



THE MANY USES OF PETROLEUM

LESSON SUMMARY

Petroleum is one of our natural resources. This lesson explores the many different products that are created using petroleum; it also connects this concept to our resources and daily lives.
(2 class periods)

UTAH STATE STANDARDS

(Will populate with specifics for state)

OBJECTIVES

The student will be able to

- Discuss the process of refining oil
- Examine the different uses for oil

VOCABULARY

Hydrocarbon (fossil fuel) – a fuel (such as coal, oil, or natural gas) that is formed in the earth from dead plants or animals

Crude oil (petroleum) – a fossil fuel that is a mixture of hydrocarbons that exists as a liquid in natural underground reservoirs (unrefined petroleum)

Petrochemical – relating to or denoting substances obtained by the refining and processing of petroleum or natural gas

Distillation – the action of purifying a liquid by a process of heating and cooling; the extraction of the essential meaning or most important aspects of something.

Casein – the main protein present in milk and (in coagulated form) in cheese

Polymer – a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together; composed of many simple molecules that are repeating structural units called monomers. A single polymer molecule may consist of hundreds to a million monomers and may have a linear, branched, or network structure.

BACKGROUND INFORMATION

Petroleum is a **hydrocarbon (fossil fuel)** that is formed over millions of years from the remains of ancient sea plants and animals (for more info, see this lesson on fossil fuel formation). Almost everyone knows that oil is refined to make gasoline for our vehicles, but not many people know that oil is not just a source of energy; it is also a remarkable raw material. Thousands of other products (even vehicles themselves) are also made from **crude oil**.

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. An amazing range of materials and objects can be made from petrochemicals, from plastics to perfumes and bed sheets. We use many oil products as synthetic alternatives to natural materials, including synthetic rubbers instead of natural rubber, and detergents instead of soap. But oil also gives us entirely new, unique materials such as nylon.



Petroleum refineries change crude oil into petroleum products that are used for many things. Refining breaks crude oil down into its various components, which are then made into new products. All refineries have three basic steps: separation, conversion, and treatment. Petrochemicals are created during this process (see Day 2 video about refinement), and they are used to make thousands of other products.

Plastics play an incredibly important part in the modern world. They find their way into our homes in many different ways and forms, from boxes used to keep food fresh to televisions and computers. 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.

Scientists are able to 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. Even the medical field is dependent on 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 – everything from cell phones to computers to printer ink requires oil. Even the production of vehicles (including electric vehicles) requires petroleum products to manufacture many of the parts.

Oil makes life possible – where we live, how we live, how we commute to work, how we travel – everything. It is the lifeblood of our communities.

LESSON ACTIVITY

Students will learn about all the different products that are made from petroleum; they will watch a video about the uses of petroleum, choose products made from petroleum on a worksheet, and then as a class go over their answers together. On Day 2, the teacher will perform a demonstration comparing milk and vinegar to crude oil separation/petrochemicals through the process of refinement.

Materials

Needed for preparing ahead:

- Measuring cup (1)
- Milk (1 cup per demo or small group)
- Stovetop oven and pan (1) or microwave and microwaveable container (1)
- Thermos (1)
- Mug or other heat-resistant cup (1 per demo or small group)
- Set of measuring spoons (1)
- White vinegar (4 tsp. per demo or small group)

Needed for each demo or small group at the time of the science activity:

- Hot milk (1 cup)
- Mug or other heat-resistant cup with 4 tsp. of vinegar (1)
- Paper towels (6)
- Spoon for stirring (1)



- Optional: Cookie cutters, glitter, food coloring, markers

Procedure

Day 1

Teacher will facilitate a class discussion about all of the different products created from petroleum using the attached list.

1. Begin class by asking students what products the students think are made from petroleum. Most will probably say gasoline or oil, but some may offer up other answers. Record all answers, but don't tell them whether or not they're correct, and don't add any of your own thoughts.
2. Have students take the questionnaire.
3. Watch [this video](#) about the uses of petroleum, and then as a class go over their **Student Questionnaire** answers together.
4. Discuss plastics and polymers; ask students which items on the questionnaire were made from plastic.

