natural gas. Fossil fuels formed from the remains of ancient plants and animals.
molecular	*adjective*	having to do with the smallest physical unit of a substance.
polymer	*noun*	compound of high molecular weight derived by the addition of many smaller molecules.
sustainable	*adjective*	able to be continued at the same rate for a long period of time.
synthetic	*adjective*	manufactured by people, not occurring naturally.
ubiquitous	*adjective*	existing or seeming to exist everywhere.
versatile	*adjective*	able to adjust to different conditions.

For Further Exploration

Articles & Profiles

- BBC: Should We Burn or Bury Waste Plastic?
- National Geographic: Is Burning Plastic Waste a Good Idea?
- Grist: What's Worse, Burning Plastic or Sending It to a Landfill?

Websites

- PlasticsEurope: What Are Plastics?