Energy4me STEM Kit

A tool for STEM classroom presentation!

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SPE's Energy4me program is pleased to provide the Energy4me STEM Kit to use in your educational outreach program. The kit offers ready-to-go tools you need for fun, exciting presentations to primary, intermediate and secondary classrooms.

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About Energy4me

Energy4me® is the Society of Petroleum Engineers' energy education program that helps students, teachers, and the public find factual, unbiased information about ALL types of energy sources. The program is STEM based and is designed to make an impact with website resources, teacher development, hands-on activities, and speaker programs.

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How to use the Kit

The kit has 4 modules that evolve from the orgin of oil and gas to the development based on the age of the students. Each module has a lesson plan and hands-on activities. The lessons correlate to pages in the Oil and Natural Gas book, included in the kit. Also included are basic supplies for the activities and a list of perishable goods that need to be procured. Once the kit is used, replenish the supplies for the next member. Lastly, let us know how the event goes by submitting an activity report and we will share your success on our social channels.

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ENERGY4ME STEM KIT CONTENT

Easily demonstrate the dynamic process of discovering oil and gas and how it shapes our world.

Module I: Where does oil come from?

Hands-on Activity 1: Fish, Fossils, and Fuel (Primary Students)

Hands-on Activity 2: Seeping Stones: What are oil traps (ALL Grade Level)

Module II: How do we find oil and gas?

Hands-on Activity 3: Exploring Oil Seep (ALL Grade Level)

Hands-on Activity 4: Exploring Core Sampling (ALL Grade Level)

Module III: How do we get the oil out of the ground?

Hands-on Activity 5: Getting the Oil Out (ALL Grade Level)

Hands-on Activity 6: Perforated Well Casing (Intermediate & Secondary)

Module IV: Oil and the Environment

Hands-on Activity 7: Enhanced Oil Recovery (Intermediate & Secondary)

Fun and Games

Great Energy Debate

Peak Oil Game

ENERGY4ME STEM KIT CONTENT

Easily demonstrate the dynamic process of discovering oil and gas and how it shapes our world.

This kit includes sufficient materials to conduct a hands-on classroom demonstration. While the majority of components are provided, certain common items (e.g., water, oil) must be sourced locally. Members are kindly requested to replenish any consumable materials after use to ensure the kit remains complete and ready for future Energy4me sessions.

Provided in the Kit (re-usable)

- Magnifying Lens (2qty.)
- Pipette (2qty.)
- Marker (1qty.)
- Ruler (4qty.)
- Scissors (4qty.)
- Kitchen Sponge (12qty.)
- Pushpin (12qty.)
- Mason Jar/Plastic Jar (2qty.)
- Plastic Tubing (1meter)
- Beaker (2qty.)
- Graduated Cylinder (1qty.)
- Spray Bottle (1qty.)
- Oil and Natural Gas Book (1qty.)

Provided in the Kit (consumable)

- Paper Towel (1qty.)
- Clay (4qty.)
- Plastic Cup (9qty.)
- Colored Sand (4 packet)
- Soil (1 packet.)
- Masking Tape (2qty.)
- Small cup (8qty.)
- Flexible Straw (6qty.)
- Clear Plastic Straw (6 sets)
- Sandwich Bag (8qty.)
- Effervescent Tablet (12qty.)

MODULE I

Where does oil come from?

Hands-on Activities

Fish, Fossils, and Fuel

Seeping Stones: What are oil traps

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Fish, Fossils and Fuel

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PRIMARY STUDENTS

Topic

Where oil comes from

Source

Oil and Natural Gas, pages 18-19

Objective

Students will gain an overall picture of the sequence of processes that leads to the formation of sedimentary rocks and fossil fuels. Oil is formed from the remains of plants and animals.

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each student (3 pages)
3. Make copies of the exit questions, one for each student
4. Read through the "Member Information" section

Vocabulary Words

Fossil - The remains or imprint of marine life embedded and preserved in rock layers deep in the earth.

Fossil fuels - A hydrocarbon deposit, such as petroleum, coal, or natural gas, derived from living matter of a previous geologic time and used for fuel.

Sediment - Sand-like material and debris that settles or is deposited by water, wind or glaciers over time.

