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Recycling's Moment of Truth

It appears that despite good intentions, our recycling efforts have proven inadequate. China is no longer willing to accept our haphazardly recycled trash, forcing the United States and many other nations to restructure their current systems of plastic and paper disposal. This issue of MUSE offers hope for a cleaner world through education and the power of action.

CONVERSATION QUESTION

What strategies are being used to address the world's recycling crisis?

TEACHING OBJECTIVES

- Students will learn why our recycling system needs to be completely restructured.
- Students will learn about the environmental impact of 3D printing.
- Students will learn why plastic debris is toxic to the Earth and all its creatures.
- Students will examine the reasons why our former recycling processes have become ineffectual.
- Students will compare and contrast the characteristics of ABS and PLA filaments.
- Students will collect evidence that details the eventual fate of various plastic products.
- Students will research their local recycling policies.
- Students will create a comic strip that depicts the process of 3D printing.
- Students will organize a campaign to take action to reduce the amount of microplastics accumulating in our oceans.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and cross-curricular activities.

SELECTIONS

- **Plastic Pile-Up**
Expository Nonfiction, ~950L
- **Is 3D Printing Environmentally Friendly?**
Expository Nonfiction, ~850L
- **How Everyday Stuff Turns into Microplastics**
Expository Nonfiction, ~850L

Plastic Pile-Up

pp. 10–13, Expository Nonfiction

This article will encourage students to sort through outdated trash-processing ideas, as well as their own recycling bins. Learn why China had to restrict the paper and plastic coming into its country and how the world is attempting to find alternative solutions to our current recycling crisis.



RESOURCES

- Paper, Plastic, or PROBLEM?

OBJECTIVES

- Students will learn why our recycling system needs to be completely restructured.
- Students will examine the reasons why our former recycling processes have become ineffectual.
- Students will research their local recycling policies.

KEY VOCABULARY

- **repurpose** (p. 11) adapt for use in a different manner; to give new purpose to
- **recyclables** (p. 12) objects that can be processed and made suitable for reuse
- **restriction** (p. 12) a limiting condition or measure, especially a legal one

ENGAGE

Conversation Question: What strategies are being used to address the world's recycling crisis?

Motivate the students to study this topic by posting the following word problem on the board. *The article we are about to read states that by 2016, the US was exporting nearly 700,000 tons of plastic waste per year to China. That's the weight of more than 25,000 full garbage trucks. What is the approximate weight of one full garbage truck? (Answer: 700,000 divided by 25,000 = 28 tons.)*

INTRODUCE VOCABULARY

Discuss the key vocabulary terms and definitions. Display the title of the article, "Plastic Pile-Up," and have students predict how the words will pertain to the content. Note that all the key words begin with the letter *r*. Challenge students to choose a different letter of the alphabet, find three relevant words from the article that begin with that letter, and define them as a post-reading activity.

READ & DISCUSS

Pose the following questions to the students to facilitate meaningful discussion following the reading of the article.

- How did Chinese entrepreneur, Zhang Yin, become China's first female billionaire?
- Why did China feel it was becoming the world's "dump"?
- Explain China's new policy for imported recyclables, *National Sword*.
- How are some recycling facilities attempting to meet new standards?

CONCEPT/SKILL FOCUS: Examining Process

INSTRUCT: Guide students to articulate that the main idea of this article is to explain the processes and problems of recycling paper and plastic. Distribute the graphic organizer, *Paper, Plastic, or PROBLEM?* and tell students that they will be using information from the article to explain how new restrictions have led to a slowdown in recycling efforts.

ASSESS: Circulate and discuss the article's content with students. Collect and review graphic organizers to further evaluate individual understanding.

EXTEND

Civics Have students research the current recycling laws in their community. Instruct them to contact local policy makers to get details and find out how they can make improvements to the current recycling procedures in their schools and homes. Give the class the platform to share what they have learned.

Paper, Plastic, or PROBLEM?

The article, "Plastic Pile-Up," states on page 12 that the current recycling system came crashing down in 2018 when China stopped buying most of the world's plastics.

Explain how our recycling process "came crashing down."

1. _____

2. _____

3. _____

Define "wishful recycling," and then write your own mission statement for being a more efficient recycler.

Is 3D Printing Environmentally Friendly?

pp. 28–31, Expository Nonfiction

3D printing is one of the most exciting technologies of our generation. Colorful filaments are producing amazing creations, but are they also producing an unacceptable amount of plastic waste?



RESOURCES

- The 3-Dimensional Dilemma

OBJECTIVES

- Students will learn about the environmental impact of 3D printing.
- Students will compare and contrast the characteristics of ABS and PLA filaments.
- Students will create a comic strip that depicts the process of 3D printing.

KEY VOCABULARY

- **filament (p. 29)** a slender, thread-like fiber
- **nozzle (p. 29)** a cylindrical spout at the end of a pipe or hose
- **spool (p. 29)** a cylindrical device on which flexible materials can be wound

ENGAGE

Conversation Question: What strategies are being used to address the world's recycling crisis?

Activate prior knowledge and create interest in the topic by showing the class a short video clip that demonstrates the process of 3D printing. Pose the question, "Do you think that 3D printing creates a large amount of plastic waste?" Discuss responses/reasons and distribute the article for reading.

