

Chemical & Physical Changes

Lesson 3: *The Engineer*

Educator's Lesson Plan

[MS-PS1-3](#)

Lesson Overview

Objective

In *The Engineer*, the students will:

1. Research a synthetic material using credible sources for information.
2. Discover the natural materials it is created from, how it is made, used and the type of pollution it creates.
3. Work as engineers to determine what can be done to stop the pollution created by the synthetic material.
4. Create an infographic or Google Slide presentation to present at the next Town Hall meeting to help everyone understand the problem and how your solution can help.

Lesson Prep

Time Required	Materials Required	Safety/Other Considerations	Science & Engineering Practices
150 minutes	<ul style="list-style-type: none">• Computers for research• Paper• Colored pencils/ markers• Appendix A. Synthetic Material Research List	None	<ul style="list-style-type: none">• Designing Solutions• Communicating Findings/Design (Oral Presentation)• Analyzing and Interpreting Data• Constructing Explanations or Arguments From Evidence

Inquiry Scale: Leveling Information

Level 1: Teacher-driven

Work as a class throughout the lesson. Lead the students through the problem that synthetics are causing to the environment. Introduce them to the challenge, and review the questions the students will use to gather and make sense of information about synthetic materials. Identify additional resources the students should use to determine the credibility and accuracy of their information. Show examples of different synthetic material types (see Appendix A). Lead the students as a class through the planning organizer and all aspects of the Engineer.

Level 2

Students work in groups of 3-4 or as a class. Lead the students through the problem that synthetics are causing to the environment, and introduce them to the challenge. The students review the questions they will use to gather and make sense of information about synthetic materials. Working in groups, the students review the questions they will use to gather and make sense of information about synthetic materials and identify additional resources they should use to determine the credibility and accuracy of their information. Show examples of different synthetic material types (see Appendix A). The student groups complete the planning organizer and all aspects of the Engineer.

Level 3: Student-driven

Students work independently or in student groups of 3-4. The students independently complete all aspects of the Engineer process: choosing the synthetic to research, describing how the synthetic contributes to the pollution affecting our planet, and creating a plan to solve the pollution caused by the synthetic. Then they present their information in an infographic or Google Slides presentation.

Agenda

I. Introduction (10-15 minutes)

1. Open the [PowerPoint](#) to review the essential concepts learned in *The Make* and provide context for their upcoming Engineer challenge.
2. Read the first page of the student guide together as a class, select students to read, or have the students read on their own.

II. Engineer Activity (150 minutes)

Pollution Solution Challenge

1. Read the second page of the student guide together as a class to introduce the Engineering Challenge and answer any questions.
2. Explain to the students that they should look over the synthetic materials listed in Appendix A and choose one to research. Then demonstrate how they will find research sources and check the credibility of each source.
3. Either complete the challenge as a class, place students into groups of 3-4, or have the students work through the challenge independently.

Part 1: Research a Synthetic Material

As a class, in groups, or individually, the students will research one of the synthetic materials listed in Appendix A. They will find two reliable sources for their research using the websites listed and check the credibility of each source to ensure they use the most credible information. They will complete all sections of their student guide using the information they find.

Part A: Production & Use

1. Browse 1-2 links for each synthetic material from Appendix A.
2. Choose a material you'd like to explore further. Which one do you pick?
3. Choose two of the sources provided for your synthetic material research. Then check the credibility rating for your sources to be sure they are credible.

Use the resources below to check the credibility of your sources:

- Easybib.com
- University of Maryland Global Campus Library

<i>Research Source Link</i>	<i>What makes you think these sources are credible?</i>
1.	
2.	

4. Use your credible sources to research your synthetic material and answer the following questions:

<i>Question</i>	<i>Answer</i>
How is the synthetic material used?	
What natural resources are used to create this synthetic material?	
What chemical processes are used to produce this synthetic material? Include diagrams, etc.	

5. What properties does this synthetic material have that make it different from the natural resources used to produce it? List the physical and chemical properties in the table below:

<i>Physical Properties</i>		<i>Chemical Properties</i>	
Natural Resources	Synthetic Materials	Natural Resources	Synthetic Materials

Part B. Problems & Pollution

1. Find at least two new online sources on your own that explain the pollution caused by the synthetic material. Choose two of the sources provided for your research. Then check the credibility rating for your sources to be sure they are credible.

Use the resources below to check the credibility of your sources:

- Easybib.com
- University of Maryland Global Campus Library

<i>Research Source Link</i>	<i>What makes you think these sources are credible?</i>
1.	
2.	

2. Describe the pollution impacts by answering the following questions:

<i>Question</i>	<i>Answer</i>		
Pollution can affect the air, land, and	Air	Land	Water

<p>water. How does the production and use of your synthetic material affect each of these areas?</p>			
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3. Now you will focus on one type of pollution. Will you focus on air, land, or water pollution?

4. Use the pollution type that you selected above to answer the following questions.

<i>Question</i>	<i>Answer</i>
How is this pollution formed?	
Is this pollution produced by physical or chemical processes? Explain.	
Pollution can harm plants, animals, humans, and more. Who or what is harmed by this pollution?	

