Fossils to Fuel
An Elementary Earth Science Curriculum
Developed for the
Oklahoma Energy Resources Board

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What is the OERB?
The Oklahoma Energy Resources Board is the nation’s first energy check off program. Created by the Oklahoma Legislature in 1993, the OERB is funded voluntarily by Oklahoma oil and natural gas producers and royalty owners through a one-tenth of one percent assessment on the sale of oil and natural gas. The OERB’s mission is to restore orphaned and abandoned well sites and to educate Oklahomans about the vitality, contributions and environmental responsibility of the Oklahoma petroleum industry.

One of our most important missions is Energy Education! Our program serves two primary goals:

1. To develop and design oil and natural gas education activities for K-12 teachers and students in Oklahoma.

2. To provide teachers with:
   - Workshops statewide that provide free training and resources in energy education
   - Educational field trips for students and teachers
   - Professional development hours
   - Petroleum Professionals in the Classroom (Petro Pros)
   - Support in teaching the P.A.S.S., Oklahoma’s state curriculum standards
   - Information about well site safety

For more information about our programs, please contact teachers@oerb.com or 1-800-664-1301.

Acknowledgments
Fossils to Fuel, a hands-on earth science curriculum, is designed to help students learn basic concepts about how energy is transformed from the sun, to petroleum and ultimately into our homes and schools.

This curriculum represents a collaborative effort between the Oklahoma Energy Resources Board and the Oklahoma Department of Education. This material was developed by a team of elementary and middle school science educators, university curriculum specialists, petroleum industry representatives and OERB representatives.

A special thanks must be given to Dr. Ed Marek, Professor of Science Education at the University of Oklahoma, Dr. Brian Gerber, Professor of Science Education at the University of Oklahoma, Ms. Patty Wood, a teacher with Union Public Schools and Mr. John Dewey, a Tulsa geologist, for their role in the initial development of this curriculum. This teacher’s guide was illustrated by Cameron Eagle.

Professional development
The OERB will provide professional development for use of this curriculum. To receive information on professional development sessions, please contact the OERB.

Petro Pros - Introducing students to the real world of oil and natural gas.
Who better to teach students about earth science than the people who make knowing what’s underground their business? Our Petro Pros visit classrooms from grades two through twelve and show students the science and business side of the oil and natural gas industry.
Field test

*Fossils to Fuel* was field tested in the spring of 1997 by a group of educators from across Oklahoma. The field test participants were:

- **Beverly Baker**, Boise City Elementary, Boise City
- **Bobbie Blackmore**, Salyer Elementary, Goodwell
- **Laurie Boulden**, Barnard Elementary, Tulsa
- **Betty Brown**, Charles Haskell Elementary, Edmond
- **Cindy Brown**, Westwood Elementary, Woodward
- **Tracy Bugg**, Taft Elementary, Enid
- **Linda Crutcher**, Stillwater
- **Melissa Onesalt**, Red Oak Elementary, Moore
- **Marilyn Currier**, Chisholm Elementary, Enid
- **Shari Dunavan**, Winding Creek Elementary, Moore
- **Mary Gervasi**, Lincoln Elementary, Enid
- **Aggie Greene**, Northmoor Elementary, Moore
- **Jenny Gwinnup**, Coolidge Elementary, Enid
- **Karen Heizer**, Eisenhower Elementary, Enid
- **Barbara James**, Boise City Elementary, Boise City
- **Peggy Kamphaus**, Broadmoore Elementary, Moore
- **Shannon Thompson**, Eastlake Elementary, Moore
- **Michelle Mabes**, Apple Creek Elementary, Moore
- **Jean McCollough**, Hayes Elementary, Enid
- **Beverley McMillan**, Plainview Middle School, Ardmore
- **Jennifer Miller**, Boise City Elementary, Boise City
- **Mollie Miller**, Bryant Elementary, Tulsa
- **Charlotte Nard**, Sky Ranch Elementary, Moore
- **Stephanie Padden**, Whitman Elementary, Tulsa
- **Lori Painter**, Monroe Elementary, Enid
- **Marie Pierce**, Glenwood Elementary, Enid
- **Rebecca Price**, Hawthorne Elementary, Tulsa
- **Adeana Sallee**, Westwood School, Stillwater
- **Phyllis Shipman**, Earlywine Elementary, Moore
- **Bill Smart**, Garfield Elementary, Enid
- **Dena Taylor**, Fisher Elementary, Moore
- **Kristy Tebow**, Glenwood Elementary, Enid
- **Beverly Thompson**, McKinley Elementary, Tulsa
- **Karen Tyler**, Grissom Elementary, Tulsa
- **Wayne Wagner**, Glenwood Elementary, Enid
- **Jaime Warren**, Key Elementary, Tulsa
- **Judith Watson**, Hoover Elementary, Enid
- **Patti Wayman**, Glenwood Elementary, Enid
- **Carrie Whitaker**, Central Elementary, Moore
- **Leesa Nelson-Whitlow**, McClure Elementary, Tulsa
- **Deborah Worman**, Bryant Elementary, Tulsa
FREQUENTLY ASKED QUESTIONS

The activities in this book are designed to teach students through discovery hands-on investigative experiences and open-ended inquiry questions.

WHAT IS ENERGY?
The world is full of movement. Birds fly in the air, trees move in the wind, and ships sail on the sea. People, animals, and machinery move around, but not without a source of energy.

Living things and machines need energy to work. For example, the energy that turns the blade of a windmill comes from the wind. The sun provides the energy needed to produce the food you eat. Food provides the energy your muscles need to ride your bike. The energy to make a car, plane or motorboat move comes from the gasoline inside the engine.

FROM WHERE DOES ENERGY COME?
All energy originates from the sun. Without the sun, there would be no life on earth. The energy from the sun is transformed into many other types of energy that we use every day. Important forms of energy are oil, natural gas and coal, also known as fossil fuels.

HOW ARE OIL, NATURAL GAS AND COAL FORMED?
Millions of years ago, the seas were filled with billions of tiny plants and animals. As these plants and animals died, their remains sank to the ocean floor and were buried in layers of sand and sediment. As more and more time passed, heat and pressure worked on the buried remains until they became fossil fuels. These fossil fuels were then trapped in underground rock formations. If rock is porous (containing holes or void spaces), it can accumulate oil, natural gas and coal.

For more than 150 years, man has been exploring and extracting fossil fuels. Today, when we use the estimated 6,000 products made from fossil fuels, we are releasing the energy that first came to earth from the sun millions of years ago.

HOW DO WE FIND OIL AND NATURAL GAS?
Edwin L. Drake was the first person to drill specifically for oil. In 1859, near Titusville, Pennsylvania, Drake struck oil. Drake’s discovery helped make the finding of oil a big business. By 1900, prospectors had found oil fields all over the country, especially in Oklahoma and Texas.

Today, prospecting for oil and natural gas is highly skilled detective work as scientists use computers, satellites, sound waves and high-tech equipment to search both underground and under the ocean floor. Long before drilling can begin, geologists and geophysicists (scientists who explore for oil and gas) gather clues to locate possible sites for drilling. These clues come in many forms . . . from maps to locating fossils to studying sound waves from deep beneath the surface. The scientists make their best predictions, locate the spot and then the exploration begins. However, this process does not proceed without concern for the environment.
For many years, oil and gas companies have devoted considerable time and resources to finding ways of reducing their impact on the environment. In fact, U.S. companies are spending more dollars protecting the environment than drilling new wells. The effects that drilling, as well as any eventual production operations, will have on an offshore environment or a sensitive onshore tract must be anticipated and thoroughly spelled out. Blowout preventers used during the drilling process insure against the potential release of oil or natural gas into the atmosphere making oil “gushers” a relic of the distant past. Steel casing is set and cemented to protect the water table from contamination. Oil companies routinely take all necessary steps to prevent harmful interaction with wildlife and crop production.

In the final analysis, it is a question of balance between the need for energy and the desire to have an undisturbed environment. Oil companies and the government must cooperate to ensure this balance is achieved.

**HOW IS OIL AND NATURAL GAS TRANSPORTED AND USED?**

Once oil and natural gas are produced and collected, they must be safely transported for their many uses. Oil can be transported by truck, pipeline or ships to factories called refineries. Natural gas can only be transported in large quantities through high pressure pipelines. Consequently, natural gas produced in the U.S. can only be used on this continent, or it can be shipped as compressed and liquifed natural gas. Crude oil can be shipped all over the world where it is made into the thousands of products that we use every day. You don’t need to leave home to find oil in some of its many forms.

By processing fossil fuels at power stations, stored energy can be converted to electricity. The carpet on your floor and the paint on your walls probably have oil in them. You brush your teeth with a plastic tooth brush which is made from petroleum (oil is the key ingredient of plastic). It is estimated that we have found more than 500,000 uses for oil.
Learning Cycle

*Fossils to Fuel* activities follow the learning cycle format:

1. **Wonder Why**

   The Wonder Why question focuses on the topic of the activity and engages student interest.

2. **Discovery Procedure**

   This stage of the learning cycle provides information and procedures for inquiry-based, hands-on investigations.

3. **Concept Formation**

   Based on the discovery activity, this stage of the learning cycle develops the main idea through questioning and additional resources.

4. **Expansion**

   Expansion allow for further development of the concept through the use of subject integration, resources, community outreach, experimentation, creativity and decision-making.
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<th>Activity Topic</th>
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Energy – It’s In The Bag

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards

Observe and measure; classify; experiment and inquiry; interpret and communicate

Physical Science Content Standards

Objects can be described in terms of the materials of which they are made. Mixtures and solutions can be separated (i.e., sand and marbles; or salt and water).

Grade 4

Process Standards

Observe and measure; classify; experiment; interpret and communicate; inquiry

Physical Science Content Standards

The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

Grade 5

Process Standards

Observe and measure; classify; experiment; interpret and communicate; inquiry

Physical Science Content Standards

Matter has physical properties that can be used for identification (e.g.; color, texture, shape).

Energy can be transferred in many ways (e.g., energy from the sun to air, water and metal).

Grade 6

Process Standards

Observe and measure; classify; experiment; interpret and communicate; inquiry

Physical Science Content Standards

Energy exists in many forms such as heat, light, electricity, mechanical motion and sound. Energy can be transferred in various ways.

Earth/Space Content Standards

The sun provides the light and heat necessary to maintain life on Earth and is the ultimate source of energy (i.e., producers receive their energy from the sun.)
National Science Education Standards

Physical Science (Grades K-4)

The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

Magnets attract and repel each other and certain kinds of other materials.

Physical Science (Grades 5-8)

The motion of an object can be described by its position, direction of motion and speed. That motion can be measured and represented on a graph.

Science and Technology (Grades K-4)

Students should make proposals to build something or get something to work better; they should be able to describe and communicate their ideas. Students should recognize that designing a solution might have constraints, such as cost, materials, time, space or safety.

Children should develop abilities to work individually and collaboratively and to use suitable tools, techniques and quantitative measurements when appropriate. Students should demonstrate the ability to balance simple constraints in problem solving.
Wonder Why . . .

Have you ever wondered where you get the energy to live and play? What things in your life require energy? Where do you think energy comes from?

Concept

Energy is the ability to cause force and motion on an object. All things use a source of fuel to produce energy. Potential energy is stored energy, such as a parked car. Kinetic energy is energy in motion, such as a moving car.

Materials
Assemble “Energy Bags” containing the following items:

- 2 rubber bands
- 1 small rubber ball
- 2 paper clips
- 2 magnets
- 1 toy car
- 3 gears
- 1 pop-up toy
- 1 ruler (with center groove)

Optional items may be included, such as small pieces of candy or dried fruit to represent energy gained from food. In addition, a battery, a bulb and wire could be used to demonstrate the transfer of potential to kinetic energy.

Discovery Procedure

1. Give an “Energy Bag” to each cooperative group. Ask students to observe the objects in the closed bag. Do you see potential energy?
2. Encourage students to work with combinations of materials in their bag and experiment with ways of making the objects “go, run or cause something to happen.”

3. Which objects in the bag have potential (stored) and/or kinetic (moving) energy? Record or draw the energy motions found in each object.

<table>
<thead>
<tr>
<th>Potential</th>
<th>Kinetic</th>
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<tbody>
<tr>
<td>ruler</td>
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</tr>
<tr>
<td>paper clip</td>
<td>moving gear</td>
</tr>
<tr>
<td>parked car</td>
<td>moving car</td>
</tr>
</tbody>
</table>

4. Assemble the objects in the bag to design a system to cause movement.

5. Record or draw the energy motions found in the system.

**Concept Formation**

1. Pose open-ended questions such as: Why do you think this is called a bag of energy? What made or makes energy?

2. Do you think the energy in the bag is potential (stored) or kinetic (moving)? *It is potential and kinetic.* Which objects in the bag have potential (stored) and/or kinetic (moving) energy? *(see example in list above)*

3. What combination of materials worked together to produce kinetic energy? *Force and motion make kinetic energy.*

4. Share and discuss findings in small groups. Encourage each group to formulate its own discovery definition of energy as it applies to motion of objects in the “energy bag.” Share and discuss definitions with the class.

5. Have each student form his/her own definition of energy and record in their journals.

6. What do all of the definitions have in common? How are they different? Create a class definition for energy to focus on the idea that energy is the ability to make things go, run and happen.

**Vocabulary Words**

- **Energy**—the ability to do work
- **Potential**—stored energy
- **Kinetic**—energy in motion
- **Work**— move or cause to move gradually or with difficulty into another position.
Teacher Information

Scientists define energy as the ability to do work. Work is created by force and motion on an object. Fuel is also necessary for work to be done. Fuel can be food for our bodies, gasoline for our cars, or electricity for our home.