U.S. National Science Education Standards

Earth/Space Science (Grades K-4)

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

Fish, Fossils and Fuel

Engagement

Do you have dinosaurs in your gas tank? Did you ever hear that oil and natural gas are **fossil fuels**? Do you think oil and natural gas can be made from old **fossils**? How long do you think it takes **fossil fuel** to form?

Exploration

1. Split the students into groups of four. Assign each student a job from the list below.

   Recorder: the student who writes down the information from the experiment

   Reporter: the student who presents their group's findings to the class

   Material Getter: the student who gathers and puts away the materials for the experiment

   Facilitator: the student who oversees the experiment and ensures their group stays on task.

2. Pass out one "Fish, Fossil and Fuel" lab packet to each student. Have students read through the lab instructions once.
3. Member says: "We are going to learn what eventually happens to animals and plants when they die." Ask the students to perform step one and step two of the experiment.
4. Member says: "As the plants and animals lay lifeless wind and ocean currents deposit **sediments** on top of the dead marine life." Explain the definition of sediments to the students. Have the students complete step three of the experiment.
5. Member asks: "As millions of years passed, what continued to cover the dead plants and animals?" (**More sediments deposited by wind and ocean currents**). Ask students to complete step four of the experiment.
6. Member says: "Something is still missing to help our fish fossilize. What is it?" (**Pressure**) Students should now complete steps five, six and seven of the experiment.
7. Have students individually answer the lab questions on Lab Worksheet, page 1.
8. Have the reporter of each group stand up in front of the class and present their findings.
9. At the end of the lab, lead a discussion with the students. Compare the colored residue of the gummy sh in the bread fossil to the remains of the plants and animals that seep into the rock. The residue left by the gummy sh represents oil deposits left behind by dead plants and animals. Over millions of years, these remains are pressurized to become oil and natural gas deposits.

As we journey back in time, let's think about how we can recreate the historical formation of fossils. What eventually happens to sea animals and plants when they die? (**They fall to the ocean floor.**) As the plants and animals lay lifeless, wind and currents deposit **sediments** on top of the dead. As these layers increase, the pressure also increases creating **fossils** and **fossil fuels**. What has changed about our "bread fossils?" What happened to the layers?

Explanation

Teacher Information

Read to students from *Oil and Natural Gas*, pages 18-19

> *Scientists once thought that most oil was formed by chemical reactions between minerals in rocks deep underground. Now, the majority of scientists believe that only a little oil was formed like this. Much of the world's oil formed, they think, from the remains of living things over a vast expanse of time. The theory is that the corpses of countless microscopic marine organisms, such as foraminifera and particularly plankton, piled up on the seabed as a thick sludge, and were gradually buried deeper by sediments accumulating on top of them. There the remains were transformed over millions of years—first by bacteria and then by heat and pressure inside Earth—into liquid oil. The oil slowly seeped through the rocks and collected in underground pockets called traps, where it is tapped by oil wells today.*

Much of what is below the surface today was under ancient seas millions of years ago. Geologists know this because many layers containing fossil remains of marine life have been found throughout the World. Millions of small marine plants and animals lived in the seas and oceans, eventually died, and then settled on the ocean floor. Sand and other sediment, much like the bread fossil, often buried the dead plants and animals. 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 gas companies drill holes in the subsurface rock looking for oil and natural gas deposits. These rock formations are sometimes in depths of five miles (8.05 kilometers) or more. As oil and natural gas are being depleted from existing wells, geologists are constantly searching for undiscovered sources of oil. 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 sources.

Evaluation

1. Students should complete the exit questionnaire worksheet individually.
2. Have the students record in a journal the life cycle of a fish until it is found as a fossil. The students should be able to tell you about the life of a fish from birth to death and then what happens after they have fallen on the ocean floor to a fossil and then become a fossil fuel.

Elaboration

1. Create a fossil by making a clay imprint of a hand or an object of choice. Let it dry, and bury it somewhere on school grounds or your backyard for you or someone to find a year from now, or millions of years from now.
2. Compare actual fossils (collected by teacher and/or students) and classify by properties.
3. Create comic strips, journal entries or models to demonstrate the process of fossil fuel formation.