INTRODUCE VOCABULARY

After watching the video clip, but prior to reading, introduce the key vocabulary terms. Have students use information from the video as well as other resources to define the words. Then post the given definition so that students can check for accuracy. Require the students to create a simple sketch of each word.

READ & DISCUSS

Read aloud the following questions prior to reading the text. Advise the students to note where in the article these answers are found. Discuss responses to the questions as a post-reading activity.

- Explain "additive manufacturing."
- How are plastic scraps generated during 3D printing?
- What are some of the reasons that biodegradable PLA may NOT break down? What is the solution?
- How can 3D printing ultimately be more environmentally friendly?

CONCEPT/SKILL FOCUS: Compare and Contrast

INSTRUCT: Students will compare and contrast the characteristics of ABS plastic and PLA plastic. Instruct pairs of students to reread the text and to underline relevant information. Introduce the graphic organizer, *The 3-Dimensional Dilemma*, and have the partners record similarities and differences on their chart.

ASSESS: Collect the *3-Dimensional Dilemma* worksheet and review. Be sure that the students have met the objective of correctly comparing or contrasting the plastics listed. Meet with a small group to remediate, if necessary.

EXTEND

Language Arts Instruct students to use information from the video clip, in addition to the article, to create a comic strip that depicts the process of 3D printing. Provide students with a five-paneled template to create their informative graphic representations. Drawings and captions must be educational and neat. Further challenge students to use all of the key vocabulary terms in their comic strips.

The 3-Dimensional Dilemma

Use information from the article, "Is 3D Printing Environmentally Friendly?" to compare/contrast the plastic filament materials listed below. Write the formal plastic name in the box below the acronym.

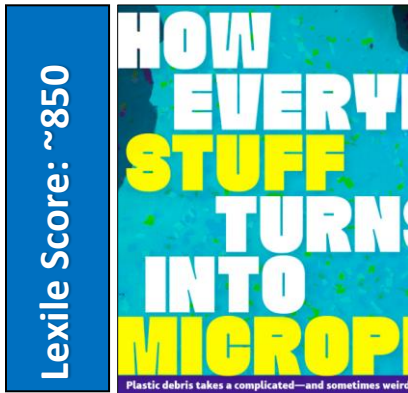
PLASTIC MATERIAL	COMPARE (How are they alike?)	CONTRAST (How are they different?)
<p>ABS</p> <div></div>	<p>1.</p> <p>2.</p>	<p>1.</p> <p>2.</p>
<p>PLA</p> <div></div>	<p>3.</p>	<p>3.</p>

How Everyday Stuff Turns into Microplastics

pp. 34–39, Expository Nonfiction

This article takes readers on the complicated journey of plastic debris and its effect on our living environment.

Learn how microplastics in our oceans are a dangerous pollutant for animals, as well as humans.



RESOURCES

- Ocean Alert

OBJECTIVES

- Students will learn why plastic debris is toxic to the Earth and all its creatures.
- Students will collect evidence that details the eventual fate of three different types of plastic products.
- Students will organize a campaign to take action to reduce the amount of microplastics accumulating in our oceans.

KEY VOCABULARY

- **hydrophobic** (p. 36) failing to mix with water
- **repel** (p. 36) to be incapable of adhering to or mixing with
- **toxins** (p. 36) poisonous substances

ENGAGE

Conversation Question: What strategies are being used to address the world’s recycling crisis?

Inform students that the article they are about to read discusses how three particular plastic products (water bottles, food containers, polyester clothing) have become dangerous pollutants. Have students create a simple tally chart to note how many of each pollutant they see over a two-day period. Discuss the results.

INTRODUCE VOCABULARY

After posting and discussing the key vocabulary terms and definitions, guide students to recognize that they are all different parts of speech (*hydrophobic*: adj, *repel*: v, *toxins*: n). Have the class fold a piece of paper into thirds and label them with the parts of speech and place each word in the correct section. After reading the article they should add other relevant words from the text into the appropriate columns.

READ & DISCUSS

Read the article aloud with the class. Have students reread the article in small groups and answer the questions below. Share responses.

- Define microplastics and explain why they are a dangerous pollutant.
- What factors contribute to the speed at which plastic breaks down into smaller pieces?
- Why are scientists so worried about plastic-eating zooplankton?
- How do microplastics end up in the ocean?

CONCEPT/SKILL FOCUS: Collecting Evidence

INSTRUCT: This article presents the reader with an abundance of detailed information regarding the presence of microplastics in our oceans. Present the *Ocean Alert* graphic organizer and tell students that they will be collecting evidence that details how plastic products become dangerous pollutants. They will need to consult the article to gather accurate information.

ASSESS: The objective of this lesson is to help students practice the skill of collecting evidence from a science-based text. Facilitate dialogue and then collect organizers to evaluate individual understanding.

EXTEND

Environmental Science Students will create a campaign in which they challenge themselves and others to boycott the three plastic products studied in this article for at least one day every week. Have them create student pledges and posters that will teach students simple ways that they can become “part of the solution” (examples include refillable water bottle, reusable food container, cotton clothing).

Ocean Alert

Collect information from the article, "How Everyday Stuff Turns into Microplastics," to explain the journey of the three plastics listed below, from product to pollutant.

Water Bottle
(Polyethylene)

Food Container
(Expanded
Polystyrene)

Clothing
(Polyester)



Eventual Fate: Microplastics in Oceans