Energy is required for everything we do whether we are working or playing. Children may associate work with mowing the lawn, doing homework, or the place adults go to earn a living. When we are talking about energy in scientific terms, it is necessary to think about the idea of “work” in a new way.

It is also important to think about the fuel that creates that energy. When we use fossil fuels, we are releasing the energy that first came to earth from the sun millions of years ago.

Enrichment

- Where does the television or computer get its energy?
- Compare your body to a working machine. Where does it get its energy?
- Demonstrate your body’s ability to use potential and kinetic energy.
- Trace the flow of energy from the child riding a bike back to the energy of the sun (Riding Bike ... Child’s Energy ... Food ... Plants ... Sun). Where do you get your energy?
- Use a magnifying lens to concentrate the sun’s energy on a small plastic container filled with water. Measure the temperature increase in degrees Celsius to demonstrate the transfer of the sun’s energy.
- Act out various scenarios to determine if work is being done. Stretch a rubber band around your two index fingers. Ask students if work is being done. (Yes, you are using fuel as provided by the food you eat.) Place the rubber band on the table. Ask students if work is being done. (No, fuel is not being used.) Ask students to give other examples.
Wonder Why . . .

Have you ever wondered where you get the energy to live and play? What things in your life require energy? Where do you think energy comes from?

Materials
“Energy Bags” containing the following items:
- 2 rubber bands
- 1 small rubber ball
- 2 paper clips
- 2 magnets
- 1 toy car
- 3 gears
- 1 pop-up toy
- 1 ruler (with center groove)

Procedure
1. Observe the objects in your closed bag.
2. Take the materials in your bag and experiment with ways of making the objects go, run or cause something to happen.
3. Which objects in the bag have potential (stored) energy? Ruler, paper clip and parked car

4. Once an initial force is applied, which of the objects in the bag have kinetic (motion) energy? Bouncing ball, moving gear and moving car

5. Record or draw the energy motions found in each object.
   Answers will vary
6. Formulate your own definition of energy as it applies to motions of objects in the “energy bag.”
   Record the definition below.
   
   *Answers will vary*

7. Record the class definition of energy.
   
   *Answers will vary*

8. Assemble the objects in your bag to design a system to cause movement.

   **Journal**
   
   Write a brief description of your system of movement.
   
   *Answers will vary*

   **Vocabulary Words**
   
   Energy  *the ability to do work*

   Potential  *stored energy*

   Kinetic  *energy in motion*

   Work  *move or cause to move gradually or with difficulty into another position.*
1. List six sources of energy.

- Oil
- Sun (Solar)
- Natural Gas
- Wind
- Coal
- Water (hydroelectric)

2. Where does the TV or computer get its energy?

TVs and computers get energy from electricity. This is electrical energy created at a power plant.

3. Where does your body get its energy?

Your body gets energy from the food you eat.

4. How are these two energy sources different?

Energy from the sun provides light energy during the day that is needed by plants. This stored energy in plants, or energy waiting to happen, is called potential energy. Electrical energy is a flow of electrons (kinetic energy) which can be generated by the burning of fossil fuels.

5. How are these two energy sources similar?

They both have the ability to change or move matter. Without energy there would be no light, no heat, no motion, and life would not exist. We get our energy from food and appliances in our home need energy to do work. Potential energy can be changed to kinetic energy.
Fish, Fossils & Fuel

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards
Classify; interpret and communicate

Grade 4

Process Standards
Classify; interpret and communicate

Physical Science Content Standards
The process of erosion, weathering and sedimentation affect Earth materials.

Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time (e.g., simulating the formation of fossils).

Grade 5

Process Standards
Classify; interpret and communicate

Physical Science Content Standards
Matter has physical properties that can be used for identification (e.g.; color, texture, shape).

Energy can be transferred in many ways (e.g., energy from the sun to air, water and metal).

National Science Education Standards

Earth/Space Science (Grades K-4)

Earth materials are solid rocks and soils, water and the gases of the atmosphere. The surface of the earth changes. Some changes are due to slow processes, such as landslides, volcanic eruptions and earthquakes.

Varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel or for growing the plants we use as food. Earth materials provide many of the resources that humans use.

Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time.

Science in Personal and Social Perspectives (Grades K-4)

Some resources are basic materials, such as air, water and soil; some are produced from basic resources, such as food, fuel and building materials; and some resources are nonmaterial, such as quiet places, beauty, security and safety.
Earth/Space Science (Grades 5-8)

Soil consists of weathered rocks and decomposed organic material from dead plants, animals and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

Fossils provide important evidence of how life and environmental conditions have changed.
Wonder Why...

Do you ever wonder why oil and natural gas are referred to as “fossil fuels”? Do you think oil and natural gas can be made from old fossils? How long do you think it takes fossil fuels to form?

Concept

Oil is formed from the remains of microscopic plants and animals found in the ocean.

Materials

• 3 slices of bread (one slice of white, wheat and rye)
• Gummy fish candy or colored fish crackers (or other gummy sea animal or plant)
• Heavy books
• Paper towels
• Magnifying lens
• Clear drinking straws

Discovery Procedure - Teacher Guided

1. Place a paper towel and 3-4 gummy fish on each group’s table. Give each group 3 slices of bread (one each of rye, white and wheat bread). Instruct students to carefully pull the crust from the bread to show the different layers.

2. Ask the students, “What eventually happens to the microscopic ocean animals and plants when they die? Place a piece of white bread on top of the paper towel. Put gummy fish (to represent the microscopic plants and animals) and the crumbs of the bread crust (to represent the sediment) on the bread.

3. “As the plants and animals lay lifeless on the bottom of the ocean, the currents deposit sediments on top of the dead marine life. Place a piece of rye bread on top of the white bread layer.
4. “As millions of years passed, what continued to cover the dead plants and animals?” (More sand and sediment were deposited by wind and ocean currents.) Add another layer of gummy fish and bread crust on top of the bread.

5. Now cover the other layers with the wheat bread. Fold the paper towel to cover your bread fossil.

6. “Something is still missing to help our fish fossilize. What else could it be?” (pressure) “What could we do to put pressure on the ‘rock layers’ of our ‘bread fossil?’” Place textbooks or other heavy objects on top of the bread to simulate pressure. Leave your model one or two days to represent the passage of millions of years.

7. After one or two days, observe the “bread fossil.” Use a clear straw to extract a core sample from your bread fossil. Remove the core sample and observe the layers through the straw. Record your observations.

8. Try to separate the layers of the bread. Why do you think the layers are difficult to separate? Try to extract the fish. Can you identify the mold (impression in the bread) and the cast (gummy fossil)?

9. Compare the colored residue of the gummy fish in the bread fossil to the remains of the plants and animals that seep into the rock. The residue left by the gummy fish represents oil deposits left behind by dead ocean plants and animals. Over millions of years, these remains are pressurized to become oil and natural gas deposits.

**Concept Formation**

1. As we journey back in time, let’s think about how we can recreate the historical formation of fossils. What eventually happens to the sea animals and plants when they die? *They fall to the ocean floor. As the plants and animals lay lifeless on the bottom of the ocean, the currents deposit sediments on top of the dead marine life. As these layers increase, the pressure also increases, creating fossils and fossil fuels.*

2. What has changed about our “bread fossils”? What happened to the layers? *The gummy fish left a visible impression in the bread and layers began to harden.*

**Vocabulary Words**

- **Fossil**—the remains or imprint of marine life embedded and preserved in rock layers deep in the earth
- **Fossil Fuels**—oil and natural gas created from the pressure, heat and plant/animal remains in rock layers deep in the earth (the liquid form of fossil fuel is crude oil, the gas form of fossil fuel is natural gas and the solid form of fossil fuel is coal)
- **Sediment**—sand-like material and debris that settle or is deposited by water, wind or glaciers over time
- **Microscopic**—so small as to be visible only with a microscope

**Application/Expansion**

- Compare actual fossils (collected by teacher and/or students) and classify by properties.
- In your journal, record the experience of the life of a fish until it is found as a fossil.
Teacher Information

Much of what is Oklahoma today was under ancient seas millions of years ago. Geologists know this because many rock layers containing fossil remains of marine life have been found throughout the state. Millions of small marine plants and animals lived in the seas and oceans, eventually died and then settled on the ocean floor. The dead plants and animals were often buried by sand and other sediment, much like the bread fossil. Heat from beneath the earth’s crust “cooked” the plant and animal remains forming oil and natural gas deposits within the rock layers. This is why oil that is produced in the sedimentary rock is called a “fossil fuel.”

Today, oil and natural gas companies drill holes in the subsurface rock looking for crude oil and natural gas deposits. These rock formations are sometimes in depths of five miles or more. As oil and natural gas are being depleted from existing wells, geologists are constantly searching for undiscovered sources of petroleum. Many scientists believe that oil and natural gas are possibly forming under the ocean floor. However, the organic matter will not form petroleum until millions of years have passed. That is why oil and natural gas are considered to be non-renewable energy resources.

Enrichment

• To reinforce the PASS objectives, interpret maps, charts and graphs. Compare and contrast areas containing many fossil sites to oil and natural gas fields (see Blackline Masters for “Fossil Locations” map).

• Create comic strips, journal entries or models to demonstrate the process of fossil fuel formation.
**Fossil Locations According to Geologic Formations**

**GEOLOGICAL PERIODS**

1. Ordovician
2. Devonian
3. Mississippian
4. Pennsylvanian
5. Permian
6. Triassic
7. Jurassic
8. Cretaceous
9. Tertiary, Quaternary

**Fossil Locations**

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<td>Gastropod</td>
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<td>6,7,8,9</td>
</tr>
<tr>
<td>Sea Urchin</td>
<td>8</td>
</tr>
<tr>
<td>Trilobite</td>
<td>4</td>
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</tbody>
</table>

Fossils are cross-referenced to their geologic time periods.
Geologic Time Scale

Brachiopod

Crinoid

Fusulina

Pelecypod

Blastoid

Bone

Cephalopod

Coral

Sea Urchin

Gastropod

Bryozoa

Trilobite
## Geologic Time Scale

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<td>CENOZOIC</td>
<td>QUATERNARY</td>
<td>Recent (10,000)</td>
<td>Modern horse evolves in North America, then dies out</td>
<td>Ice Ages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pleistocene (1,000,000 to 2,000,000)</td>
<td>Earliest man</td>
<td>Grand Canyon carved</td>
</tr>
<tr>
<td>TERTIARY</td>
<td></td>
<td>Pliocene (11,000,000)</td>
<td>Rapid spread and evolution of grazing animals</td>
<td>Pacific Coast Ranges formed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miocene (25,000,000)</td>
<td>Earliest elephants</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oligocene (40,000,000)</td>
<td>First primitive horse, rhinoceroses and camels</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eocene (60,000,000)</td>
<td>First primates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paleocene (70,000,000)</td>
<td>Uplift and folding of Western Geosyncline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRETACEOUS (135,000,000)</td>
<td>Extinction of dinosaurs</td>
<td>Uplift and folding of Western Geosyncline</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Great evolution and spread of flowering plants</td>
<td>Widespread swamps, coal source</td>
<td>Uplift of Sierra Nevada</td>
</tr>
<tr>
<td></td>
<td>JURASSIC (180,000,000)</td>
<td>First birds and mammals</td>
<td>Arid climates in much of Western North America</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dinosaurs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRIASSIC (225,000,000)</td>
<td>Dinosaurs at their peak</td>
<td>Ice Ages in Southern Hemisphere</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERMIAN (270,000,000)</td>
<td>Mammal-like reptiles</td>
<td>World climate much like today</td>
<td>Deserts in Western United States</td>
</tr>
<tr>
<td></td>
<td>PENNSYLVIANIAN (305,000,000)</td>
<td>First reptiles</td>
<td>Widespread flooding of North America, limestone deposited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MISSISSIPPANIAN (350,000,000)</td>
<td>First reptiles</td>
<td>Widespread flooding of North America, limestone deposited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DEVONIAN (400,000,000)</td>
<td>First amphibians</td>
<td>Uplift and folding of Appalachian Geosyncline</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>First forests</td>
<td>Filling of Appalachian geosyncline and Western Geosyncline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILURIAN (440,000,000)</td>
<td>First air-breathing animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Scorpions), First land plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORDOVICIAN (500,000,000)</td>
<td>Trilobites</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAMBRIAN (600,000,000)</td>
<td>Marine shelled invertebrates</td>
<td>Widespread flooding of North American by seas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>common, first abundant animal fossils</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRECAMBRIAN Archezoic Proterozoic (2,500,000,000)</td>
<td>Marine invertebrates probably common few with shells (1,200,000,000)</td>
<td>Many geosynclines filled, uplifted and eroded</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4,500,000,000)</td>
<td>Earliest plants (marine algae)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3,200,000,000)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numbers refer to time in years B.P. (Before Present) Since the Era, Period, or Epoch.
Wonder Why...

Do you ever wonder why oil and natural gas are referred to as “fossil fuels”? Do you think oil and natural gas can be made from old fossils? How long do you think it takes fossil fuels to form?

Materials

- 3 slices of bread (one slice of white, wheat and rye)
- Gummy fish candy or crackers
- Heavy books
- Paper towels
- Magnifying lens
- Clear drinking straws

Procedure

1. Carefully pull the crust from each slice of bread.

2. What eventually happens to microscopic ocean animals and plants when they die? Place the white bread on the paper towel. Put gummy fish and bread crumbs on the bread.

   They fall to the ocean floor.