Day 2

1. Show [this video about how crude oil is refined](#).

2. Teacher will then perform demonstration (alternatively students could perform experiment) to compare crude oil refinement (separating parts of the oil to get separate byproducts) to mixing milk and vinegar.

In this activity, milk is a model for crude oil.

- Explain the definition of crude oil - unrefined oil or petroleum. Teacher then asks students to recall some products made from petroleum. Point out how many are plastic.
 - Perform demonstration/experiment
1. Heat 1 cup of milk for each classroom demo or small group. Heat the milk in a pan on a stovetop or on a hotplate until the milk is steaming. Alternatively, you can microwave the milk in a microwaveable container by warming it at 50% power for 5 minutes, watching to make sure it does not overflow. It should be about the same temperature as you would want milk to be for making hot cocoa. If it is not heated enough, microwave it for 2 minutes at 50% power and repeat this until the milk is hot.
 2. If you have to do this before class, store the hot milk in a thermos until it is needed.
 3. Right before doing the classroom demo or small group exploration, add 4 teaspoons (tsp.) of white vinegar to a mug. Each group should have one mug with vinegar if students are doing experiment.
 4. Each classroom demo or small group should have 1 cup of hot milk, one mug with vinegar, paper towels, and a stirring spoon.
 5. Teacher/students should measure out 1 cup of hot milk from the thermos and add the hot milk to the mug or other heat-resistant cup with vinegar. When the hot milk is added to the vinegar, the milk should form white clumps (curds). Have students mix the mug of hot milk and vinegar slowly with a spoon for a few seconds. Ask them to write down their observations. Explain to the students that when the milk and vinegar (an acid), mix together, a chemical reaction takes place. A substance called Casein forms. Casein is a very long molecule that bends like plastic – that's why the lumps of milk are pliable.
 6. Stack four layers of paper towels on a surface that is safe to get damp.
 7. Once the milk and vinegar mixture has cooled a bit, have students use a spoon to scoop out the curds. Direct them to tilt the spoon against the inside of the mug to let excess liquid drain out while retaining the curds in the spoon. Have them collect as many curds as they can in this way and put the curds on top of the paper towel stack.



8. Direct students to fold the edges of the paper towel stack over the curds and press down on them to absorb excess liquid from the curds. Two more paper towels can be pressed down on top of the curds to soak up the rest of the extra liquid.
9. Have students knead all of the curds together in a ball of dough. This is the casein plastic.
10. If students want to make the casein plastic into something, they can color, shape, or mold it now (within an hour of making the plastic dough) and leave it to dry on paper towels for at least 48 hours. To shape the plastic, students must knead the dough well before shaping it. Molds and cooking cutters work well, or, with more patience, the dough can be sculpted. Food coloring, glitter, or other decorative bits can be added to the wet casein plastic dough, and dried casein plastic can be painted or colored with markers. Once it has dried, the casein plastic will be hard. Drying time varies depending on the thickness of the final item (thicker pieces take longer), but plan on at least two days.
11. Explain to students how this experiment is similar to the separation of crude oil into usable parts. Crude oil is similar to the mixture in that it must first be heated to separate into different substances before it can be made into other products.
12. Pass out and have students fill out **Student Observation Sheet**.
13. Show [this visual representation](#) of a distillation column that can be found at *How Stuff Works*.

ASSESSMENT

Student Questionnaire and class discussion:

- Were you surprised at the number of products that petroleum is used to make? Which product was the most surprising to you?
- What are some products made from petroleum that are in your home that you use every day?

Student Observation Sheet

Have the students make a collage of pictures of the above-mentioned products (and more) using one of the following tools:

- Take pictures and create a digital collage using a free online program such as [PicMonkey](#), [Photovisi](#), or another free online tool.
- Students can also choose to create a Power Point using their own digital photos.
- A final option is to cut pictures out of magazines or other publications and create a collage on paper.

LESSON EXTENSIONS:

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.

Write a story about what life would look like if we stopped drilling for oil.

