



UTAH GOVERNOR'S OFFICE OF **ENERGY DEVELOPMENT**

Where Do Plastics Come From?

Grade/Subject: 8th-grade Integrated Science

Strand/Standard 8.1.4 Obtain and evaluate information to describe how synthetic materials come from natural resources, what their functions are, and how society uses these new materials. Examples of synthetic materials could include medicine, foods, building materials, plastics, or alternative fuels. (PS1.A, PS1.B, ESS3.A)

Lesson Performance Expectations (description):

- Students will research different types of plastics and their uses.
- Students will conduct several tests on the plastics to determine their physical properties.

Materials:

- Plastic containers/items from all seven types of plastic. These will be cut into small pieces (students may be assigned to bring and collect)
- Connection to the internet and device
- These items will be available for the students to choose from for their plastic tests.
 - Paper clips or nails
 - Acetone (fingernail polish remover will work)
 - Denatured alcohol
 - Hot water
 - 250 mL beakers
 - 50 mL beakers
 - Tweezers
 - Paper towels
 - Goggles for each group member
 - Hot plate to heat the water
 - Hot pads to move the hot water

Time: Two periods of 45 minutes

Teacher Background Information:

- Plastic is the term used to describe a wide range of synthetic or semi-synthetic materials. Plastics are organic materials, just like wood, paper, or wool. The raw materials used to produce plastics are natural products such as cellulose, coal, natural gas, salt, and crude oil. Plastics have a variety of uses, including transportation, containers,

medical supplies, packaging, and even musical instruments. Some plastics can be recycled into clothing, trays, pallets, benches, draining systems, car bumpers, bags, etc. ([EIA](#)).

- Plastics require hydrogen and carbon, freely available in the Earth's atmosphere. The most convenient way of accessing them is by extracting them from oil to provide the hydrocarbons ethylene, propylene styrene, and more. Hydrocarbons can also be made from methane, coal, and biomass (e.g., bio-ethanol) ([BPF](#)).
- Other possible raw materials for plastics are starch, cellulose, sugars, lactic acid, organic waste, vegetable oils, micro-organisms, and even the atmosphere.
- Fossil fuels represent 99% of the raw material base of plastics.
- Crude oil, a complex mixture of thousands of compounds, must be processed before using it. The production of plastics begins with the distillation of crude oil in an oil refinery. This separates the heavy crude oil into groups of lighter components. One of these is naphtha which is a crucial compound for the production of plastics.
- Utah has long been a major producer of oil. It is the 11th largest producer of oil in the United States. The first oil production in Utah occurred in September 1948 at the Ashley Valley #1 well operated by Equity Oil Co. in Uintah County, followed in 1955 by the discovery of the Bluebell field in Duchesne County, followed quickly by the discovery of the Greater Aneth Field in 1956. As of 2011, Utah was estimated to have the 8th largest proven reserves among states ([Trust Lands Administration](#)).
- Utah has five refineries, with over 150,000 barrels per day of refining capacity for gasoline, diesel, jet fuel, and related products. While Utah is an overall net exporter of energy, it imports approximately 72% of the crude oil processed here. In 2011, crude oil made up approximately 14% of Utah's total produced energy resources. Crude oil also accounts for 32% of the energy consumed by Utahns ([Trust Lands Administration](#)).

Student Background Knowledge:

- Students need to understand the definition of synthetic materials and natural resources. Natural materials are found in nature and are not made by humans. By comparison, synthetic materials are man-made and are not found in nature. Synthetic products are usually created in laboratories by mixing different chemicals or prepared compounds and substances made in a laboratory.

Teacher Step by Step: A 3-D lesson should insist students think deeply. Provide time and space for the students to experience the phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. **Introduce *Phenomenon*:** Show the students the first minute of [Indestructible Coating - Polyurea](#). You can show the rest of it at the end of the class period on the second day. (7 min)
2. Students are to ask questions about the phenomenon and record them on their student sheets.
3. Review where plastics come from. Use this [article](#) and the first three minutes of this [video](#) for information.
4. Students will individually research the name and applications of each type of plastic.
5. Divide the students into groups of 2-4 students.
6. Each group will create seven tests that can be conducted on each type of plastic using the equipment and material provided. Make sure that every student is wearing their goggles.
7. Record the results of each test.
8. Students will complete the paragraph after the testing.
9. Each group will be assigned a type of plastic and give a 3-minute presentation to the class. The questions they should address are: What is the plastic's name? What are its physical properties that were tested? Why is this plastic a good one to use for the applications found?
10. Show the remainder of the phenomenon video.

Assessment of Student Learning. Each group will present information on their assigned plastic.