3. As the plants and animals lay lifeless on the bottom of the ocean, the currents deposit sediments on top of the dead marine life. Place the rye bread on top of the white bread layer.

4. As millions of years passed, what continued to cover the dead plants and animals? Add another layer of gummy fish and bread crust on top of the bread.

   Ocean and wind currents deposit more sand and sediment over the dead plants and animals.

5. Cover the other layers with the wheat bread. Fold the paper towel to cover your bread fossil.

6. Place textbooks or other heavy objects on top of the bread to simulate pressure. Leave your model one or two days to represent the passage of millions of years.
7. After one or two days, observe the “bread fossil.” Use a clear straw to “extract” a core sample from your bread fossil. Remove the core sample and observe the layers through the straw. Now, compare it to the actual core sample. Record and draw your observations.

*Both the bread fossils and the real core sample have multiple layers.*

8. Try to separate the layers of bread. Why do you think the layers are difficult to separate? Try to extract the fish. Can you identify the mold (impression in the bread) and the cast (gummy fossil)?

*Time and pressure make the layers hard to separate.*

**Journal**

Compare the colored residue of the gummy fish in the bread to the remains of the plants and animals that seep into the rock.

*Answers will vary.*

**Vocabulary Words**

- **Fossil** — the remains or imprint of marine life embedded and preserved in rock layers deep in the earth
- **Fossil Fuels** — oil and natural gas created from the pressure, heat and plant/animal remains in rock layers deep in the earth
- **Sediment** — sand-like material and debris that settle or is deposited by water, wind or glaciers over time
- **Microscopic** — so small as to be visible only with a microscope
Fish, Fossils & Fuel

Conclusion

1. What are some of the most common types of fossils found in Oklahoma?
   The most common fossils are plants and animals.

2. After a few days, how did the layers in your bread fossil change?
   The gummy fish left a visible impression in the bread and layers began to harden.

3. Why did they change?
   It changed because of the pressure of the books and the time that went by.

4. When you took your core sample, did you strike oil or drill a dry hole?
   Answers will vary.

5. Based on what you learned, why do you think oil production is so expensive?
   Answers will vary. Oil production takes a lot of expensive equipment and a lot of people need to be involved.
It’s a Gas

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards
Observe and measure; classify; experiment and inquiry; interpret and communicate

Grade 4

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Earth/Space Science Content Standards
Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at the time (e.g., simulating the formation of fossils)

Grade 5

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Life Science Content Standards
Changes in environmental conditions due to human interactions or natural phenomena can affect the survival of individual organisms and/or entire species.

Earth/Space Science Content Standards
Soil consists of weathered rocks and decomposed organic material from dead plants, animals and bacteria. Soils are often found in layers.

Grade 6

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards
Matter has physical properties that can be measured (i.e., mass, volume, temperature, color and texture). Changes in physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

National Science Education Standards

Life Science (Grades K-4)
All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organism or the other organisms, whereas others are beneficial.
Earth/Space Science (Grades 5-8)

Soil consists of weathered rocks and decomposed organic material from dead plants, animals and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rock and contributing to the weathering of rocks.
Wonder Why…

Have you ever thought about how natural gas is formed? Where would you go to find natural gas?

Concept

Natural gas in a substance formed over millions of years from decaying ocean plants and animals.

Materials

- 20g tuna or 1 hard-boiled egg with shell
- 2 lettuce leaves or equal amount of shredded lettuce (about 1/3 cup)
- Clear plastic bottle (8oz or 16oz)
- 1 balloon
- Graduated Cylinder
- 50g sand
- 25ml aquarium or pond water
- Masking tape
- Balance scale/weights

Note: This activity can also be done with a sealable baggy in place of the bottle and balloon.

Discovery Procedure

1. Measure 20g of an organic substance and put in bottle. Tear the lettuce leaves into small pieces and put them in the bottle.

2. Use the balance scale to measure 50g sand. Carefully pour the sand into the bottle so the sand covers the organic substance and the lettuce. Do not shake the bottle.
3. Measure 25ml of water. **Slowly** pour the water into the bottle. Try to make the water run down the inside of the bottle instead of pouring the water directly onto the sand.

4. Stretch the opening of the balloon over the opening of the bottle. Seal with masking tape.

5. Carefully move the bottles to a warm place (preferably outside as contents could produce a strong odor). Let the bottle stay in that place for several days.

6. Predict what will happen over the next few days.

7. Design a chart and record your daily observations (changes in balloon, etc.).

**Concept Formation**

1. Have each group summarize their data and draw conclusions. Share conclusions with the class.

2. What do you think caused the changes in the balloon? *Decaying lettuce (plants) and tuna/egg (animals) caused the change.*

3. What happened to the materials in the bottle as time passed? What name could we give this newly formed substance? *The materials start to decay and emit a gas. The new substance is a gas.*

4. How did the substance change? *It changed from a solid to a gas.*

**Vocabulary Words**

- **Organic**—derived from a living matter
- **Inorganic**—not consisting of living matter
- **Natural Gas**—a gas that comes from the earth’s crust
- **Chemical Change**—a substance that is altered chemically and displays different physical and chemical properties
- **Physical Change**—a change from one state (solid or liquid or gas) to another without a change in chemical composition

**Teacher Information**

**Note:** In this model, lettuce represents the plant material while the tuna/egg represents the animal material. The sand represents the layers of the earth and sediment that provided the pressure necessary for oil and natural gas formation.

Natural gas is a colorless, odorless gas. From the well site, natural gas is carried by pipelines to a refinery. There it is cleaned, and for safety reasons, an odor is added. This enables people to smell natural gas. It is dangerous to breathe and highly flammable. From the refinery, natural gas is piped to storage facilities until needed by consumers. Most natural gas is sold to consumers by public utility companies. Public utilities buy their natural gas supplies from the private companies that produce it.
It’s a Gas
Student Sheet-TEACHER KEY

Wonder Why...
Have you ever thought about how natural gas is formed? Where would you go to find natural gas?

Materials
• 20g tuna or 1 hard-boiled egg with shell
• 2 lettuce leaves or equal amount of shredded lettuce (about 1/3 cup)
• Clear plastic bottle (8oz or 16oz)
• 1 balloon
• Graduated Cylinder
• 50g sand
• 25ml aquarium or pond water
• Masking tape
• Balance scale/weights

Procedure
1. Measure 20g of an organic substance and put it in the bottle. Tear the lettuce leaves into small pieces and put them in the bottle.

2. Use the balance scale to measure 50g sand. Carefully pour the sand into the bottles so that the sand covers the organic substance and lettuce. Do not shake the bottle.

3. Measure 25ml of water. Slowly pour the water into the bottle. Try to make the water run down the inside of the bottle instead of pouring the water directly onto the sand.

4. Stretch the opening of the balloon over the opening of the bottle. Seal with masking tape.

5. Carefully move the bottles to a warm place (preferably outside as contents could produce a strong odor). Let the bottle stay in place for several days.

6. Predict what will happen over the next few days.
   Answers will vary.
7. Design a chart and record your daily observations (change in the balloon, etc.).

Journal

What do you think caused the changes in the balloon? What happened to the materials in the bottle as time passed? What name could we give this newly formed substance? How did the substance change?

_The decaying lettuce and tuna/egg cause the balloon to start to fill up with gas. The materials in the bottle started to decay. The newly formed substance is a gas. The substance changed from a solid to a gas._

Vocabulary

Organic  _derived from a living matter_

Inorganic  _not consisting of living matter_

Natural Gas  _a gas that comes from the earth’s crust_

Chemical Change  _a substance that is altered chemically and displays different physical and chemical properties_

Physical Change  _a change from one state (solid or liquid or gas) to another without a change in chemical composition_
It’s a Gas
Conclusion

1. In your gas formation bottle that you created, what does each ingredient represent?

   Water  \( \text{Ocean water} \)

   Sand  \( \text{Layers of the earth} \)

   Lettuce  \( \text{Plant material} \)

   Tuna or egg  \( \text{Animal material} \)

2. After a few days, what happened to the ingredients in your gas formation bottle?
   \( \text{The lettuce and tuna/egg began to decay.} \)

3. What physical changes occurred?
   \( \text{The lettuce started to wilt and the tuna/egg started to grow mold. The bottle began to emit a foul odor.} \)

4. What chemical changes occurred?
   \( \text{The solids began to change into a gas.} \)

5. How do you know the chemical changes occurred?
   \( \text{The balloon started to inflate and trap the gas.} \)
Let’s Get Physical With Oil

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards

Observe and measure; classify; experiment and inquiry; interpret and communicate

Physical Science Content Standards

Objects can be described in terms of the materials of which they are made. Mixtures and solutions can be separated (i.e., sand and marbles; or salt and water).

Grade 4

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Grade 5

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards

Matter has physical properties that can be used for identification (e.g., color, texture, shape).

Physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

Grade 6

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards

Matter has physical properties that can be measured (i.e., mass, volume, temperature, color and texture). Changes in physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

National Science Education Standards

Physical Science (Grades K-4)

Objects have many observable properties, including size, weight, shape, color, temperature and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances and thermometers.
Physical Science (Grades 5-8)

A substance has characteristic properties, such as density, a boiling point and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
Let’s Get Physical With Oil
Properties of Oil
Cycle 4

Wonder Why…
How can we describe oil? What are its **physical properties**?

Concept
The **physical properties** of oil are unique and different. Oil is a thick liquid that feels slick. It has color and odor. The same volume of oil has less mass than water because oil is less dense than water.

**Materials**
- 2 clear plastic cups per group
- Water
- Vegetable oil
- 1 paper towel per person
- 1 balance scale per group
- 2 plastic graduated cylinders per group (labeled water and oil)
- Crude oil sample

**Teacher Information**
For safety reasons, do not let students taste oil products. Using the graduated cylinders allows practice in measurement skills.

**Discovery Procedure**
1. Pick 5 objects around the classroom and have students describe their physical properties.
2. Compare and contrast the physical properties of oil and water. Record your observations.
3. Using graduated cylinders, measure 25ml of water and 25ml of vegetable oil. Pour the water into a clear cup. Then pour the vegetable oil into a clear cup.

4. Predict which substance has more mass.

5. Using a balance, compare the mass of the 25ml of oil to the mass of the 25ml of water. What happens? What can you say about the mass of oil when compared to an equal volume of water?

6. Slowly pour the vegetable oil into the 25ml of water. What happens? What physical property of oil can be observed from the experiment?

**Concept Formation**

1. Have each group summarize their findings and share those finding with the class.

2. As a class, decide on a final list of physical properties of oil. Record on the board. Support/enhancement questions to facilitate discussion:

   a. What is the state of matter that oil exists in at room temperature? *Liquid*
   
   b. How did the vegetable oil feel? (Texture) *Thick, slimy, greasy, slick*
   
   c. How did the vegetable oil smell? (Odor) *Not a very strong smell.*
   
   d. Does oil have mass? How does that mass compare to the mass of water? *Oil has less mass than water*
   
   e. What happened to the oil when mixed with water? What does this tell you about oil? *Oil and water do not mix. Oil sits above water, which means it is less dense than water.*

**Vocabulary Words**

- **Mass**—the quantity of materials that an object contains

- **Density**—amount of mass in a certain volume of matter. The lighter liquid (less dense) floats on top of the heavier liquid (more dense)

- **Physical Property**—what can be seen or measured

**Application/Expansion**

- Compare and contrast the crude oil sample to the vegetable oil. Write a paragraph describing the samples you have observed.

- Explore changes in the physical properties of the vegetable oil when exposed to different environments by putting it in the refrigerator, in the freezer and in direct sunlight. Measure 30mL of vegetable oil into each of the three clear plastic cups. Measure 30mL of water into each of the three clear plastic cups. Set one cup of water and one cup of vegetable oil in each of the three areas (refrigerator, freezer and direct sunlight). Leave the samples for the same period of time...suggested time is overnight. Describe any changes observed. (Suggestion: Students design and use a chart for recording data collected.)
Teacher Information

Crude oil comes in a variety of colors and thickness. Over the years, the industry and the media have called it a variety of names, including Black Gold and Texas Tea. The color of crude oil is determined by chemical composition.

Enrichment

- Write an acrostic poem including all that you learned about the physical properties of oil. (Suggestion: the title can be “CRUDE OIL” creating an easy lead into the physical properties of oil.

   **Example:**

   Comes from
   Right
   Under the
   Dirt and
   Earth

   Oil
   Is formed from
   Life
Let’s Get Physical With Oil
Student Sheet—TEACHER KEY

Wonder Why…

How can we describe oil? What are its physical properties?

Materials
• 3 clear plastic drink bottles with lids (less than 1 liter)
• 2 clear plastic cups per group
• Water
• Vegetable oil
• 1 paper towel per person
• 1 balance scale per group
• 2 plastic graduated cylinders per group

Procedure

1. Using graduated cylinders, measure 25ml of water and pour into a clear cup. Measure 25ml of vegetable oil and pour into a clear cup.

2. Compare and contrast the characteristics of oil and water. Record your observations.
   DO NOT taste the oil.

   *Oil is a thick liquid with a distinct smell. Water is a thin liquid with no smell.*

3. Predict which substance has more mass.

   *Water has more mass than oil.*

4. Using a balance, compare the mass of the 25ml of oil to the mass of 25ml of water. What happens? What can you say about the mass of oil when compared to an equal volume of water?

   *The cup with water goes down, while the cup with oil goes up on the balance; therefore, water has more mass than oil.*
5. Slowly pour the vegetable oil into the 25ml of water. What happens? What physical property of oil can be observed from the experiment?

