UTAH GOVERNOR'S OFFICE OF
ENERGY DEVELOPMENT

The Many Uses of Petroleum

Grade/Subject: 8th 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, food, building materials, plastics, and alternative fuels. (PS1.A, PS1.B, ESS3.A)

Lesson Performance Expectations:

- Students will obtain information about the difference between natural and synthetic materials by creating their own plastic sample from milk. They will compare it to the process of refining oil and obtain information about all the different products that are made from petroleum.

Materials:

- Supplies for making casein
  - Glass beakers, mugs or other microwave safe containers - 2 per group
  - Microwave
  - Milk - 1 cup per group: Use whole milk if you want it to be more moldable or 1% if you want the casein to clump together more and make less of a mess.
  - Vinegar (3 tsp. Per group)
  - Plastic Spoon - 1 per group
  - 1ft. Squares of cheesecloth or muslin - 1 per group
  - Hot Pad
  - Paper Towels
  - Tin foil or plastic wrap
  - Optional: Cookie cutters, molds, food coloring, markers, glitter, etc.
  - Safety Goggles

- One Crude oil sample (if possible) Used motor oil can substitute
- One sample each of various natural and synthetic substances such as wood, glass, wax, plastic (see student sheet.)
- One sample each of various materials made from plastics. Vinyl, acrylic, pvc, synthetic rubber, polyester, nylon, rayon, elastic, pleather)
- Computers or tablets for finding information on the internet

Time:

Two 45 minute class periods

Teacher Background Information:

- **What is Petroleum?** Petroleum is a hydrocarbon (fossil fuel) that was formed over millions of years from the remains of ancient sea plants and animals. Petroleum is refined to make transportation fuels, and the most common fuel is in the form of gasoline for vehicles. Oil is not just a source of energy, it is also a remarkable raw

material. Thousands of other products (even vehicles themselves) are made from crude oil. See this source for a list of some of the many products that are made using oil.

- **How is petroleum processed?** Energy Production from Field to Pump video: https://www.youtube.com/watch?v=zx28qcRRo1M (7:14 min)
- Petroleum's rich mix of hydrocarbons can be processed to give useful substances known as petrochemicals. Processing usually alters the hydrocarbons so completely that it is hard to recognize the oil origins of petrochemical products.

- **What can be made from petroleum?** A large range of materials and objects can be made from petrochemicals, from plastics to perfumes and bed sheets. Oil products are used as a synthetic alternative to natural materials, including synthetic rubbers instead of natural rubber, and detergents instead of soap. Oil also gives us entirely new, unique materials such as nylon.
- Plastics are materials that can be heated and molded into almost any shape. They have this quality because they are made from incredibly long, chainlike molecules called polymers. Some plastic polymers are natural, but almost all the polymers we use today are artificially made, and the majority of them are produced from oil and natural gas. Plastics are found in our homes in many forms, from boxes used to keep food fresh to televisions and computers.
- Scientists use the hydrocarbons in oil to create an increasing variety of polymers-not only for plastics, but also to make synthetic fibers and other materials. The medical field uses oil from plastics to electricity to medication, our modern health sciences would not be possible without petroleum.
- Technology also relies on products from petroleum refinement for cell phones to computers to printer ink. Even the production of vehicles requires petroleum products to manufacture many of the parts.

Student Background Knowledge:

- Students need to know what properties of matter are. Properties of matter are the traits, or characteristics of a substance. Properties include all the ways you can describe something using your 5 senses as well as what the substance can or cannot react with chemically. Find more information here.
- Students need to know what a chemical reaction is. A chemical reaction is when atoms in molecules are rearranged to create new molecules. Energy can either be released or taken in by a chemical reaction.

Teacher Step by Step: A 3-d lesson should insist students do the thinking. 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. **Phenomenon:** Casein

A few days before this lesson, follow the directions below to create some samples of casein that will be dried out by the time you teach the lesson.

Organize the students into groups of 3 or 4. Each group will perform the following experiment. As they complete it, ask them to record three observations they have about what is happening on their student sheet.