Lab Question Answer Key

1. What piece of bread looks like the sandy floor of the ocean? **White**
2. What layer of bread could we use to represent the sediments? **Rye**
3. What does the last layer of bread represent? **More sediment deposits**
4. What was used in your experiment to put pressure on the "rock layers" of the "bread fossil?" **Books or a heavy object**

Exit Questionnaire Answer Key

1. What was applied to the organisms that caused them to transform into oil?

   a. Heat and pressure

2. Scientist once thought that oil was formed by chemical reactions between minerals in rocks deep undeground. Now, scientists believe fossil fuels are formed from the remains of living organisms buried in the ground. Fossil fuels formed over a long period of time because **heat** and **pressure** were applied to **sediments** that were **deposited** in the ground.

3. Is oil considered to be a renewable or non-renewable energy source?
   Oil is a non-renewable resource because it cannot be replenished, or made again, in a short period of time

Bread Fossils: Discover the Origin of Fossil Fuels
Lab Packet

Reporter____

Recorder____

Material Getter___________________________________

Facilitator_______________________________________

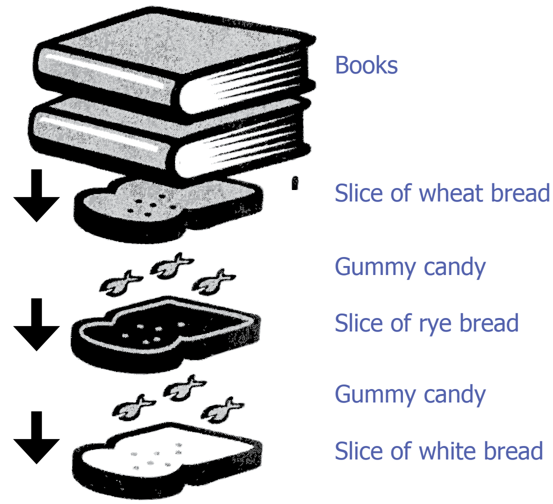
Bread Fossils: Discover the Origin of Fossil Fuels

Materials Included in the Kit

- ❑ Paper towels
- ❑ Magnifying lens
- ❑ Clear drinking straws

Materials the member needs to provide

- ❑ 3 slices of bread (one slice each of white, wheat, and rye)
- ❑ Gummy candy
- ❑ Heavy books



Instructions

1. Carefully pull the crust from the three slices of bread.
2. Place a piece of white bread on top of the paper towel. Put two or three gummy candies on top of the white bread.
3. Place a piece of rye bread on top of the white bread layer. Put two or three gummy candies on top of the rye bread.
4. Place a piece of wheat bread on top of the rye bread layer.
5. Fold the paper towel to cover your bread fossil.
6. Place two textbooks or a heavy object found in the room on top of the bread. Place your bread fossil with the pressure source in a secure area of the classroom.
7. Turn to page 2 of your lab packet and complete the table for Day 1. Answer the lab questions below. Each student in your group will complete their own chart and lab questions..

Lab Questions

1. What piece of bread looks like the sandy floor of the ocean?______________________________________
2. What layer of bread could we use to represent the sediments?______________________________________
3. What does the last layer of bread represent?____
4. What was used in your experiment to put pressure on the "rock layers" of the "bread fossil?" ______________

   ____

Fish, Fossils and Fuel

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Exit Questionnaire

PRIMARY STUDENTS

Name:______________________

Questions

1. What was applied to the organisms that caused them to transform into oil?

    a. Heat and pressure

    b. Carbon filtered through limestone

    c. Bacteria on top of the mud

    d. Nitrogen mixed in the water

2. Scientist once thought that oil was formed by chemical reactions between minerals in rocks deep underground. Now, scientists believe fossil fuels are formed from the remains of living organisms buried in the ground. Fossil fuels formed over a long period of time because ____________________ and ____________________ were applied to ____________________ that were ____________________ in the ground.

3. Is oil considered to be a renewable or non-renewable energy source? ____________________
   Why?

   ____

   ____

   ____

Seeping Stones

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Topic

Oil traps

Source

Oil and Natural Gas, pages 24-25

Objective

Students will learn that some rocks are **porous**, which allows oil to collect in the rock.

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each group
3. Make copies of the exit questions, one for each student
4. Read through the "Member Information" section

Vocabulary Words

Oil traps - places where oil collects underground after seeping up through the surrounding rocks.

Permeability - the ability of liquids and gases to move through pore spaces in rocks

Porous - having pore spaces

Porosity - the ability of the rock to hold liquid and/or gas in its pores, much like water collects in a sponge.