The oil floats on top of the water, which means it is less dense than water. The oil is thicker, but lighter than water.

Journal

What is the state of matter that oil exists in at room temperature? How did the vegetable oil feel? How did the vegetable oil smell? How does the mass of oil compare to the mass of water? What happened to the oil when mixed with water? What does this tell you about oil?

At room temperature, oil is a liquid. The vegetable oil is greasy and thick. It had a odor, but it is not very strong. The mass of water is greater than the mass of oil. The oil floats on top of the water, which means it is less dense than water.

Vocabulary Words

Mass  the quantity of materials that an object contains

Density amount of mass in a certain volume of matter. Weight per volume; the lighter liquid (less dense) floats on top of the heavier liquid (more dense).

Physical Property what can be seen or measured
Let’s Get Physical With Oil
Conclusion

Write an acrostic poem including all that you learned about the physical properties of oil.

Samples:  

C omes from  
R ight  
U nder the  
D irt and  
E arth  
O il  
I s  
L ife  

O ut of the ground  
I s less dense than water  
Leaves a residue  
Factor is water when  
Lifting and shaking in a container  
Oil is slower  
When moving and  
Slimy to touch
Seeping Stones

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards

Observe and measure; classify; experiment and inquiry; interpret and communicate

Earth/Space Science Content Standards

Make observations of similarities and differences in rocks and minerals (i.e., size of particles, color pattern and layering.)

Grade 4

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Grade 5

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards

Matter has physical properties that can be used for identification (e.g., color, texture, shape).

Grade 6

Process Standards

Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards

Matter has physical properties that can be measured (i.e., mass, volume, temperature, color and texture). Changes in physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

National Science Education Standards

Physical Science (Grades K-4)

Objects have many observable properties, including size, weight, shape, color, temperature and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances and thermometers.
Wonder Why…

You have probably heard the expression “solid as a rock.” Do you think rocks are solid or do they have spaces/pores?

Concept

Some rocks are porous. They have pores that allow oil to collect in the rocks.

Materials

• Samples of sedimentary rock provided by teacher such (limestone, sandstone, shale and granite)
• 1 eyedropper or pipette per group
• Water
• Paper towels

Teacher Preparation

(Optional) Call OERB to schedule a Petro Pro at (800) 664-1301 or visit OERB.com/educators.

Discovery Procedure

1. Provide samples of sandstone, limestone, shale and granite to share with each group (each group should have 4 rocks).

2. Instruct groups to predict and record what they think will happen when 3 drops of water are dropped on each rock.

3. Discuss your findings.
Concept Formation

1. What happens to the water? *The water absorbed into the rock.* Can you select and sort the rocks that “drank” or absorbed the water?

2. What happened to the water that was not absorbed into the rocks? *The water either sat on top of the rock or fell off of the side of the rock.* Why do you think some rocks absorbed the water while others repelled it? *The rock that has more porosity will absorb the water.*

3. Where do you think the water went if it “disappeared?” *It was absorbed into the rock and is stored inbetween the pores of the rock.*

4. Teacher then provides information introducing the new concept of *porosity.* **Porosity** is the ability of a liquid and/or gas to collect in pores of rocks much like water collecting in a sponge (see porosity illustration below- draw an example on the board).

5. Do you think rocks could store things other than water? *Under the right conditions, pores inside rocks may also hold oil and natural gas.* **The more porous** the rock, **the more oil and natural gas** it **can hold.**

Vocabulary Words

**Porous**—having pore spaces or tiny holes

**Non-porous**—not having tiny holes that collect and store liquids; a surface that water and air cannot penetrate

**Sedimentary Rocks**—rocks that form when sediments and other minerals press together and harden

**Igneous Rocks**—rocks that form when magma (melted rock) cools and turns solid

**Metamorphic Rocks**—rocks that form when existing rocks are exposed to increased heat and pressure inside the earth’s crust
Application/Expansion

• Using collected data, hypothesize what will happen if 10 drops of water are used. Test hypothesis.

• Predict which rocks will hold the most water. Separate the rocks according to the least to most porous. Chart and graph the number of water drops absorbed by each rock.

• Compare your rocks to a rice cake, sponge and pores of skin. How are they alike or different? How does sweat leave your body? How do liquids or gases leave rocks?

• Construct models of sedimentary rock using various types of material.

• Construct a T-chart of foods you eat that are porous and nonporous.

Example:

<table>
<thead>
<tr>
<th>Porous</th>
<th>Nonporous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cake</td>
<td>Flavored gelatin</td>
</tr>
<tr>
<td>Cornbread</td>
<td>Hard candy</td>
</tr>
<tr>
<td>Rice cake</td>
<td>Hershey Chocolate Bar</td>
</tr>
</tbody>
</table>

Teacher Information

Some sedimentary rocks are porous, like a sponge. Tiny particles of sand are held together with rock “cement.” Pressure, time and sediments create this natural type of “cement.”

Oil and natural gas form from decayed plant and animal material. Over time, the many layers of sand and sediments are compacted into sedimentary rock. Tiny spaces, or pores, exist between the particles that enable the rock to hold a liquid. Oil and natural gas become trapped inside the pores. Many pores may be connected to form a pore passage. Rocks that contain pores and pore passages are identified as porous and permeable. Permeability is the ability of liquids and gases to move through pore spaces in rocks. A rock may be porous, but if the pore spaces are not connected together, the liquids will not be able to pass through the rocks.

Through drilling and pumping, oil and natural gas are extracted from the inside of porous and permeable rock. This is contrary to the belief that oil is formed in puddles or pools underground.
Enrichment

Design a texture collage of an oilfield cross-section for a bulletin board or poster display (see below). Suggestions are given for textured layering, but your class may have additional ideas. A reproducible collage is provided.
You have probably heard the expression “solid as a rock.” Do you think rocks are solid or do they have spaces/porosity?

Materials
- Samples of sedimentary rock provided by teacher such as limestone, sandstone, shale and granite
- 1 eyedropper or pipette per group
- Water
- Paper towels

Procedure
1. Predict and record what you think will happen when 3 drops of water are dropped on each rock.

<table>
<thead>
<tr>
<th>Rock</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
</tr>
</tbody>
</table>

2. Using the pipettes, place 3 drops of water on each rock. Discuss and record your findings.

<table>
<thead>
<tr>
<th>Rock</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
</tr>
</tbody>
</table>
3. What happens to the water? Can you select and sort the rocks that “drank” or absorbed the water?

The water is absorbed into the rock. All of the rocks “drank” the water.

4. What happened to the water that was not absorbed into the rocks? Why do you think some rocks absorbed the water while others repelled it?

The water that was not absorbed sat on top of the rock, or fell down the side of the rock. Rocks that repel water are not as porous as rocks that absorb it.

5. Where do you think the water went if it “disappeared?”

The water is being stored in between the rock’s pores.

Journal

Do you think rocks can store things other than water? Explain what you think they might be able to store and why?

They are able to store crude oil and natural gas, because it becomes trapped inside the rock’s pores.

Vocabulary Words

Porous having pore spaces or tiny holes

Non-porous not having tiny holes that collect and store liquids; a surface that water and air cannot penetrate

Sedimentary Rocks rocks that form when sediments and other minerals press together and harden

Igneous Rocks rocks that form when magma (melted rock) cools and turns solid

Metamorphic Rocks rocks that form when existing rocks are exposed to increased heat and pressure inside the earth’s crust
Seeping Stones
Conclusion

1. What are igneous rocks?
   *Rocks that form when magma (melted rock) cools and turns solid.*

2. What are sedimentary rocks?
   *Rocks that form when sediments and other minerals press together and harden.*

3. What are metamorphic rocks?
   *Rocks that form when existing rocks are exposed to increased heat and pressure inside the earth’s crust.*

4. What are some differences in these three kinds of rock?
   *They all were formed differently and are made up of different components.*

5. Which ones are the least porous and most porous?
   *Sedimentary rocks are more porous than metamorphic and igneous rocks.*
Let’s Rock

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards
Observe and measure; classify; experiment and inquiry; interpret and communicate

Physical Science Content Standards
Objects can be described in terms of the materials of which they are made. Mixtures and solutions can be separated (i.e., sand and marbles; or salt and water).
Sound is produced by vibrations (i.e., pitch and loudness).
Compare how sound travels through air, water and/or solids.

Earth/Space Science Content Standards
Make observations of similarities and differences in rocks and minerals (i.e., size of particles, color pattern and layering).

Grade 4

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Grade 5

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards
Matter has physical properties that can be used for identification (e.g., color, texture, shape).

Grade 6

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards
Matter has physical properties that can be measured (i.e., mass, volume, temperature, color and texture). Changes in physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

National Science Education Standards

Physical Science (Grades K-4)
Sound is produced by vibrating objects. The pitch of the sound can be varied by changing rate of vibration.
Wonder Why . . .

Geologists looking for petroleum must locate porous and permeable rocks that may contain oil and/or natural gas. Have you ever wondered how they do this?

Concept

Geologists use sound waves to locate rocks that may contain oil and/or natural gas. Sound waves are affected by different types of rock.

Materials

- Metal dinner forks
- 100 cm string
- Samples of a variety of rocks

Discovery Procedure

1. Tie the fork to the center of the string, just above the tines.
2. Wrap the ends of the string around forefingers and press gently to ears.
3. Lean forward so fork hangs free (similar to the look of a stethoscope).
4. Gently swing the fork against a variety of objects around the room. Note variations in sounds produced by different objects.
5. Have a partner gently strike the tines of the fork with a variety of rocks. Note variations in sounds produced by different rocks.
Concept Formation

1. Have students discuss the differences in the sounds produced from different objects.

2. Why do you think there are differences in the sounds produced from different objects? Each object reflects sound differently.

3. How could scientists use this information to help map the rock layers beneath the earth? Scientists study the sound waves and their speeds on different rocks. They can then determine what rock formations are beneath the earth by listening and studying the sound waves.

Vocabulary Words

- Petroleum—complex hydrocarbon occurring naturally in the earth in solid, liquid or gaseous state
- Sound waves—vibration in air or other medium causing a sensation in the ear
- Sound—an audible impression; something you can hear
- Seimograph—device that records ground vibration

Application/Expansion

- Do a career search of job opportunities in the field of oil and natural gas exploration.

Teacher Information

Sound waves travel at different speeds through different types of rock. Seismologists use special trucks equipped with high tech equipment that read the speeds at which sound travels through various types of rocks. This information is in turn interpreted by geologists to identify rock formations at a prospective drilling site. This helps them to determine if the site could be a good prospect for oil and natural gas location.

Sound waves travel through different types of rocks at different speeds. For example, sound travels through shale at approximately 6,500 feet per second; sandstone at approximately 7,500 feet per second; and limestone at approximately 9,000 feet per second.

One of the most accurate exploration methods is seismic technology. In seismic technology, sound waves created by thumper trucks or explosives detonated either on the earth’s surface or underground are recorded by seismographs. Seismographs are similar to instruments used to measure earthquakes. The reflected sound waves are received by geophones, which transmit the sound waves to a seismograph located in a truck. The particular rate at which the sound waves are reflected back create a picture of the underground geology and possible location of petroleum deposits.

Even after the seismic picture is assimilated and analyzed by geophysicists, there is no guarantee of discovering oil or natural gas. At best, the seismic picture can provide only a guess of what lies beneath us. Drilling for oil and natural gas is a risky business.
Wonder Why . . .

Geologists looking for petroleum must locate porous and permeable rocks that may contain oil and/or natural gas. Have you ever wondered how they do this?

**Materials**
- Metal dinner fork
- 100 cm string
- Samples of a variety of rocks

**Procedure**

1. Tie the string to the center of the fork, just above the tines.
2. Wrap the ends of the string around forefingers and gently press to ears.
3. Lean forward so fork hangs free (similar to the look of a stethoscope).
4. Gently swing the fork against a variety of objects around the room. Record variations in sounds produced by different objects.

<table>
<thead>
<tr>
<th>Item Tested</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
</tr>
<tr>
<td>Answers will vary.</td>
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</tr>
<tr>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
</tr>
</tbody>
</table>

Answers will vary.
5. Have a partner gently strike the tines of the fork with a variety of rocks. Record variations in sound produced by different rocks.

<table>
<thead>
<tr>
<th>Rock Tested</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone</td>
<td>Answers will vary.</td>
</tr>
<tr>
<td>Shale</td>
<td>Answers will vary.</td>
</tr>
<tr>
<td>Limestone</td>
<td>Answers will vary.</td>
</tr>
<tr>
<td>Granite</td>
<td>Answers will vary.</td>
</tr>
</tbody>
</table>

**Journal**

Why do you think there are differences in the sounds produced from different objects? How could scientists use this information to help map the rock layers beneath the earth?

*Each rock is different, therefore the sound waves travel differently through each rock sample. The rate at which the sound waves are reflected back creates a picture of the underground rocks and possible locations of petroleum.*

**Vocabulary**

- Sound waves: *vibration in air or other medium causing a sensation in the ear*
- Seismograph: *device that records ground vibration*
- Sound: *an audible impression; something you can hear*
- Petroleum: *complex hydrocarbon occurring naturally in the earth in solid, liquid or gaseous state*
Let’s Rock
Conclusion

Now that you know geologists use sound waves to search for certain kinds of rocks, let’s learn about other jobs in the oil and natural gas industry. Want to learn more? Ask your teacher to invite a Petro Pro to your classroom.

