Products from Petroleum

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Lesson Plan - Page 1

INTERMEDIATE STUDENTS

This lesson requires four activity sessions.

Topic

Polymers and materials from oil

Source

Oil and Natural Gas, pages 44-45, 46-47, 48-49

Objective

Students will learn that petroleum is a part of our daily lives. Many products such as nylon, plastics, and rubber come from petroleum-based polymers. Scientists have been able to develop polymers with many different properties.

Lesson Preparations

1. Make copies of Polymer Power handout
2. Read through 'Explanation' section of lesson plan

Materials

Exploration, Activity One

- Polymer Power handouts

Elaboration

- How much is a gallon? Handouts
- Volume Conversion Table

National Science Education Standards

NS.5-8.1
Science As Inquiry
Students should develop

- Abilities necessary to do science inquiry
- Understanding of science inquiry

NS.5-8.2
Physical Science

- Properties and changes in properties of matter
- Motions and Forces
- Transfer of Energy

NS.5-8.5
Science and Technology

- Abilities of technological design
- Understanding about science and technology

NS.5-8.6
Personal and Social Perspectives

- Personal health
- Populations, resources, and environments
- Natural hazards
- Risks and benefits
- Science and technology in society

NS.5-8.7
History and Nature of Science

- Science as a human endeavor
- Nature of science
- History of science

Math topics on volume and measurement are also included.

Engagement

Have students to get out a sheet of paper and a pencil. Ask them write down everything they see around the room that they think is made from petroleum. Give the students 3-4 minutes. Do not allow talking during this exercise. Afterwards, ask the students to tell you some of the objects that they listed and how many products were listed. Ask students if they can think of any other objects made from petroleum.

Today we are going to learn that in our daily lives there are many products that we use made from petroleum.

Exploration

Activity One - Day One

1. Ask for eight volunteers to demonstrate the chemical concept of 'cross-linking.' Tell the class that each volunteer represents a "monomer"—one unit
2. Have monomers move freely around the room.
3. Have two groups of four monomers join hands to form two short segments of the polymer chain. 'Poly' means many, and 'mer' means unit. Thus, a polymer is many units linked together.
4. Have each polymer move around the room with hands still linked. Point out that they can move relatively freely.
5. Explain that some polymer chains contain cross-linkers that connect the polymer chains together. Have one other student play the role of the cross-linker by holding the arm of one monomer in the middle of each of the polymer chains.
6. Have the polymers try to move around as before. While some movement is still possible, it will be more restricted than before the cross-linker was added.
7. Ask the class the following questions: When was the polymer movement least restrictive? When was the polymer movement most restrictive? Were the polymers still able to move about when the cross-linker was added? What does this experiment tell us about the characteristics of polymers?
8. Pass out the 'Polymer Power' handout and discuss with the students items they did not realize came from petroleum.
9. After discussing the 'Polymer Power' handout, please teach the students the information presented in the 'Explanation' section of this lesson. After completing a discussion on polymers, their molecular structure and their role in our everyday lives, ask the students if they have any questions.

Exploration

Activity One - Days Two, Three, and Four

1. What would our lives be like today if we didn't have petroleum? Split students into groups of 3 or 4. Tell them they are to describe what certain parts of our lives would be like if we did not have oil products. They can use any medium they choose to tell their stories; produce a video, drawings, perform a play or write a story.

   Some topics to choose from:

   - What would our grocery stores look like if there were no fuel? (Hint: research polymers-plastics bags for storage; corn fields-production before and after diesel)
   - What would our teenagers do if there were no fuel? (Research current products used from oil)
   - What would ladies do about make-up and cosmetics if there were no fuel? (Products used before petroleum)
   - What would our doctors do if there were no fuel? (Petroleum based medicines)
   - What would our school cafeteria do if there were no fuel? (Plates and eating utensils made from oil products. The importance of conservation and environmental concerns)

2. Allow the students one class period to go research their topic, one class to prepare their presentations, and one to present their presentations.