5. How are the natural resources being impacted by the production of this synthetic material?

6. How is the use and production of this synthetic material contributing to our global pollution crisis?

Part 2: Engineer a Solution

In this section, the students will work as engineers to design a device, method or plan to reduce the pollution caused by the synthetic material. They will complete this activity by answering all of the questions in their student guide.

1. Will your solution focus on air, water, or land pollution? (Choose one)

2. Brainstorm ideas to solve the pollution caused by the synthetic. Include sketches.



3. How will your solution reduce the pollution? Explain in detail.

4. What materials and/or resources would you need for this solution?

5. What are the pros and cons of your solution?

<i>Pros</i>	<i>Cons</i>

6. Why should the community embrace your solution?

Part 3: Alert the Community

In this section, the students will create a presentation to alert the community of the harmful effects of the synthetic and their proposed solution to the pollution it causes.

1. Explain to the students that they may choose an infographic or a Google Slides presentation to present their information to the class. Review the format of each option with the students and answer any questions.

III. Presentation & Assessment (10 minutes)

In this section, the students present their final design solutions as if they are alerting the community about the pollution associated with their chosen synthetic and their solution to reduce that pollution.

1. Have the students or student groups present by asking for volunteers and then randomly selecting others. Give each presenter 5-10 minutes to present their infographic or slideshow.

Assessment: Final Presentation

Use the Checklist and Science & Engineering Practices Rubric to ensure you have addressed all aspects of *The Engineer* with quality work.

Chemical & Physical Changes *The Engineer* Checklist: Content Concepts & Practices

Your Challenge: Design a device, method, or plan to reduce pollution caused by the synthetic materials.

Project Completeness

- Completion of Synthetic Research questions
- Completion of Engineering a Solution questions/planning
- Alert the Community Presentation Includes:
 - Title: Name of design plan/a catchy caption as a heading
 - Identify the Problem
 - Name of synthetic being addressed
 - Natural resource(s) used to create the synthetic
 - How the synthetic is created
 - How the synthetic is used
 - Air, water and land pollution caused by the production and use of the synthetic
 - Identify your Solution
 - How the solution reduces one of the types of pollution
 - Pros and cons to the solution
 - Why the community should embrace the proposed solution

DCI Standards Checklist

- Clearly and accurately identifies physical and chemical properties of natural and synthetic materials.
- Identifies how natural resources chemically combine to produce a synthetic that has a different chemical structure than the natural resources used to create it.

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Science & Engineering Practices

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Designing Solutions	Applies no scientific principles and/or data to design, construct, and/or test the design of an object, tool, process, or system.	Applies minimal scientific principles and/or data to design, construct, and/or test the design of an object, tool, process, or system.	Applies adequate scientific principles and/or data to design, construct, and/or test the design of an object, tool, process, or system.	Applies complete scientific principles and/or data to design, construct, and/or test the design of an object, tool, process, or system.
Communicating Findings / Design (Oral Presentation)	Findings/design are incomplete and/or inaccurate. Or no use of appropriate eye contact, adequate volume, or clear pronunciation.	Findings/design are completely communicated with some misconceptions. Or uses minimal eye contact, inappropriate volume, or inconsistent pronunciation.	Findings/design are completely communicated but lack depth and complexity. Or often uses eye contact and engaging and appropriate volume and pronunciation but is inconsistent.	Findings/design are completely communicated with depth and complexity. Or mostly uses eye contact and engaging and appropriate volume and pronunciation.

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Appendix A: Synthetic Material Research List

It is recommended that teachers go to the Mosa Mack site for this unit to access the links in the remote instruction format.

Synthetic Material	Suggested Resource Links
<p>Plastic Water Bottles</p> 	<p>American Chemistry Council, The Basics: Polymer Definition and Properties</p> <p>Thomasnet.com, Plastic Bottle Manufacturing</p> <p>Packaging of the World, Plastic vs. Glass—Why plastic containers are better</p> <p>Healthy Human</p> <p>This is Plastics</p>
<p>Plastic Bags</p> 	<p>Stopwaste.org, From Oil to Plastic</p> <p>The Atlantic, What is Crude Oil, Exactly?</p> <p>How Stuff Works, Plastics</p> <p>How Stuff Works, Which is more environmentally friendly: paper or plastic?</p> <p>Canadian Plastics Industry Association, All About Bags, Paper vs. Plastic Bags</p> <p>Eco Myths Busted, Myth: Paper Bags Are Greener Than Plastic</p>
<p>Synthetic Fabric (Nylon)</p> 	<p>ChemMatters, Nylon</p> <p>Explain That Stuff, Nylon</p> <p>Science360, Fabricating Fabric: Profile of Nylon</p>

Synthetic Rubber



[American Chemical Society, National Historic Chemical Landmarks, U.S. Synthetic Rubber Program](#)

[Explain that Stuff, Rubber](#)

[Akron Global Polymer Academy, A Brief History of Rubber](#)

[Discovery Communications, How It's Made - Synthetic Rubber](#)