Are you good with your hands? (Drilling Crews)

- Toolpushers oversee the drilling crews that work on the rig floor, supervise all drilling operations and coordinate operating company and contractors.
- Drillers are directly responsible for the drilling of the hole. They supervise other crew members and operate drilling controls.
- Derrickhands handle the upper end of the pipe as it is hoisted out of or lowered into the well hole. They are also responsible for the circulating machinery and the conditioning of the drilling fluid.
- Rotary helpers, or roughnecks, help handle the lower end of the pipe and help maintain the rig.

Is science your second language? (Geoscientists)

- Geoscientists are stewards of the earth’s resources and environment. They gather and interpret data about the earth’s processes to improve the quality of human life.
- Geochemists use organic chemistry to study the composition of oil, natural gas and coal deposits.
- Environmental geologists study the interaction between the environment and human activities. They work to solve problems associated with pollution, waste management, urbanization and natural hazards.
- Geologists study the processes, physical nature, resources and history of the earth.
- Petroleum geologists aid in the exploration for and production of oil and natural gas.

Are you a math whiz? (Engineers)

- There are many career opportunities in the petroleum industry for engineers. Nearly every variety of engineer plays a part, including chemical engineers, industrial engineers, mechanical engineers, civil engineers, electrical engineers, bioengineers and, of course, petroleum engineers.
- Petroleum engineers search for oil and natural gas reservoirs. Once discovered, they work with geologists and other specialists to understand the geologic formation of the rock containing the reservoir. This helps them determine the best drilling methods to be used. Petroleum engineers also design equipment and processes to achieve the maximum profitable recovery of petroleum from reservoirs.
Weighty Problems

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3
Process Standards
Observe and measure; classify; experiment and inquiry; interpret and communicate

Grade 4
Process Standards
Observe and measure; classify; experiment; interpret and communicate

Grade 5
Process Standards
Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards
Physical properties of objects can be observed, described and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances and Celsius thermometers.

Grade 6
Process Standards
Observe and measure; classify; experiment; interpret and communicate

National Science Education Standards

Physical Science (Grades K-4)
The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.
Wonder Why....

Have you ever wondered how you reach the petroleum deep below the surface of the earth? Do you think you could **drill** a deep hole to reach the petroleum?

Concept

Oil and gas companies **drill** for oil and natural gas, and the derricks they use are designed to bear weight and withstand stress.

Materials

- 50 straws (no fewer than 25 – no more than 50) per group
- 10 small paper clips per group
- Tape – 100cm per group
- String
- Weights
- 2 buckets
- 2 boards (with a cutout in center)
- 2 rulers

Discovery Procedure

1. Present students with the following problem. You are an Oklahoma oil and natural gas producer. At a site you have found, you believe petroleum is at 30,000 feet. You must design a derrick that can support the stress and weight of **drilling** a deep well.

2. With your team, decide what shape and design you will try first and sketch it. **Your structure must be a minimum of 12 inches tall.** Decide with your team what materials you want to use to build your structure. From your design, estimate if you have enough materials. Students will need to consider the size of the base and opening to ensure that the derrick will not fall through.
3. Begin building. Remember, your derrick must be portable. When you have completed your
design, place your derrick on the platform (provided) over the hole.

4. Place a crossbeam (ruler) across the top of your structure and attach the string to the
crossbeam (the bucket attached to the other end of the string hangs below the board through
the center hole). The board is supported on two opposite sides by flat tables or desks.

5. Slowly place weights in the bucket until your derrick begins to bend. Subtract the last gram
from the weight of your bucket. Record your data.

6. With your team, decide how you will redesign your structure to handle more stress and
weight.

7. Build and test your structure for weight and stress. Record your data. Run several more trials.
(Have students decide what type of graph would best display their data.)

8. Have student teams do a presentation of their findings and justify their conclusions.
Concept Formation

1. What derrick design could support more weight? What geometric shapes were more successful? *Triangles and squares should be the most successful, because they distribute weight evenly.* Why do you think this is true?

2. How did your group make its decision? What were the important issues your team needed to consider while making the choices?

Vocabulary

- **Derrick**—a supporting framework over an oil well to hoist **drilling** equipment (pipe, etc.)
- **Drill**—make a hole by boring
- **Weight**—a measure of heaviness
- **Drilling Rig**—oilfield equipment set up to explore for oil and natural gas

Application/Expansion

Have students develop a class graph to display all of their data and see if their conclusions are the same using more data.

Teacher Information

The deepest well **drilled** thus far in the state of Oklahoma is the Lone Star – Bertha Rogers in Washita County. Through drilling, they found it to be a dry hole at 34,411 feet. **Drilling** a deep well requires a rig and derrick that can withstand a great deal of weight and stress.
Weighty Problems
Student Sheet-TEACHER KEY

Wonder Why....

Have you ever wondered how you reach the petroleum deep below the surface of the earth? Do you think you could drill a deep hole to reach the petroleum?

Materials
• 50 straws (no fewer than 25 – no more than 50) per group
• 10 small paper clips per group
• Tape – 100cm per group
• String
• Weights
• 2 buckets
• 2 boards (with a 6” square cut in center)
• 2 rulers

Procedure
1. You are an Oklahoma oil and natural gas producer. You have found a promising area and you believe petroleum is at 30,000 feet. You must design a derrick that can support the stress and weight of drilling a well that is 30,000 feet deep.

2. With your team, decide what shape and design you will try first and sketch it. Your structure must be at least 12 inches tall. Decide with your team what materials you want to use to build your structure. From your design, estimate if you have enough materials. Consider the size of the base and opening to ensure that the derrick will not fall through.

3. Begin building. Remember – your derrick must be portable. When you have completed your design, place your derrick on the platform of boards over the hole.

4. Place a crossbeam (ruler) across the top of your structure and attach the string to the crossbeam (the bucket attached to the other end of the string hangs below the board through the center hole). The board is supported on two opposite sides by flat tables or desks. Predict how much weight your derrick will hold.

Answers will vary.
5. Slowly place weights in the bucket until your derrick begins to bend. Subtract the last gram from the weight of your bucket. Record your data.

*Answers will vary.*

6. With your team, decide how you will redesign your structure to handle more stress and weight.

7. Build and test your structure for weight and stress. Record your data. Run several more trials.

*Answers will vary.*

8. How did your group make its decision? What were the important issues your team needed to consider while making the choices?

*Answers will vary.*

**Journal**

What derrick could support more weight? What geometric shapes were more successful? Why do you think this is true?

*Triangles and squares should be the most successful, because they distribute weight evenly. Answers will vary.*

**Vocabulary Words**

Derrick *a supporting framework over an oil well to hoist drilling equipment*

Drill *make a hole by boring*

Weight *a measure of heaviness*

Drilling Rig *oilfield equipment set up to explore for oil and natural gas*
Weighty Problems
Conclusion

THE DAILY NEWS

dailynews.com  OKLAHOMA'S FAVORITE NEWSPAPER  1974

OKLAHOMA DRILLS DEEPEST WELL!
Burns Flat, OK -- Oklahoma oilfield workers have completed drilling the deepest well Oklahoma has ever seen. The Bertha Rogers No. 1 drilled about 60 feet per day and cost $7 million. Once the drilling was complete the depth reached 34,411 feet. The rig sits in Washita county, which is set in the Anadarko Basin, and used about 1.45 million pounds of pipe. Even after all of the hard work that was put into this well, oilfield workers were disappointed when they discovered it was a dry hole.

1. What is the name of the deepest well ever drilled in Oklahoma?
   Bertha Rogers No. 1.

2. In what town was the well drilled?
   Burns Flat

3. In what county was the well drilled?
   Washita

4. How deep was the well?
   34,411 feet

5. Was the well a producer or a dry hole?
   Dry hole
Give It A Lift

Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3
Process Standards
Observe and measure; classify; experiment and inquiry; interpret and communicate

Grade 4
Process Standards
Observe and measure; classify; experiment; interpret and communicate

Physical Science Content Standards
The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

Grade 5
Process Standards
Observe and measure; classify; experiment; interpret and communicate

Grade 6
Process Standards
Observe and measure; classify; experiment; interpret and communicate

National Science Education Standards

Physical Science (Grades K-4)
The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.
Wonder Why…

Have you ever wondered how oil is recovered or lifted from rock deep within the earth?

Concept

Oil can be recovered from a rock formation using artificial lifting equipment, such as a pumping unit.

Activity One – Lifting Fluids

Materials

• 8 to 10 Drinking straws
• Masking Tape
• Scissors
• Can of dark-colored carbonated beverage
• Step stool or stable chair
• Student volunteer

Discovery Procedure

1. Cut a 1cm slit at one end of each straw.
2. Construct one long tube (approximately 150cm or more) by joining straws end-to-end, placing the slit end into the inside of the adjoining straw.
3. Place masking tape over each connected end to secure the joint and create an air tight seal.
4. Have one student stand on a step stool or chair. Insert the extended straw “tubing” into the can of carbonated beverage.
5. Instruct student to try to bring the liquid to the top of the “tubing” using his/her suction.
6. Have student try to bring the liquid to the top of the shorter lengths of “tubing.”
7. Compare and contrast the effort required to bring the liquid to the top of various lengths of “tubing.”
Concept Formation

1. Does the length of the straw “tubing” make a difference in the amount of suction needed to lift the carbonated beverage? Yes, the longer the tubing, the more suction that is needed.

2. What kind of equipment would we need to lift oil from rock 7,500 feet below the earth’s surface? Artificial lifting systems or pumping units.

3. How does this experiment relate to getting oil out of the ground? The straws represent the pipe and the dark beverage represents the oil. The same concept is used when trying to get oil out of the ground.

Activity Two – Pumping Simulation

Materials
- 1 glass dropper with removable bulb
- 1 plastic dropper with removable bulb
- 1 plastic pipette
- 1 BB
- Container of dark liquid (dark carbonated beverage or water colored with food coloring)

Teacher Preparation

1. Remove the bulb from the glass eyedropper. Place a BB inside the eyedropper.

2. Using the scissors, cut the bulb off the top of the plastic pipette. Cut four or five millimeters off the nose of the pipette.

3. Place the nose of the pipette into the top of the glass eyedropper (the one with the BB).

4. Remove the bulb from the plastic eyedropper. Place the nose of the plastic eyedropper inside the plastic pipette.

Discovery Procedure

1. Holding the eyedropper apparatus with one hand, place the tip of the apparatus into a container of dark-colored liquid.

2. Place the index finger of your opposite hand over the open end of the eyedropper apparatus, creating an airtight seal.

3. Draw the liquid into the eydodrppers by holding the pipette and glass eyedropper with one hand and moving the plastic eyedropper up and down with the other hand. (Note: You must continue holding one finger over the open end of the dropper to maintain the airtight seal.)
Concept Formation

1. What did you discover by using the droppers to **lift** the liquid? *The dropper allows the liquid to be lifted from the cup little by little. The BB allows the liquid to stay in the pipe of the dropper.*

2. What would happen if the BB was removed? *The liquid would fall back into the cup.*

3. How does this experiment relate to getting oil out of the ground? *The pumping motion from the fingers on the eye dropper represents the “horsehead” and it’s up and down motion. This motion causes pressure so the oil can be lifted out of the ground. The BB represents the equipment used to keep the oil from falling back into the ground.*

Vocabulary

- **Lift**—to raise from a lower to a higher position
- **Pumping Unit**—oilfield equipment that pumps oil out of the ground

Teacher Information

Because oil, natural gas and saltwater are under extreme pressure below the surface, these fluids sometimes flow up a well without assistance (much like a soft drink that has been shaken and then opened). This is called primary recovery. When the initial pressure is depleted from production, only a portion of the oil and natural gas has been produced. This does not, however, mean the end of the well’s life.

Artificial **lifting** systems, or pumping units, are used to help pull the oil out of the reservoir rock and pump it up the well. A downhole pump in the well is connected to the pumping unit by steel rods that are screwed together. The pump is activated from the up and down movement of the pumping unit on the surface. As the pump plunges down, fluid from the rock formation flows into the pump chamber. On the upstroke, the fluid in the chamber is forced up the tubing to the surface.

Enrichment

- Show the OERB’s “DUH-DUH-Dangerous” safety DVD.
- Share these Oilfield Safety Facts with your students.
Oilfield Safety Fast Facts

Oilfield equipment can be extremely dangerous, and people should not “hang around” tank batteries and pumping units. Some of the dangers are:

**Tank Batteries**

- The smallest spark, especially a cigarette or lighter, can cause an explosion from fumes or flammable liquids.
- Anyone opening a hatch might be overcome with fumes and pass out.
- The stairs and rails, which can be as high as two stories, can be covered with oil and be slippery, causing someone to fall down the stairways or over the side.

**Pumping Units**

- The counterweights weigh up to 20,000 pounds and will crush a human body without stopping. Anyone who falls off the beam or tries to ride the weights can be seriously injured or accidentally killed.
- Anyone who tries to grab the cable on the front of the unit can have their hands cut off as the cable travels up and down.
- The numerous moving parts of a pumping unit can catch, then injure or even kill a person.
- Electrical boxes, wires and components operate at high voltage. Anyone who touches them could receive serious electrical shock.

**NOTE** Even if a pumping unit is stopped, it is NOT safe. Many units are on timers that start without warning, causing harm if a person is on the unit.

**Other Equipment**

- Some heater treaters (long, tall tanks) operate at extreme temperatures that could cause burns.
- Many fences are topped with barbed or razor wire, which could cause serious injury.
- Pipelines could leak or explode if tampered with by untrained personnel.
- Chemicals are sometimes used at oilfield sites and could cause burns if touched.
Give It A Lift
Student Sheet-TEACHER KEY

Wonder Why...
Have you ever wondered how oil is recovered or lifted from rock deep within the earth?