A. Provide each group with two beakers. In one beaker they will place 1 cup of milk. In the other beaker, they will place 3 tsp. of vinegar.
B. Place a stack of four paper towels on the table top.
C. Place the beaker with the milk in a microwave for one minute. (Alternatively, you may heat up the milk on a hot plate or stove top.) The milk should be about the same temperature as water for hot cocoa.
D. Remove the beaker with hot pads and pour in the vinegar. Stir with a plastic spoon. The students should see a white substance separating out of the clear liquid in the milk within a few seconds.

E. Carefully remove the white substance with the spoon and place it on a paper towel. You may need to strain it through cheesecloth or muslin. Gently squeeze out the extra liquid. Note: If too much water is removed at this point it will make the casein harder to work with.
F. Briefly knead the material until it forms a ball.
G. Spread the material out on the napkin or cheesecloth . At this point, you may use cookie cutters to cut it into shapes, place it into molds, or just shape it with your fingers.
H. Put the material aside on tin foil or plastic wrap to dry for at least 2 days. (It will stick to paper towels.)

Ask the students to come up with an explanation for what happened. Ask three questions about the phenomenon, including what the substance is and what it could be used for.

2. **Casein and its uses**

Tell students that if they leave the substance for a few days it will dry into a hard substance called casein. Show them the samples you created a few days before. Ask the students to list some of the properties of casein on their student sheet. How do you think this substance could be used based on its properties?

Ask students if this substance reminds them of any other substances. They should record one of these on their student sheet. After hearing their responses, tell them that casein is a type of plastic and in the early 20th century it was used for things such as buttons and jewelry.

3. **Natural vs. Synthetic Materials**

Prepare a box full of objects made of materials such as wood, glass, wool, cotton, cardboard, etc. (You may also do this as a slideshow. See the list on the student sheet.) As you show each item, ask them to make a prediction about whether each item is natural or synthetic. Discuss as a class which items they thought were natural and which were synthetic. Discuss what makes a substance synthetic. The students will then choose five items from the list and use the internet to research where we get that product.

4. **Petroleum and its Uses**

If possible, obtain a sample of crude oil. If not, find a video of an oil seep such as this one on the Carpinteria State Beach in California. (1:42) Show the oil to the students without telling them what it is. Ask the students to list some of the properties of the substance. (Liquid, flammable, oily texture, crude oil can smell like sulfur or gasoline or asphalt on a hot day.) What could we use the substance for based on these properties? Ask the students what they think the substance is. If they haven't already guessed, tell the students that it is crude oil or petroleum. Is it natural or synthetic? In its current form it is a natural substance. Could we take the oil straight out of the ground and put it in our cars to run our cars?

How can we make oil more useful than it is in its natural form? Have students use the internet to obtain information about how crude oil is processed to make it more useful. Show them this video (4:25 min) about how oil is refined.

Provide each student with two small post-it notes. Ask the students to use the internet to find some items that are created using oil. On each post-it note, ask them to write the name of one of those items. Mark that item with the post-it note.

Give each student a copy of the Student Questionnaire and ask them to circle all of the objects they think are made from petroleum. Show them the answers. Is there anything else in the room we could have marked? Show this video (2:26

min) about the uses of petroleum.

5. **Return to the phenomenon**.
Ask the students to respond to the prompts about the phenomenon at the end of their student sheet. How is milk like crude oil? Is casein natural or synthetic?

Assessment of Student Learning.
Ask students to make a collage of objects they use during one day of their life that come from oil. They may take photos or find existing photos in magazines or on the internet. Write a paragraph on 'What would life look without oil?'

Standardized Testing Preparation:

Many Uses of Petroleum

1. What is a synthetic substance?
   a. A substance made from artificial materials.
   b. A substance created in chemistry laboratories.
   c. A natural substance that has been altered by people.*
   d. A combination of new atoms and molecules.

2. What are modern plastics made from?
   a. Older plastics
   b. Chemicals
   c. Petroleum*
   d. Plants

3. Which of the following is a synthetic substance?
   a. Wood
   b. Nylon*
   c. Rock
   d. Wool

4. How do the properties of synthetic substances compare to the natural substances they are made from?
   a. The properties are the same.
   b. The properties are almost the same.
   c. The properties are often different.*
   d. The properties are all different.

Extension of lesson and Career Connections:
Further research the oil refinement process and present your findings to the class. Choose five petroleum products from the list and find out if any refineries in Utah produce them. Interview someone who works at a refinery about the products they sell or make and about their job.