Standardized Test Preparation:

1. Most plastics are produced from which natural resource?
 - a. Oil or petroleum*
 - b. Mining processes
 - c. Plant material
 - d. Ocean water

2. Which of the following are characteristics of plastics that make them valuable to people? Choose two.
 - a. Breakdown quickly after use
 - b. Are flexible and waterproof*
 - c. Can be created in a home
 - d. Can be molded into shapes*
 - e. Are made from renewable resources

Use this information to answer the next two questions.

| Plastic | Floats in water | Creases when folded | Changes shape in hot water | Reaction to acetone |
|---------|-----------------|---------------------|----------------------------|---------------------|
| A | yes | yes | yes | dissolves |
| B | yes | no | no | none |
| C | no | no | no | none |
| D | yes | yes | no | none |
| unknown | yes | no | no | none |

3. Which plastic would change in an automatic dishwasher set on “hot”?
 - a. A*
 - b. B
 - c. C
 - d. D

4. Which plastic is the “unknown” most likely to be?
 - a. A
 - b. B*
 - c. C
 - d. D

Extension of lesson:

- Research what raw materials make certain plastics and the process.
- Research the importance of recycling plastics, then develop a plan to minimize plastic waste. This could include recycling/upcycling plastic products.

Career Connections: Careers in chemical and plastic engineering design new plastics and products from recycled plastics.

Where do Plastics Come From?

Name _____

Phenomenon: Watch the phenomenon in the video. Ask three questions about what they see.



1.






2.

3.

Is the coverage on the watermelon made Synthetic or Natural? Give evidence for your claim.

Use the internet to research the Names and Applications of each type of plastic.

| Container Sample | Letter Code - & Full name | Applications |
|---|-------------------------------------|--|
| Numeric Symbol | Examples: PVC - Polyvinyl Chloride, | Examples: paints, adhesives, electronic, others... |
|  | | |
|  | | |

| | | |
|---|--|--|
|  | | |
|  | | |
|  | | |
|  | | |
|  | | |

Procedure:

1. Using the items provided, create 7 tests that can be conducted on each type of plastic. These tests will help determine the properties of each plastic. Describe the tests here:
 - A.
 - B.
 - C.
 - D.

- E.
- F.
- G.

2. Record the response of each plastic on the table. At the top of each column, write the test type.

Test

| Plastic # | A | B | C | D | E | F | G |
|-----------|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |

Use complete sentences to explain the following: What role does plastic play in our society? Explain the various properties and functions of plastic. Use examples to help explain. What are some of the advantages and disadvantages of using certain plastics over others?

Plastic number and name: _____

Prepare a 3-minute presentation that answers the following points. What is the name of the plastic? What physical properties were tested? How do the physical properties of this plastic make it a good one to use for applications?




Where do Plastics Come From? (Teacher Answer Sheet)





Name _____

Phenomenon: Watch the phenomenon in the video. Ask three questions about what they see.

- 1.
- 2.
- 3.

Was a synthetic or natural covering put on the watermelon? Use evidence to explain why.

| Container Sample | Letter Code - & Full name | Applications |
|---|---|---|
| Numeric Symbol | Examples: PVC - Polyvinyl Chloride, others... | Examples: paints, adhesives, electronics, others. |
|  | PET Polyethylene Terephthalate | Soft drink bottle, mineral water, fruit juice container, cooking oil container. |
|  | HDPE - High-density polyethylene | Jugs for milk, leaning agents, laundry, detergents, bleaching shampoo, washing and shower soaps, picnic tables, plastic lumber, waste bins, park benches, bed liners, |
|  | PVC - Polyvinyl chloride | Trays for sweets, fruit, plastic packing (bubble foil) and food foils to wrap the foodstuff |

| | | |
|--|--------------------------------------|--|
|  | LEDP -Low-density polyethylene | Shrink wraps, dry cleaner garment bags, squeezable bottles, bread packaging, |
|  | PP - Polypropylene | Furniture, luggage, toys, bumpers, lining and external borders of cars, disposable diapers, pails, plastic bottle tops, margarine and yogurt containers, potato chip bags, straws, packing tape and rope |
|  | PS - Polystyrene | Drinking cups, take-out "clamshell" food containers, egg cartons, plastic picnic cutlery, foam packaging |
|  | Other - | Nylon, fiberglass, acrylic, polycarbonate |

Information depends upon what tests are conducted. Below are listed possible tests.

| Plastic # | Water float or sink | Alcohol float or sink | Paper clip/nail scratch? | Acetone test | Flexibility | Crease Color | Heat |
|-----------|---------------------|-----------------------|--------------------------|--------------|-------------|--------------|------|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |

| | | | | | | | |
|---|--|--|--|--|--|--|--|
| 6 | | | | | | | |
| 7 | | | | | | | |

Plastic 7 is a mixed group of plastics that may have different results.

Paragraph: Ensure that the student answered the 3 questions.

Presentation: Ensure that the student answered the 3 questions.