Materials
- 8 to 10 Drinking straws
- Masking Tape
- Scissors
- Can of dark-colored carbonated beverage
- Step stool or stable chair
- Student volunteer

Procedure
1. Cut a 1cm slit at one end of each straw.

2. Construct one long tube (approximately 150cm or more) by joining straws end to end, placing the slit end over the outside of the adjoining straw.

3. Place masking tape over each connected end to secure the joint.

4. Have one member of your group carefully stand on a step stool or chair. Insert the extended straw “tubing” in the can of carbonated beverage.

5. Try to bring the liquid to the top of the “tubing” using your suction. Does the length of the straw “tubing” make a difference in the amount of suction needed to lift the carbonated beverage?

   Yes, the longer the tubing, the more suction that is needed.

6. Try to bring the liquid to the top of shorter lengths of “tubing.” Record your findings in the chart below.

<table>
<thead>
<tr>
<th>Number of Straws</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Answers will vary</td>
</tr>
<tr>
<td>9</td>
<td>Answers will vary</td>
</tr>
<tr>
<td>10</td>
<td>Answers will vary</td>
</tr>
</tbody>
</table>
7. Holding the eyedropper apparatus with one hand, place the tip of the apparatus into a container of dark-colored liquid.

8. Place the index finger of your opposite hand over the open end of the eyedropper apparatus, creating an airtight seal.

9. Draw the liquid into the eyedroppers by holding the pipette and glass eyedropper with one hand and moving the plastic eyedropper up and down with the other hand. (Note: You must continue holding one finger over the open end of the dropper to maintain the airtight seal.)

Journal

What did you discover by using the droppers to lift water? What would happen if the BB was removed? How does this experiment relate to getting oil out of the ground?

*Suction can be used to pick up liquids, but you can also use a pumping motion. If the BB is removed, the liquid would fall back into the cup. This experiment shows how a pumping unit works to get oil out of the ground.*

Vocabulary

Lift  *to raise from a lower to a higher position*

Pumping Unit  *oilfield equipment that pumps oil out of the ground*
Give It A Lift

Conclusion

1. What did you learn from the “DUH-DUH-Dangerous” safety DVD?

*Answers will vary*

2. List some of the dangers of playing on or around oilfield equipment?

*The tank batteries can explode.*

*The pumping unit can crush or severely hurt a person.*

*The heater treaters can cause burns.*

*Pipelines can leak and explode if tampered with.*

*Chemicals can cause burns.*

**True or False**

3.  *False*  It is safe to go near a wellsite as long as you don’t touch anything.

4.  *False*  If a pumping unit is not moving, it is safe to play on it.

5.  *False*  The liquids and fumes around oilfield equipment are not flammable.
Oklahoma’s Priority Academic Student Skills (PASS)

Grade 3

Process Standards
Observe and measure; classify; interpret and communicate

Physical Science Content Standards
Objects can be described in terms of the materials of which they are made. Mixtures and solutions can be separated (i.e., sand and marbles; or salt and water).

Grade 4

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Grade 5

Process Standards
Observe and measure; classify; experiment; interpret and communicate

Grade 6

Process Standards
Observe and measure; classify; experiment; interpret and communicate

National Science Education Standards

Science in Personal and Social Perspectives (Grades K-4)
Some resources are basic materials, such as air, water and soil; some are produced from basic resources, such as food, fuel and building materials; and some resources are nonmaterial, such as quiet places, beauty, security and safety.
Wonder Why...

How many different products come from one substance called crude oil? How are these products made?

Concept

Heat is needed to separate crude oil/petroleum into usable substances to make the products we use everyday.

Materials

- 400ml whole milk
- 100ml vinegar
- Large container
- 250mL graduated cylinder
- Cordless kettle
- Petro Bags

Discovery Procedure – Teacher Demonstration

SAFETY: Please take a moment to read the safety instructions for the cordless kettle. Safety information is printed in the back of this curriculum guide.

1. Use the Oil Refining Tower to discuss the process of heating crude oil (oil as it comes from the earth before the refining process) and the products that are given off at different temperatures.

2. Ask students, “What are some of the products we can make from milk? (buttermilk, butter, cream, yogurt, cheese) What are some of the things we must do to milk to get these products?” (heat) In this activity, we are going to use milk as a model for crude oil.

3. In a place where all students can see, turn on the cordless kettle. Stir together milk and vinegar in the kettle and allow it to heat up. Wait about 3 minutes and check the substance. You should begin to see that it has separated and the curds are visible.
4. Pour milk and vinegar mixture into the large container. Show the students the separation of the two liquids.

**Concept Formation**

1. What was done to the milk and vinegar mixture to separate it? *It was heated.*

2. How is this model 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 products.*

3. Show students some of the types of products made from crude oil.

**Vocabulary**

- **Products**—things made or manufactured
- **Refine**—to convert into a finished or higher grade product
- **Crude Oil**—oil in its natural state (a mixture of gases, oil and water) as it comes out of the ground

**Application/Expansion**

- Have students cut out pictures of products made from refined petroleum from magazines (refer to “Tower of Power” Blackline master). Classify the products according to major by-product categories. Use the pictures to create mobiles or collages showing major by-product categories and representative household items within each category. Display around the room.
- List things in the classroom made from petroleum products.
- Visit a local refinery.

**Teacher Information**

The crude oil taken from the ground has limited use in its purest form. First, it is treated in a large chemical plant called a refinery. There, the crude oil is heated until it boils. The vapor rises through towers where it cools and condenses at different temperatures. The substances removed at these various temperatures creates the broad categories of by-products from which usable goods are manufactured. The vapor left at the top of the tower becomes bottled gas (propane). The sludge left at the bottom of the tower is used for products like asphalt and roofing materials.

The most used by-product of crude oil is gasoline. Many other important products are made from the substance taken from crude oil. They include plastics, paints, make-up and medicines.

Today, about 6,000 products are produced, wholly or in part, from petroleum. Among the major categories derived from petroleum are petroleum gas, gasoline, kerosene, lubricants, fuel oil and bitumen (see “Tower of Power” Blackline master).
Enrichment

- Write and perform a rap or jingle to inform others about petroleum **products**.

- Have students work in small groups and generate lists of all the petroleum-based **products**, appliances or conveniences their family uses on a daily basis. If students did the Application/Expansion activity using mobiles or posters, have each student retain his/her’s for use with the group’s work. Once the list is completed (or using the mobiles or posters), have students list the 10 most important **products**. Students have now created two groups of products – necessities and luxuries. Have groups present their lists of the 10 most important **products** and supporting reasons for their choices. Have the class come to a consensus on one list of 10 most important **products** (generated from the group presentations). Have students then work in groups again. Assign each group two or three of the 10 **products**.

Activity Two – Petro Bags

**Materials**

- Petro Bags

**Procedure**

1. Give each student group a Petro Bag.

2. Have each group classify objects by placing objects on their desk into either a petroleum based or non-petroleum based product.

3. Discuss results.

**Discussion**

Have student share findings:

1. Why is it important to conserve our use of oil and natural gas? *Over 50% of energy used in our nation comes from oil and natural gas. Oil and natural gas are non-renewable resources and are only available in limited quantities.*

2. Why are the replacement ideas not readily used? *Cost and effectiveness*

3. Why are better conservation practices not used on a regular basis? *Better education is needed on why and how to conserve.*

4. Develop a class definition of what it means to act responsibly when using oil and natural gas. *Not wasting energy. Energy needs to be conserved not only to cut present day costs, but to preserve the fossil fuels for longer use.*
Common Petroleum By-Products

Petroleum Based

- Ink Pens
- Crayons
- Candles
- Books with Pictures
- Panty Hose
- Lotion
- Helmets
- Hard Hats
- Shoes
- Toothbrush
- Combs
- Lipstick
- Tennis Racquets
- Ice Chests
- Eyeglasses
- Toilet Seats
- DVD Cases
- Aspirin
- Golf Balls
- Detergent
- Dice
- Trash Bags
- Shaving Cream
- Credit Cards
- Library Cards
- Clothes
- Tires
- Computers
- Radios
- CD Cases
- Hand Sanitizer
- Markers

Non-Petroleum Based

- Nail Polish
- Pants
- Petroleum Jelly
- Dyes
- Nylon Rope
- Glue
- Umbrellas
- Balloons
- TVs
- Water/Pop bottles
- IPods
- Cell Phones
- Sunglasses
- Buttons
- Erasers
- Plastic Pencils
Tower of Power
Oil Refining Tower

- **Process**
  - Oil heated to 1220° f
  - Gas oil
  - Kerosene
  - Gasoline
  - Oil vapor

- **Product**
  - Fuel oil
  - Lubricants
  - Gas oil
  - Kerosene
  - Gasoline

- **By-Products**
  - Bitmen
  - Fuel for planes
  - Fuel for camping lanterns
  - Gas for gas stoves
  - Propane
  - Butane
  - Gasoline
  - Plastics
  - Chemicals
  - Diesel fuel
  - Heating oil
  - Wax
  - Motor oil
  - Lubricating oil
  - Fuels for factories
  - Fuels for utilities
  - Surfacing for roofs
  - Surfacing for roads
Wonder Why…

How many different **products** come from one substance called crude oil? How are these **products** made?

**Procedure**

1. List 5 products we can make from milk. What are some of the things we must do to milk to get these products?

<table>
<thead>
<tr>
<th>Product</th>
<th>Done to milk to make product</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cream</strong></td>
<td><em>The milk sits out and the cream rises to the top of the milk.</em></td>
</tr>
<tr>
<td><strong>Buttermilk</strong></td>
<td><em>The milk is pasteurized and bacteria is added.</em></td>
</tr>
<tr>
<td><strong>Cheese</strong></td>
<td><em>Cheese is made from curds. It can also be made from heat.</em></td>
</tr>
<tr>
<td><strong>Butter</strong></td>
<td><em>Churning cream creates butter.</em></td>
</tr>
<tr>
<td><strong>Powdered milk</strong></td>
<td><em>Evaporating the milk until it is dry then adding heat and sugar.</em></td>
</tr>
</tbody>
</table>

2. Observe teacher stirring together milk and vinegar in the saucepan over heat. Predict what will happen.

*Answers will vary.*

3. What was done to the milk and vinegar mixture to separate it?

*Heat was added to the milk and vinegar and the mixture separated into two parts. One part is a solid (the curds) and the other part is a liquid (the whey).*
4. Look around the room and list as many products made from petroleum as you can. Using the Tower of Power chart, classify each product into a major by-product category.

<table>
<thead>
<tr>
<th>Product</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers will vary.</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
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<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td>Answers will vary.</td>
<td></td>
</tr>
</tbody>
</table>

**Journal**

How is this model similar to the separation of crude oil into usable parts?

*Crude oil occurs naturally as a mixture of hydrocarbons and impurities. The crude oil is HEATED and separates according to weight and boiling point. Both the model (milk and vinegar) and the separation of crude oil used heat to cause a reaction.*

**Vocabulary Words**

Products  *things made or manufactured*

Refine  *to convert into a finished or higher grade product*

Crude Oil  *oil in its natural state (a mixture of gases, oil and water) as it comes out of the ground*
1. What is the most used byproduct of crude oil?
   *Gasoline*

2. List any four byproducts of crude oil. *(Answers will vary)*
   - paint
   - plastics
   - fuel
   - medicine

3. Why is it important to conserve use of oil and natural gas?
   *Many by-products that we use everyday come from oil and natural gas. These resources are available to us in a limited amount. We need to use our oil and natural gas resources wisely.*
## Vocabulary Review

<table>
<thead>
<tr>
<th>Energy</th>
<th>Potential Energy</th>
<th>Drill</th>
<th>Pumping Unit</th>
<th>Work</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>Kinetic Energy</td>
<td>Refine</td>
<td>Porous</td>
<td>Non-porous</td>
<td>Physical Change</td>
</tr>
<tr>
<td>Petroleum</td>
<td>Derrick</td>
<td>Sound Waves</td>
<td>Density</td>
<td>Mass</td>
<td>Sound</td>
</tr>
<tr>
<td>Igneous</td>
<td>Physical Property</td>
<td>Crude Oil</td>
<td>Fossil Fuels</td>
<td>Sedimentary</td>
<td>Products</td>
</tr>
<tr>
<td>Microscopic</td>
<td>Chemical Change</td>
<td>Lift</td>
<td>Inorganic</td>
<td>Weight</td>
<td>Metamorphic</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Seimographs</td>
<td>Drilling Rig</td>
<td>Fossil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

- **Fossil**: The remains or imprint of plant and animal life preserved in rock layers deep in the earth.
- **Porous**: Having pore space or tiny holes.
- **Sound Waves**: Vibration of air or other medium that causes a sensation in the ear.
- **Work**: The ability to do work.
- **Sand-like material and debris that settles to the bottom of water**: Sand-like material and debris that settles to the bottom of water.
- **Crude Oil**: Oil in its natural state (a mixture of gases, oil and water) as it comes out of the ground.
- **Fossil Fuels**: A gas that comes from the earth’s crust.
- **The quantity of materials that an object contains**: The quantity of materials that an object contains.
- **Possible to move through**: Possible to move through.
- **Drilling Rig**: A supporting framework over an oil well to hoist the drilling equipment.
- **Make a hole by boring**: Make a hole by boring.
- **Oil and natural gas created from the pressure, heat and plant/animal remains in rock layers deep in the earth**: Oil and natural gas created from the pressure, heat and plant/animal remains in rock layers deep in the earth.
- **Amount of mass that is in certain volume of matter**: Amount of mass that is in certain volume of matter.
- **Rocks that form when magma (melted rock) cools and turns solid**: Rocks that form when magma (melted rock) cools and turns solid.
Energy in motion

Stored energy

So small as to be visible only with a microscope

Device that records ground vibration

Derived from a living matter

Things made or manufactured

A change from one state to another without a change in chemical composition

Complex hydrocarbon occurring naturally in the earth in solid, liquid or gaseous state

Rocks that form when existing rocks are exposed to increased heat and pressure inside the earth’s crust

To raise from a lower to a higher position

To convert into a finished or higher grade product

A substance that is altered chemically and displays different physical and chemical properties

Not having tiny holes that collect and store liquids; a surface that water and air cannot penetrate

A measure of heaviness

Not consisting of living matter

An audible impression; something you can hear

Rocks that form when sediments and other minerals press together and harden

Oilfield equipment set up to explore for oil and natural gas

What can be seen or measured

Move or cause to move gradually or with difficulty into another position
## Vocabulary Review—Answer Key

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<th>Definition</th>
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Wonder Why . . .