U.S. National Science Education Standards

Process Standards (Grades 3-6)

Earth/Space Science Content Standards (Grade 3)

Physical Science Content Standards (Grades 5-6)

Physical Science (Grades K-4)

Engagement

You have probably heard the expression "solid as a rock." Do you think rocks are solid or do they have **porosity** (spaces)?

Teacher Demo: Use a small clear plastic cup full of marbles or rocks. Pose the following question: If I add water to this container, how much water do you predict it will hold? Measure 100ml of water in a graduated cylinder,. Start by pouring 20ml of the water into the cup. After observing the cup, have students decide how much water you should add. Continue this procedure until the cup is full of water (a tray may be needed for spills). How does this demonstrate porosity? Where does the water collect?

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.

Exploration

1. Split the students into groups of four. Assign each student a job from the list below.

   Recorder: the student who writes down the information from the experiment

   Reporter: the student who presents their group's findings to the class

   Material Getter: the student who gathers and puts away the materials for the experiment

   Facilitator: the student who oversees the experiment and ensures their group stays on task.

2. Pass out one "Seeping Stones" lab packet to each group. Have students read through the lab instructions once.
3. Member says: "Today we are going to learn how some rocks are **porous**. They have pores that allow oil to collect in the rocks."
4. Let the students begin their experiment. Monitor the students to make sure that everyone is participating.
5. Once the students have completed the experiment, have the students present their charts and graphs on what will happened if ten drops are dropped on each rock.
6. After the presentations, discuss with the students again the concept of porosity and the rocks ability to hold a liquid and/or gas.
7. Have the students individually complete the "Seeping Stones" exit questionnaire.

Explanation

Member 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 the rock to let liquids and gases flow through pore spaces in the rock. 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 rock. This is contrary to the belief that oil is formed in puddles or pools underground.

Read to students from *Oil and Natural Gas*, page 24

> *When oil companies drill for oil, they look for* ***oil traps****. These are places where oil collects underground after seeping up through the surrounding rocks. This slow seepage, called migration, begins soon after liquid oil first forms in a "source" rock. Shales, rich in solid organic matter known as kerogen, are the most common type of source rock. The oil forms when the kerogen is altered by heat and pressure deep underground. As source rocks become buried even deeper over time, oil and gas may be squeezed out like water from a sponge and migrate through permeable rocks. These are rocks with tiny cracks through which fluids can seep. The oil is frequently mixed with water and, since oil floats on water, the oil tends to migrate upward. Sometimes, though, it comes up against impermeable rock, through which it cannot pass. Then it becomes trapped and slowly accumulates, forming a reservoir.*

Evaluation

1. Students should complete the exit questionnaire worksheet.

Elaboration

1. Construct a T-Chart of foods you eat that are porous and nonporous.

Example:

Porous	Nonporous
Cake	Flavored gelatin
Cornbread	Hard Candy
Rice Cake	Hershey Chocolate Bar

Exit Questionnaie Answer Key

1. When oil companies drill for oil, they look for **oil traps**. These are places where oil collects underground after seeping up through the surrounding rocks.

2. The more porous the rock, the more oil and natural gas it can hold.

   a. True

3. **Porosity:** the ability of the rock to hold liquid and/or gas in its pores, much like water collects in a _________.

   b. Sponge

Seeping Stones Experiment
Lab Packet

Reporter____

Recorder____

Material Getter__________________________________

Facilitator______________________________________

Seeping Stones Experiment

Materials Provided in the Kit

- ❑ 1 Pipette
- ❑ Marker
- ❑ Paper towels

Materials the member needs to provide

- ❑ Rock Samples (ie. Limestone, sandstone, shale and granite)
- ❑ Water

Instructions

1. Place the rock samples in the middle of table.
2. The material getter should collect the following rocks from the materials workstation: paper towels, a cup of water, syringe, and a marker as well. The group should have at least 3 rocks and all the materials needed to begin the experiment.
3. Using the marker, place a number (1-3) on the rocks. This is so we can identify the rocks through out the experiment.
4. Fill in the group's predictions of what they think will happen when five drops of water are dropped on each rock.

Predictions

Rock Samples	Will the rock absorb the water?	Will the rock repel the water?
Sandstone		
Limestone		
Shale		
Granite		

5. Conduct the experiment. Place the rocks on the paper towels; carefully drop 5 drops of water on each rock.

Results

Rock Samples	Did the rock absorb the water?	Did the rock repel the water?
Sandstone		
Limestone		
Shale		
Granite		

Record what happens to the water.