Explanation

The most used by-product of crude oil is gasoline; however, today more that 6,000 products are produced wholly or in part, from petroleum. These products contain polymers.

A polymer is a huge, chain-like molecule made by combining many small molecules called monomers. A wide variety of polymers are obtainable because they can be made from different kinds of monomers, and monomers can be put together in many different ways to form polymers. They may be flexible or rigid, transparent of opaque, heat resistant or not, waterproof or water-soluble, electrical insulators or conductors, hard or soft, and elastic or not.

Nearly all the materials that make up living organisms involve polymers. These include such things as bone, cartilage, tendons, hair, enzymes, certain hormones, DNA, cotton, wool, wood and latex from rubber trees. These are called natural polymers.

Synthetic polymers are becoming more and more a part of our daily lives. They are made from petroleum and are used to make thousands of products. We encounter these substances constantly in everything from plastic soda bottles to foam polystyrene cups to disposable diapers. Synthetic polymers are used to manufacture such a variety of items because chemists are able to design products with the specific properties required.

As tiny plankton die and sink to the bottom of the sea, they add the carbon containing chemicals in their bodies to the sediment and mud on the ocean floor. Over time the mud becomes solid rock. Under great heat and intense pressure, chemical reactions change the plankton into the fossil fuels, oil and natural gas.

Some rocks are good at holding oil. These rocks are called "reservoir" rocks. These rocks have spaces in them that hold the oil like a sponge holds water. Other rocks act like the walls of a bank vault. These rocks are known as "trap" rocks. These rocks won't let any oil move through them - at least, not until a petroleum geologist comes along to help get the oil out of the ground!

Molecular Structure

Oil and natural gas are naturally occurring hydrocarbons. Two elements, hydrogen and carbon make up a hydrocarbon. Hydrogen and carbon have a strong attraction to each other. As a result, they form many compounds.

Once purchased, the oil is taken to a refinery. At the refinery, crude oil is distilled and separated into its components or fractions. Distillation involves heating the petroleum until it boils. The vapor rises through the towers where it cools and condenses. The different hydrocarbon components that make up petroleum vaporize at different temperatures; thus when they are condensed, they separate out into different fractions. The fractions represent the diverse range of products that can be obtained from petroleum. The simplest hydrocarbon is methane. It has one atom of carbon and four atoms of hydrogen. Under normal pressure and temperature, methane is a gas. Methane is the main component of natural gas.

Ethane, propane and butane often occur with natural gas. Ethane is a liquefied petroleum gas (LPG), but LPG is mainly propane and butane. When propane and butane are compressed at a normal temperature, they liquefy. When the pressure is released they turn into a gas; therefore, they can be used as a portable fuel. LPG travels in a pressurized container as a liquid. When connected to a stove's burner and the pressure is released, LPG changes into a gas.

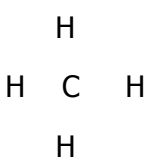
Hydrocarbons with more carbon and hydrogen atoms than propane and butane may be liquid or solid under normal conditions. Gasoline is a mixture of several hydrocarbons that are liquid under normal conditions. Crude oil is also a mixture that usually occurs as a liquid.

Tars and asphalts are solid hydrocarbon under normal conditions. Raising the temperature liquefies them. When a roofer heats tar, it liquefies and binds gravel or other roofing materials into a spreadable mixture. When it cools back to normal temperature, it solidifies to form a waterproof surface.

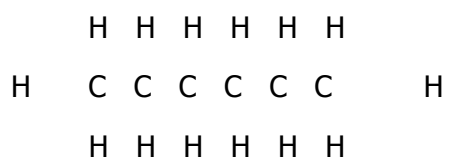
Hydrocarbons

The chemical structure of two hydrocarbons is shown below.

Methane (CH4-simplest hydrocarbon)



Hexane (C6H14)



Naming Hydrocarbons

Hydrocarbons are compounds made up of carbon and hydrogen. Hydrocarbons called alkanes are the simplest hydrocarbons. These compounds are named by using a prefix that tells the number of carbon atoms they contain and the root –ane.