Have you ever wondered where you get the energy to live and play? What things in your life require energy? Where do you think energy comes from?

Materials
“Energy Bags” containing the following items:
- 2 rubber bands
- 1 small rubber ball
- 2 paper clips
- 2 magnets
- 1 toy car
- 3 gears
- 1 pop-up toy
- 1 ruler (with center groove)

Procedure
1. Observe the objects in your closed bag.

2. Take the materials in your bag and experiment with ways of making the objects go, run or cause something to happen.

3. Which objects in the bag have potential (stored) energy?

4. Once an initial force is applied, which of the objects in the bag have kinetic (motion) energy?

5. Record or draw the energy motions found in each object.
6. Formulate your own definition of energy as it applies to motions of objects in the “energy bag.” Record the definition below.


7. Record the class definition of energy.


8. Assemble the objects in your bag to design a system to cause movement.

Journal
Write a brief description of your system of movement.


Vocabulary Words
Energy
Potential
Kinetic
Work
Energy—It’s In The Bag

Conclusion

1. List six sources of energy.
   ___________________________________________  ___________________________________________
   ___________________________________________  ___________________________________________
   ___________________________________________  ___________________________________________

2. Where does the TV or computer get its energy?
   ___________________________________________
   ___________________________________________
   ___________________________________________
   ___________________________________________

3. Where does your body get its energy?
   ___________________________________________
   ___________________________________________
   ___________________________________________
   ___________________________________________

4. How are these two energy sources different?
   ___________________________________________
   ___________________________________________
   ___________________________________________
   ___________________________________________

5. How are these two energy sources similar?
   ___________________________________________
   ___________________________________________
   ___________________________________________
   ___________________________________________
Fish, Fossils & Fuel  
Student Sheet

Wonder Why…
Do you ever wonder why oil and natural gas are referred to as “fossil fuels”? Do you think oil and natural gas can be made from old fossils? How long do you think it takes fossil fuels to form?

Materials
- 3 slices of bread (one slice of white, wheat and rye)
- Gummy fish candy or crackers
- Heavy books
- Paper towels
- Magnifying lens
- Clear drinking straws

Procedure
1. Carefully pull the crust from each slice of bread.

2. What eventually happens to microscopic ocean animals and plants when they die? Place the white bread on the paper towel. Put gummy fish and bread crumbs on the bread.

3. As the plants and animals lay lifeless on the bottom of the ocean, the currents deposit sediments on top of the dead marine life. Place the rye bread on top of the white bread layer.

4. As millions of years passed, what continued to cover the dead plants and animals? Add another layer of gummy fish and bread crust on top of the bread.

5. Cover the other layers with the wheat bread. Fold the paper towel to cover your bread fossil.

6. Place textbooks or other heavy objects on top of the bread to simulate pressure. Leave your model one or two days to represent the passage of millions of years.
7. After one or two days, observe the “bread fossil.” Use a clear straw to “extract” a core sample from your bread fossil. Remove the core sample and observe the layers through the straw. Now, compare it to the actual core sample. Record and draw your observations.

8. Try to separate the layers of bread. Why do you think the layers are difficult to separate? Try to extract the fish. Can you identify the mold (impression in the bread) and the cast (gummy fossil)?

Journal

Compare the colored residue of the gummy fish in the bread to the remains of the plants and animals that seep into the rock.

Vocabulary Words

Fossil

Fossil Fuels

Sediment

Microscopic
Fish, Fossils & Fuel
Conclusion

1. What are some of the most common types of fossils found in Oklahoma?

________________________________________________________________________

________________________________________________________________________

2. After a few days, how did the layers in your bread fossil change?

________________________________________________________________________

________________________________________________________________________

3. Why did they change?

________________________________________________________________________

________________________________________________________________________

4. When you took your core sample, did you strike oil or drill a dry hole?

________________________________________________________________________

________________________________________________________________________

5. Based on what you learned, why do you think oil production is so expensive?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Wonder Why...

Have you ever thought about how natural gas is formed? Where would you go to find natural gas?

Materials
• 20g tuna or 1 hard-boiled egg with shell
• 2 lettuce leaves or equal amount of shredded lettuce (about 1/3 cup)
• Clear plastic bottle (8oz or 16oz)
• 1 balloon
• Graduated Cylinder
• 50g sand
• 25ml aquarium or pond water
• Masking tape
• Balance scale/weights

Procedure
1. Measure 20g of an organic substance and put it in the bottle. Tear the lettuce leaves into small pieces and put them in the bottle.

2. Use the balance scale to measure 50g sand. Carefully pour the sand into the bottles so that the sand covers the organic substance and lettuce. Do not shake the bottle.

3. Measure 25ml of water. Slowly pour the water into the bottle. Try to make the water run down the inside of the bottle instead of pouring the water directly onto the sand.

4. Stretch the opening of the balloon over the opening of the bottle. Seal with masking tape.

5. Carefully move the bottles to a warm place (preferably outside as contents could produce a strong odor). Let the bottle stay in place for several days.

6. Predict what will happen over the next few days.
7. Design a chart and record your daily observations (change in the balloon, etc.).

**Journal**

What do you think caused the changes in the balloon? What happened to the materials in the bottle as time passed? What name could we give this newly formed substance? How did the substance change?

__________________________

__________________________

__________________________

__________________________

__________________________

**Vocabulary**

Organic ________________________________

Inorganic ______________________________

Natural Gas ______________________________

Chemical Change ______________________________

Physical Change ______________________________
It’s a Gas

Conclusion

1. In your gas formation bottle that you created, what does each ingredient represent?

   Water
   ________________________________

   Sand
   ________________________________

   Lettuce
   ________________________________

   Tuna or egg
   ________________________________

2. After a few days, what happened to the ingredients in your gas formation bottle?

   ________________________________

3. What physical changes occurred?

   ________________________________

   ________________________________

4. What chemical changes occurred?

   ________________________________

   ________________________________

5. How do you know the chemical changes occurred?

   ________________________________

   ________________________________
Let’s Get Physical With Oil
Student Sheet

Wonder Why…
How can we describe oil? What are its physical properties?

Materials
• 3 clear plastic drink bottles with lids (less than 1 liter)
• 2 clear plastic cups per group
• Water
• Vegetable oil
• 1 paper towel per person
• 1 balance scale per group
• 2 plastic graduated cylinders per group

Procedure
1. Using graduated cylinders, measure 25ml of water and pour into a clear cup. Measure 25ml of vegetable oil and pour into a clear cup.

2. Compare and contrast the characteristics of oil and water. Record your observations.
   
   DO NOT taste the oil.

3. Predict which substance has more mass.

4. Using a balance, compare the mass of the 25ml of oil to the mass of 25ml of water. What happens? What can you say about the mass of oil when compared to an equal volume of water?
5. Slowly pour the vegetable oil into the 25ml of water. What happens? What physical property of oil can be observed from the experiment?

Journal

What is the state of matter that oil exists in at room temperature? How did the vegetable oil feel? How did the vegetable oil smell? How does the mass of oil compare to the mass of water? What happened to the oil when mixed with water? What does this tell you about oil?

Vocabulary Words

Mass

Density

Physical Property
Let’s Get Physical With Oil
Conclusion

Write an acrostic poem including all that you learned about the physical properties of oil.

Samples:

**C**omes from **O**ut of the ground
**R**ight **I**s less dense than water
**U**nder the **L**eaves a residue
**D**irt and **E**arth **F**actor is water when
**E**arth **L**ifting and shaking in a container

**O**il **O**il is slower

**I**s **W**hen moving and

**L**ife **S**limy to touch
### Seeping Stones
#### Student Sheet

**Wonder Why...**

You have probably heard the expression “solid as a rock.” Do you think rocks are solid or do they have spaces/porosity?

**Materials**
- Samples of sedimentary rock provided by teacher such as limestone, sandstone, shale and granite
- 1 eyedropper or pipette per group
- Water
- Paper towels

**Procedure**

1. Predict and record what you think will happen when 3 drops of water are dropped on each rock.

<table>
<thead>
<tr>
<th>Rock</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Using the pipettes, place 3 drops of water on each rock. Discuss and record your findings.

<table>
<thead>
<tr>
<th>Rock</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
3. What happens to the water? Can you select and sort the rocks that “drank” or absorbed the water?

__________________________________________

4. What happened to the water that was not absorbed into the rocks? Why do you think some rocks absorbed the water while others repelled it?

__________________________________________

5. Where do you think the water went if it “disappeared?”

__________________________________________

Journal

Do you think rocks can store things other than water? Explain what you think they might be able to store and why?

__________________________________________

__________________________________________

__________________________________________

__________________________________________

Vocabulary Words

Porous ______________________________________

Non-porous __________________________________

Sedimentary Rocks ___________________________

Igneous Rocks ________________________________

Metamorphic Rocks ____________________________
Seeping Stones
Conclusion

1. What are igneous rocks?
   ____________________________
   ____________________________

2. What are sedimentary rocks?
   ____________________________
   ____________________________

3. What are metamorphic rocks?
   ____________________________
   ____________________________

4. What are some differences in these three kinds of rock?
   ____________________________
   ____________________________
   ____________________________

5. Which ones are the least porous and most porous?
   ____________________________
   ____________________________
   ____________________________
   ____________________________
Wonder Why . . .

Geologists looking for petroleum must locate porous and permeable rocks that may contain oil and/or natural gas. Have you ever wondered how they do this?

**Materials**
- Metal dinner fork
- 100 cm string
- Samples of a variety of rocks

**Procedure**

1. Tie the string to the center of the fork, just above the tines.

2. Wrap the ends of the string around forefingers and gently press to ears.

3. Lean forward so fork hangs free (similar to the look of a stethoscope).

4. Gently swing the fork against a variety of objects around the room. Record variations in sounds produced by different objects.

<table>
<thead>
<tr>
<th>Item Tested</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
5. Have a partner gently strike the tines of the fork with a variety of rocks. Record variations in sound produced by different rocks.

<table>
<thead>
<tr>
<th>Rock Tested</th>
<th>Observation</th>
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**Journal**

Why do you think there are differences in the sounds produced from different objects? How could scientists use this information to help map the rock layers beneath the earth?

________________________________________________________________________
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**Vocabulary**

Sound waves

Seismograph

Sound

Petroleum
Now that you know geologists use sound waves to search for certain kinds of rocks, let’s learn about other jobs in the oil and natural gas industry. Want to learn more? Ask your teacher to invite a Petro Pro to your classroom.

**Let’s Rock Conclusion**

**Are you good with your hands? (Drilling Crews)**

- Toolpushers oversee the drilling crews that work on the rig floor, supervise all drilling operations and coordinate operating company and contractors.
- Drillers are directly responsible for the drilling of the hole. They supervise other crew members and operate drilling controls.
- Derrickhands handle the upper end of the pipe as it is hoisted out of or lowered into the well hole. They are also responsible for the circulating machinery and the conditioning of the drilling fluid.
- Rotary helpers, or roughnecks, help handle the lower end of the pipe and help maintain the rig.

**Is science your second language? (Geoscientists)**

- Geoscientists are stewards of the earth’s resources and environment. They gather and interpret data about the earth’s processes to improve the quality of human life.
- Geochemists use organic chemistry to study the composition of oil, natural gas and coal deposits.
- Environmental geologists study the interaction between the environment and human activities. They work to solve problems associated with pollution, waste management, urbanization and natural hazards.
- Geologists study the processes, physical nature, resources and history of the earth.
- Petroleum geologists aid in the exploration for and production of oil and natural gas.

**Are you a math whiz? (Engineers)**

- There are many career opportunities in the petroleum industry for engineers. Nearly every variety of engineer plays a part, including chemical engineers, industrial engineers, mechanical engineers, civil engineers, electrical engineers, bioengineers and, of course, petroleum engineers.
- Petroleum engineers search for oil and natural gas reservoirs. Once discovered, they work with geologists and other specialists to understand the geologic formation of the rock containing the reservoir. This helps them determine the best drilling methods to be used. Petroleum engineers also design equipment and processes to achieve the maximum profitable recovery of petroleum from reservoirs.
Weighty Problems
Student Sheet

Wonder Why....

Have you ever wondered how you reach the petroleum deep below the surface of the earth? Do you think you could drill a deep hole to reach the petroleum?

Materials
• 50 straws (no fewer than 25 – no more than 50) per group
• 10 small paper clips per group
• Tape – 100cm per group
• String
• Weights
• 2 buckets
• 2 boards (with a 6” square cut in center)
• 2 rulers

Procedure
1. You are an Oklahoma oil and natural gas producer. You have found a promising area and you believe petroleum is at 30,000 feet. You must design a derrick that can support the stress and weight of drilling a well that is 30,000 feet deep.