6. Select and sort the rocks that "drank" or absorbed the water.
7. 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?

____

____

____

8. Where do you think the water went if it "disappeared?"

____

____

____

9. Using collected data, hypothesize what will happen if ten drops of water are used. Make your own chart and test your hypothesis.

10. Chart and graph the number of water drops absorbed by each rock. Be prepared to share your findings with the class.

Seeping Stones

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Exit Questionnaire

ALL GRADE LEVELS

Name:______________________

Questions

1. When oil companies drill for oil, they look for __________ ___________. These are places where oil collects underground after seeping up through the surrounding rocks.

2. The more porous the rock, the more oil and natural gas it can hold.
    a. True
    b. False

3. **Porosity:** the ability of the rock to hold liquid and/or gas in its pores, much like water collects in a _________.
    a. Cup
    b. Sponge
    c. Lake

MODULE II
Where do we find oil and gas?

Hands-on Activities

Exploring oil seeps

Exploring core sampling

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Exploring Natural Oil Seeps

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ALL GRADE LEVELS

Topic

How do we find oil and gas?

Source

Oil and Natural Gas, page 41

Objective

Students will be able to explain the process of natural oil seepage and its ecological impact by conducting a hands-on simulation and participating in group discussions.

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each sgroup
3. Read through the "Explanation" section

Vocabulary Words

Natural Oil Seep - is a geological phenomenon where hydrocarbons, primarily crude oil, escape from underground reservoirs to the Earth's surface. This process occurs through fractures and porous rock formations, allowing oil to seep into the surrounding environment, often resulting in visible pools or tar deposits on land or in marine areas. Natural oil seeps can significantly impact local ecosystems, as they introduce hydrocarbons into the environment, affecting soil, water quality, and wildlife. Unlike oil spills caused by human activities, natural oil seeps are a natural occurrence and can account for a substantial portion of the oil entering coastal environments.

U.S. National Science Education Standards

Next Generation Science Standards (NGSS) HS-ESS3-1: Construct an explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

NGSS HS-LS2-7:
Design and evaluate a solution for a problem related to the management of natural resources

Exploring Natural Oil Seeps

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ALL GRADE LEVELS

Engagement

Start with a brief statement: "Although we think of oil spills as caused by tankers, natural seepage accounts for as much as one half of the oil that enters the coastal environment."
Pose the question: "What comes to mind when you hear the term 'oil spill'?"

Exploration

Introduction to the Activity (5 minutes):

- Briefly explain the purpose of the activity: to simulate how natural oil seeps occur and to observe how oil interacts with soil and water.
- Discuss the importance of understanding natural oil seepage in the context of environmental science.

Setting Up the Experiment (10 minutes):

- Divide students into small groups (5 or 10 students each).
- Distribute materials to each group, instructing them to follow instructions in the lab worksheet

Simulating Oil Seepage (15 minutes):

- If using food coloring, add a few drops to the oil to visualize the seepage process.
- Students should observe and record what happens to the oil

Observation and Data Collection (15 minutes):

- Encourage students to look for specific behaviors, such as:
- How does the oil spread on the surface?
- Does the oil mix with water or remain separate?
- Have students take notes on their observation sheets, focusing on patterns and any changes they see over a set period (e.g., 10 minutes).

Explanation

Natural oil seepage is a geological process where oil, primarily in the form of hydrocarbons, escapes from underground reservoirs to the Earth's surface. This phenomenon occurs through various geological formations and can have both ecological and economic implications.

Explanation

Formation of Natural Oil Seeps

Geological Processes:

- Source Rocks: Oil is formed from the remains of ancient marine organisms, which undergo heat and pressure over millions of years in sedimentary rocks.
- Migration: Once formed, oil migrates through porous rock layers (reservoir rocks) until it accumulates in traps, often created by impermeable rocks that prevent further upward movement.
- Seepage: Over time, geological forces (such as tectonic activity) can create fractures or faults that allow oil to escape from these reservoirs. This escape creates natural oil seeps.

Characteristics of Natural Oil Seeps:

- Location: Natural oil seeps are often found in coastal areas, along fault lines, or near oil fields.
- Appearance: They can manifest as visible pools of oil on the surface, tar deposits, or oily sediments along shorelines.