Prefix	# of Carbon Atoms	Use
Meth-	1	Natural gas, bottled fuel gas
Eth-	2	Natural gas, bottled fuel gas
Prop-	3	Natural gas, bottled fuel gas
But-	4	Natural gas, bottled fuel gas
Pent-	5	Solvent, paint thinner, cleaner
Hex-	6	Solvent, paint thinner, cleaner
Hept-	7	Motor fuel, solvent
Oct-	8	Motor fuel, solvent
Non-	9	Illuminating oil, diesel fuel, jet fuel, cracking stock
Dec-	10	Illuminating oil, diesel fuel, jet fuel, cracking stock

Read to students from *Oil and Natural Gas*, pages 44-45

Oil is the world's top energy source, and over 80 percent of all the oil produced is used to provide energy to keep the world moving. Oil's energy is unlocked by burning it, which is why it can only ever be used once. A little is burned to provide heat for homes. A lot is burned to create steam to turn turbines and generate electricity But most is burned in engines in the form of gas, diesel, maritime fuel oil, and aviation fuel for transportation. It takes 30 million barrels of oil each day to keep all our cars and trucks, trains, ships and aircraft on the move.

Read to students from *Oil and Natural Gas*, pages 46-47

Oil is not just a source of energy-it is also a remarkable raw material. Its rich mix of hydrocarbons can be processed to give useful substances known as petro-chemicals. 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.

Read to students from *Oil and Natural Gas*, pages 48-49

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 TV remote controls. Plastics are essentially 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 entirely natural, such as horn and amber. But nearly all the polymers we use today are artificially made, and the majority of them are produced from oil and natural gas. Scientist 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.

Evaluation

1. Students share their 'Exploration' activity
2. Students should complete the Exit Questionnaire.

Elaboration

How much is a gallon?

We use gasoline everyday. It helps us get to school and work. It helps us get our groceries and clothes. But how is the price of a gallon of gasoline determined?

Since gasoline is refined from crude oil, you may think that the price of crude oil is what determines the price of gasoline. But there are more factors than that involved.

According to the Department of Energy, only about 58% of the price of gasoline is determined by crude oil prices. Approximately 15% of the cost of a gallon of gasoline is due to taxes-local, state and federal. About 27% of the cost of a gallon is due to the cost of refining, distributing, and marketing the gasoline.

Before complaining about the latest price increase in a gallon of gasoline, compare it with other products with which you are familiar. You'll to use a conversion table for this exercise.

Try comparing the amount and price of gasoline to the amount and price of other substances. You might just be amazed at what you pay for everyday, commonly used products such as:

Shampoo	Mouthwash
Bottled water	Coffee
Ketchup	Paint

You may know the price of these items in the units in which they are sold. What are their prices if you convert their units to that of a gallon?

Get a copy of a local grocery store circular. The prices and amounts of items should be listed. Use these unit prices for calculations. Make sure that every student has a copy of a conversion table. This will allow them to convert ounces to gallons or liters to gallons.

1. Demonstrate to students how to perform these problems.
2. Practice a few simple problems independently.
3. Do not allow students to submit answers that have not units. Every number utilized must contain units.