List of Some Petroleum Products

Personal

- makeup
- shampoo
- toothpaste
- mouthwash
- deodorant
- perfume
- hair color
- hair spray
- contact lenses
- lotion
- sunscreen
- shaving foam
- razors
- sanitary pads
- diapers

Technology

- computers
- phones
- printers & ink
- televisions

Leisure

- toys
- guitar strings
- cameras
- photographs
- sports equipment
- life jackets
- helmets

Clothing

- polyester
- nylon
- rayon
- elastic
- shoes

Fuel

- heating & cooling
- propane
- electricity generation

Automotive

- gasoline & diesel
- tires
- antifreeze
- asphalt & tar

Automotive, cont'd

- motor oil
- brake fluid
- coolant

Medical

- antihistamines
- inhalers
- aspirin
- band aids
- latex gloves
- rubbing alcohol
- syringes
- anesthetics
- cough syrup
- artificial limbs
- vitamins

Agriculture

- pesticides
- herbicides
- insecticides
- fertilizers
- food preservatives

Household

- all plastic (bags, containers, packaging)
- styrofoam
- fabric softeners
- Teflon coated pans
- appliances
- furniture
- sponges
- cleaning chemicals

Building Materials

- water pipes
- wiring insulation
- linoleum
- upholstery
- carpet
- vinyl
- shingles
- paint



Student Questionnaire

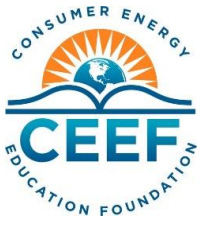
Find out how much you know about petroleum products by taking this little “quiz”. Circle or highlight all of the items that you think are made from petroleum products.

- | | | |
|----------------|------------------------|---------------------------|
| makeup | rayon | fabric softener |
| shampoo | elastic | furniture |
| toothpaste | shoes | Teflon coated pans |
| mouthwash | heating & cooling | appliances |
| deodorant | propane | sponges |
| perfume | electricity generation | cleaning chemicals |
| hair color | gasoline & diesel | water pipes |
| hair spray | tires | wiring insulation |
| contact lenses | antifreeze | linoleum |
| lotion | asphalt & tar | upholstery |
| sunscreen | motor oil | carpet |
| shaving foam | brake fluid | vinyl |
| razors | coolant | shingles |
| sanitary pads | candles | paint |
| diapers | antihistamines | wool rug |
| computers | inhalers | glass |
| phones | aspirin | CD's |
| printers & ink | band aids | lipstick |
| televisions | latex gloves | leather wallet |
| toys | rubbing alcohol | additives in canned food |
| guitar strings | syringes | pen ink |
| cameras | cough syrup | paper |
| photographs | artificial limbs | sports equipment |
| life jackets | wool blanket | helmets |
| wood | polyester | rubber |
| nylon | Styrofoam | athletics protective gear |

Student Questionnaire (answers)

All products EXCEPT the highlighted ones are made from petroleum.

makeup	rayon	fabric softener
shampoo	elastic	furniture
toothpaste	shoes	Teflon coated pans
mouthwash	heating & cooling	appliances
deodorant	propane	sponges
perfume	electricity generation	cleaning chemicals
hair color	gasoline & diesel	water pipes
hair spray	tires	wiring insulation
contact lenses	antifreeze	linoleum
lotion	asphalt & tar	upholstery
sunscreen	motor oil	carpet
shaving foam	brake fluid	vinyl
razors	coolant	shingles
sanitary pads	candles	paint
diapers	antihistamines	wool rug
computers	inhalers	glass
phones	aspirin	CD's
printers & ink	band aids	lipstick
televisions	latex gloves	leather wallet
toys	rubbing alcohol	food additives in canned
food		
guitar strings	syringes	pen ink
cameras	cough syrup	paper
photographs	artificial limbs	



sports equipment

protective gear

life jackets

wool blanket

helmets

wood

polyester

rubber

nylon

styrofoam

SAMPLE



Student Observation Sheet

Describe what happened when the milk and the vinegar were mixed.

Is vinegar an acid or a base?

How did the mixture feel in your hands?

Did it seem like plastic?

What is a polymer?

Compare the process of refining oil to make plastics to the demonstration using milk and vinegar to get a new substance.

SAMPLE