2. With your team, decide what shape and design you will try first and sketch it. Your structure must be at least 12 inches tall. Decide with your team what materials you want to use to build your structure. From your design, estimate if you have enough materials. Consider the size of the base and opening to ensure that the derrick will not fall through.

3. Begin building. Remember – your derrick must be portable. When you have completed your design, place your derrick on the platform of boards over the hole.

4. Place a crossbeam (ruler) across the top of your structure and attach the string to the crossbeam (the bucket attached to the other end of the string hangs below the board through the center hole). The board is supported on two opposite sides by flat tables or desks. Predict how much weight your derrick will hold.
5. Slowly place weights in the bucket until your derrick begins to bend. Subtract the last gram from the weight of your bucket. Record your data.

6. With your team, decide how you will redesign your structure to handle more stress and weight.

7. Build and test your structure for weight and stress. Record your data. Run several more trials.

8. How did your group make its decision? What were the important issues your team needed to consider while making the choices?

Journal
What derrick could support more weight? What geometric shapes were more successful? Why do you think this is true?

Vocabulary Words
Derrick
Drill
Weight
Drilling Rig
1. What is the name of the deepest well ever drilled in Oklahoma?

2. In what town was the well drilled?

3. In what county was the well drilled?

4. How deep was the well?

5. Was the well a producer or a dry hole?
Give It A Lift
Student Sheet

Wonder Why…

Have you ever wondered how oil is recovered or lifted from rock deep within the earth?

Materials
• 8 to 10 Drinking straws
• Masking Tape
• Scissors
• Can of dark-colored carbonated beverage
• Step stool or stable chair
• Student volunteer

Procedure
1. Cut a 1cm slit at one end of each straw.

2. Construct one long tube (approximately 150cm or more) by joining straws end to end, placing the slit end over the outside of the adjoining straw.

3. Place masking tape over each connected end to secure the joint.

4. Have one member of your group carefully stand on a step stool or chair. Insert the extended straw “tubing” in the can of carbonated beverage.

5. Try to bring the liquid to the top of the “tubing” using your suction. Does the length of the straw “tubing” make a difference in the amount of suction needed to lift the carbonated beverage?

6. Try to bring the liquid to the top of shorter lengths of “tubing.” Record your findings in the chart below.

<table>
<thead>
<tr>
<th>Number of Straws</th>
<th>Observations</th>
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7. Holding the eyedropper apparatus with one hand, place the tip of the apparatus into a container of dark-colored liquid.

8. Place the index finger of your opposite hand over the open end of the eyedropper apparatus, creating an airtight seal.

9. Draw the liquid into the eyedroppers by holding the pipette and glass eyedropper with one hand and moving the plastic eyedropper up and down with the other hand. (Note: You must continue holding one finger over the open end of the dropper to maintain the airtight seal.)

Journal

What did you discover by using the droppers to lift water? What would happen if the BB was removed? How does this experiment relate to getting oil out of the ground?

Vocabulary

Lift

Pumping Unit
Give It A Lift
Conclusion

1. What did you learn from the “DUH-DUH-Dangerous” safety DVD?

2. List some of the dangers of playing on or around oilfield equipment?

3. True or False
   - It is safe to go near a wellsite as long as you don’t touch anything.
   - If a pumping unit is not moving, it is safe to play on it.
   - The liquids and fumes around oilfield equipment are not flammable.

Name _____________________ Date ____________
Wonder Why…

How many different products come from one substance called crude oil? How are these products made?

Procedure

1. List 5 products we can make from milk. What are some of the things we must do to milk to get these products?

<table>
<thead>
<tr>
<th>Product</th>
<th>Done to milk to make product</th>
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2. Observe teacher stirring together milk and vinegar in the saucepan over heat. Predict what will happen.

____________________________________________________________________________________

____________________________________________________________________________________

3. What was done to the milk and vinegar mixture to separate it?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
4. Look around the room and list as many products made from petroleum as you can. Using the Tower of Power chart, classify each product into a major by-product category.

<table>
<thead>
<tr>
<th>Product</th>
<th>Category</th>
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**Journal**

How is this model similar to the separation of crude oil into usable parts?

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**Vocabulary Words**

Products: ________________________________________________________________

Refine: ________________________________________________________________

Crude Oil: _____________________________________________________________
1. What is the most used byproduct of crude oil?

__________________________________________________________________________

2. List any four byproducts of crude oil. *(Answers will vary)*

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

3. Why is it important to conserve use of oil and natural gas?

__________________________________________________________________________

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__________________________________________________________________________

__________________________________________________________________________

# Vocabulary Review

<table>
<thead>
<tr>
<th>Energy</th>
<th>Potential Energy</th>
<th>Drill</th>
<th>Pumping Unit</th>
<th>Work</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>Kinetic Energy</td>
<td>Refine</td>
<td>Porous</td>
<td>Non-porous</td>
<td>Physical Change</td>
</tr>
<tr>
<td>Petroleum</td>
<td>Derrick</td>
<td>Sound Waves</td>
<td>Density</td>
<td>Mass</td>
<td>Sound</td>
</tr>
<tr>
<td>Igneous</td>
<td>Physical Property</td>
<td>Crude Oil</td>
<td>Fossil Fuels</td>
<td>Sedimentary</td>
<td>Products</td>
</tr>
<tr>
<td>Microscopic</td>
<td>Chemical Change</td>
<td>Lift</td>
<td>Inorganic</td>
<td>Weight</td>
<td>Metamorphic</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Seimographs</td>
<td>Drilling Rig</td>
<td>Fossil</td>
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</tbody>
</table>

The remains or imprint of plant and animal life preserved in rock layers deep in the earth

Having pore space or tiny holes

Vibration of air or other medium that causes a sensation in the ear

The ability to do work

Sand-like material and debris that settles to the bottom of water

Oil in its natural state (a mixture of gases, oil and water) as it comes out of the ground

A gas that comes from the earth’s crust

The quantity of materials that an object contains

A supporting framework over an oil well to hoist the drilling equipment

Make a hole by boring

Oil and natural gas created from the pressure, heat and plant/animal remains in rock layers deep in the earth

Amount of mass that is in certain volume of matter

Rocks that form when magma (melted rock) cools and turns solid
Energy in motion

Stored energy

So small as to be visible only with a microscope

Device that records ground vibration

Derived from a living matter

Things made or manufactured

A change from one state to another without a change in chemical composition

Complex hydrocarbon occurring naturally in the earth in solid, liquid or gaseous state

Rocks that form when existing rocks are exposed to increased heat and pressure inside the earth’s crust

To raise from a lower to a higher position

To convert into a finished or higher grade product

A substance that is altered chemically and displays different physical and chemical properties

Not having tiny holes that collect and store liquids; a surface that water and air cannot penetrate

A measure of heaviness

Not consisting of living matter

An audible impression; something you can hear

Rocks that form when sediments and other minerals press together and harden

Oilfield equipment set up to explore for oil and natural gas

What can be seen or measured

Move or cause to move gradually or with difficulty into another position
Safety Information for Rival Hot Pot Model 4071-WN

**IMPORTANT SAFEGUARDS**

When using electrical appliances, basic safety precautions should always be followed, including the following:

1. Read all instructions before using.
2. Do not touch hot surfaces. Use handles or knobs.
3. To protect against fire, electric shock and personal injury, do not immerse hot pot, its cord or plug in water or other liquid.
4. Close supervision is necessary when any appliance is used near children.

Save these instructions!

**SAVE THESE INSTRUCTIONS**

This appliance is for **HOUSEHOLD USE ONLY**. No user-serviceable parts inside.

In order to ensure quality, Rival boils water in each hot pot prior to shipping. This testing may leave spots on the heating plate inside the unit. This is a normal occurrence and should not

---

**OTHER CONSUMER SAFETY INFORMATION**

This appliance is intended for household use only. To avoid an electrical circuit overload, do not operate another high wattage appliance on the same circuit with this appliance.

**WARNING** Shock Hazard: If the plug on this appliance does not fit in your outlet, do not modify the plug and do not use an adapter. Have an electrician replace the obsolete outlet.

The length of the cord used on this appliance was selected to reduce the hazards of becoming tangled in, or tripping over a longer cord. If a longer cord is necessary, an approved extension cord may be used. The electrical rating of the extension cord must be equal to or greater than the rating of the appliance. Care must be taken to arrange the extension cord so that it will not drape over the counter top or tabletop where it can be pulled on by children or accidently tripped over.

**WARNING** To avoid burns and reduce risk of personal injury, use extreme caution when carrying kettle containing hot water. Do not pour in the direction of people or over people.

---

**SAFETY INFORMATION FOR RIVAL 1.7 LITER CORDLESS ELECTRIC KETTLE**

**IMPORTANT SAFEGUARDS**

When using electrical appliances, basic safety precautions should always be followed, including the following:

1. Read all instructions before using.
2. Do not touch hot surfaces. Use handles or knobs.
3. To protect against fire, electric shock and personal injury, do not immerse cord or plug in water or other liquid.
4. Close supervision is necessary when any appliance is used near children.

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**SAVE THESE INSTRUCTIONS**

This appliance is for **HOUSEHOLD USE ONLY**. No user-serviceable parts inside.

In order to ensure quality, Rival boils water in each hot pot prior to shipping. This testing may leave spots on the heating plate inside the unit. This is a normal occurrence and should not
Safety Information for Proctor Silex Electric Kettle Model K2070

Using the Automatic Kettle

Before First Use: Fill kettle to maximum capacity, bring to a boil, then manually shut off the kettle. Discard water and repeat. Rinse well.

NOTES:
- Use water only in the kettle. If used for foods or beverages such as tea or coffee, the warranty will be voided.
- For increased efficiency and longer life the kettle must be kept clean of mineral deposits. We recommend that you empty the kettle after each use to prevent mineral deposits.

1. Unplug kettle before filling.
2. Fill kettle with desired amount of water. Make sure to cover the element. The water level must be between minimum and maximum indicator lines on the water level indicator.

\[ \text{WARNING} \] Burn Hazard. If kettle is overfilled there is a risk that boiling water may spout out of the spout.

NOTE: This kettle has a built-in safety feature for protection should the unit be plugged in without an adequate amount of water or if the kettle boils dry.

3. Make sure that the lid is in place and the kettle or power base (cordless models only) is standing on a level surface. If the lid is not in place auto shut-off will not operate.

4. For cordless models, ensure kettle is correctly engaged on base. (See illustration.)

5. Plug in kettle.
6. Switch to ON (1) position. A light will illuminate when the kettle is on.

7. The kettle will switch off automatically when the water has boiled or you can manually shut the kettle OFF (O) when desired.

\[ \text{IMPORTANT} \]: Ensure that the cordless kettle has switched off automatically or is switched off manually before removing it from the base.

8. Unplug kettle before pouring.
9. If you want to refill kettle immediately, first check the water level indicator and then, if required, run cold water in through the spout.
10. After use, unplug the kettle and empty.
11. Do not hold the switch on while the kettle is boiling.

If Your Kettle Boils Dry

The kettle element is protected by an automatic safety device. If the kettle is accidentally switched on without water, or is allowed to boil dry, the kettle will automatically repeat a cycle of switching off, cooling down, and switching back on. If this happens, you should:

1. Unplug the kettle.
2. Wait about 20 minutes for the element to cool down and then use as normal and check that the kettle functions correctly.

Cleaning and Descaling Your Kettle

\[ \text{WARNING} \] Electric Shock Hazard.
Never immerse the kettle in water or other liquids.

1. With kettle unplugged, empty any remaining water and rinse. Allow kettle to cool.
2. To avoid scale/time deposit build-up, empty kettle after each use.
3. If you have scale/time deposit build-up, add 1/2 teaspoon cream of tartar to your kettle and fill to max line with water. Switch kettle on and allow to boil. Switch kettle off. Let sit for 15 minutes. Empty kettle and rinse with fresh water.
4. Wipe the exterior of kettle with a damp cloth. Do not use abrasive scouring pads or powders as they may scratch the smooth surface of the kettle.

Proctor Silex Limited Warranty

This warranty applies to product purchased in the U.S. and Canada. This is the only express warranty for this product and is in lieu of any other warranty or condition.

This product is warranted to be free from defects in material and workmanship for a period of one (1) year from the date of original purchase. During this period, our exclusive remedy is repair or replacement of this product or any component found to be defective, at our option; however, you are responsible for all costs associated with returning the product to us and our returning a product or component under this warranty to you. If the product or component is no longer available, we will replace it with a similar one of equal or greater value.

This warranty does not cover glass, filters, wear from normal use, use not in conformity with the printed directions, or damage to the product resulting from accident, alteration, abuse, or misuse. This warranty extends only to the original consumer purchaser and does not cover damage caused by improper or inadequate maintenance or repair.

We exclude all claims for special, incidental, and consequential damages caused by breach of express or implied warranty. All liability is limited to the amount of the purchase price. Every implied warranty, including any statutory warranty of merchantability or fitness for a particular purpose, is disclaimed except to extent prohibited by law, in which case such warranty or condition is limited to the duration of this written warranty. This warranty gives you specific legal rights. You may have other legal rights that vary depending on where you live. Some states or provinces do not allow limitations on implied warranties or special, incidental, or consequential damages, so the foregoing limitations may not apply to you.

To make a warranty claim, do not return this appliance to the store. Please call 1.800.851.8800 in the U.S. or 1.866.267.2829 in Canada or visit prosilex.com in the U.S. or prosilex.ca in Canada. For faster service, locate the model, type, and serial numbers on your appliance.