Exit Questionnaire Answer Key

1. A _____is a huge, chain-like molecule made by combining many small molecules called monomers.

   Answer: Polymer

2. What is the world's top energy source? _____

   Answer: Oil

3. Name five everyday products made from petroleum:
   a._____
   b._____
   c._____
   d._____
   e._____

   Answers on the Polymer Power Handout

Products from Petroleum
Lab Packet

Polymer Power Handout

Artificial Hearts
Aspirin
Baby Bottles
Baby Rattles
Balloons
Bandages
Basketballs
Bicycle Hand Grip
Blenders
Book Bags
Bubble Gum
Bubble Packing
Buttons
Cameras
Candles
Car Batteries
Carpet
CD Players
Ceiling Light Covers
Cellophane Tape
Chair Seats
Clarinets
Cleats
Clothing
Coasters
Coffee Mugs
Combs
Compact Discs/DVDs
Computers
Contact Lenses
Containers
Crayons
Credit Cards
Dashboards
Dentures
Deodorant
Digital Clocks
Disposable Diapers
Disposable Razors
Dyes
Earphones
Egg Cartons
Electrical Tape
Epoxy Glue
Erasers
Exercise Mats
Extension Cords
False Teeth
Fan Belts
Fertilizers
Fishing Bobbers
Fishing Line
Flea Collars
Floor Mats
Floor Wax
Flower Pots
Flutes
Food Preservatives
Food Storage Containers
Food Wraps
Football Pads and balls
Furniture Polish
Galoshes
Garbage Bags
Glasses
Glue
Golf Balls
Guitar Strings
Hair Dryers
Hair Spray
Hang Gliders
Hearing Aids
Helmets
Hockey Pucks
Ice Chests
Ice Cube Trays
Ink
Insecticides
Insulated Foam Cups
Insulation
Lawn Chairs
Life Jackets and Rafts
Lipstick
Luggage
Lunch Boxes
Mannequins
Measuring Tapes
Medical Equipment
Medicines
Milk Jugs
Model Cars/Airplanes
Movie Film
MP3 Players
Pacifiers
Paint and Paint Brushes
Panty hose
Parachutes
Particle Board
Patio Screens
Pencil Cases
Pens
Perfumes
Photographic Film
Photographs
Piano Keys
Ping Pong Balls
Plastic Bags
Plastic Cups
Plastic Eating Utensils
Playing Cards
Portable Radios
Protractors
Raincoats
Reflectors
Refrigerators
Roller Blades
Roofing
Rubber Bands
Rubber Ducks
Rubber Gloves
Rubber Tubing
Rulers
Safety Glasses
Sails
Seat Cushions
Shampoo Bottles
Shaving Cream
Shoe Soles
Shoestring Tips
Shrink Wrap
Skateboard Wheels
Snorkles
Soft Contact Lenses
Sponges
Sun Visors
Sunglasses
Surfboards
Sweaters
Swim Fins
Synthetic Fabrics
Table Tops
Tackle Boxes
Telephones
Tennis Balls
Tennis Racquets
Tents
Thermos Bottles
Tights
Tile
Tires
Toothbrushes
Toothpaste
Toys
Trash Cans
Umbrellas
Velcro®
Vinyl Siding
Vitamin Capsules
Volleyballs and nets
Waders
Watch Faces
Water Pipes
Wet Suits
Whistles
Wigs
Windbreakers
Windshield Wipers
Zippers

Conversion Table

When you know:	Multiply by:	To find:
inches	25	millimeters
feet	30	centimeters
yards	0.9	meters
miles	1.6	kilometers
centimeters	0.393	inches
meters	1.1	yards
kilometers	0.6	miles
ounces	28	grams
pounds	0.45	kilograms
short tons	0.9	metric tons
grams	0.035	ounces
kilograms	2.2	pounds
metric tons	1.1	short tons
fluid ounces	30	milliliters
pints, US	0.47	liters
pints, UK	0.568	liters
quarts, US	0.95	liters
quarts, UK	1.137	liters
gallons, US	3.8	liters
gallons, UK	4.546	liters
milliliters	0.034	fluid ounce
liters	2.1	pints, US
liters	1.76	pints, UK
liters	1.06	quarts, US
liters	0.88	quarts, UK.
liters	0.26	gallons, US
liters	0.22	gallons, UK

Products from Petroleum

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Exit Questionnaire

INTERMEDIATE STUDENTS

Name:_____

Questions

1. A _____is a huge, chain-like molecule made by combining many small molecules called monomers.

2. What is the world's top energy source? _____

3. Name five everyday products made from petroleum:
   a._____
   b._____
   c._____
   d._____
   e._____