Comparison to Human-Caused Oil Spills

Differences:

- Source: Natural oil seeps are a natural phenomenon, while human-caused oil spills result from accidents, leaks, or intentional discharges (e.g., from tankers or drilling operations).
- Volume and Impact: Natural seepage can contribute significantly to the total oil entering coastal environments, sometimes accounting for up to 50 of the oil present. In contrast, oil spills often release large quantities of oil suddenly, leading to more immediate and severe environmental damage.

Management Implications:

- Understanding the role of natural oil seepage is crucial for effective environmental management and response strategies. It helps differentiate between natural and anthropogenic sources of oil pollution, informing remediation efforts.

Evaluation

1. Students should complete the exit questionnaire worksheet.

Exploring Natural Oil Seep Experiment
Lab Packet

Reporter____

Recorder____

Material Getter___________________________________

Facilitator_______________________________________

Exploring Natural Oil Seeps

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Lab Worksheet

ALL GRADE LEVELS

BACKGROUND

Oil and gas seeps are natural springs where liquid and gaseous hydrocarbons leak out of the ground. These seeps are fed by natural underground accumulations of oil and natural gas. Oil that leaks to the Earth's surface looks tar-like due to evaporation of lighter components over time.

This activity models the formation and process of oil seeps. After the activity, discuss how density of oil and Earth's materials contribute to the process and any modifications that could be made to the model.

QUESTION

How does oil seep naturally from beneath layers of rock to the surface of the ocean?

Materials Provided in the Kit

- ❑ 1 Large Clear Plastic Cup
- ❑ Clay

Materials the member needs to provide

- ❑ Sand
- ❑ Soil
- ❑ Cooking Oil

INSTRUCTIONS

1. Flatten the clay into a circle as large as the opening of the plastic cup (set aside).
2. Pour sand into the bottom of the clear plastic cup.
3. Pour the oil into the sand and mix - let the oil settles and get absorbed completely.
4. Add the soil on top of the sand, pack it tightly on top of the sand mixture.
5. Get the flattened clay and make a thin seal over the soil with the clay.
6. Fill the glass with water.
7. Observe the surface of the water to see how long it takes the oil to seep through the layers to the top of the water.
8. If seeping doesn't occur after 10 minutes, agitate the sides of the container to accelerate the seep effect.
9. Record observations.

EXIT QUESTIONS

1. How long do you think it would take for all the oil to seep to the top?

   ____

2. Would the oil seep faster if you continually agitated the glass?

   ____

3. Would a taller glass with more water (more pressure) affect the rate of seepage?

   ____

4. What effect would using salt water have?

   ____

Core Sampling

Topic

Exploring Core Sampling

Source

Oil and Natural Gas, page 29

Objective

Understand the concept and purpose of core sampling.
Analyze core samples to determine the composition of Earth's layers.
Apply scientific methods to collect and interpret data from core samples

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each group
3. Make copies of the exit questions, one for each group
4. Read through the "Member Information" section

Vocabulary Words

Core Sample: A cylindrical section of a material, often soil or rock, taken to analyze its composition and structure.

Sediment: Particles of soil, sand, or other materials that settle at the bottom of a liquid or are deposited by wind or water.

Layer: A distinct stratum of soil or rock that differs in composition, texture, or color from adjacent layers.

Geology: The scientific study of the Earth, its structure, processes, and history.

Sample Extraction: The process of collecting a core sample from the ground or another medium.

Data Collection: Gathering information systematically for analysis and interpretation.

National Science Education Standards

Next Generation Science Standards (NGSS): HS-ESS2-2 - Analyze geoscience data to make predictions about the Earth's systems.

Common Core State Standards (CCSS): CCSS.ELA-LITERACY.RST.11-12.7 - Integrate and evaluate multiple sources of information presented in diverse formats.

Engagement

Introduce vocabulary related to core sampling and Earth's layers.

Exploration

Set-up Instructions for Facilitators
Prepare Materials: opaque cup, colored (kinetic) sands, if using loose colored sands, use the spray bottle to mist the sands, and soil for additional layer.

- Using the ruler, measure and add a 1 cm layer of one of the earth materials to the cup. Mist with the spray bottle of water until damp, but do not soak.
- Place another earth material 1 cm deep on top of the first layer. Moisten with water until damp.
- Continue alternating layers of earth materials and water. The layers should total 4 cm deep in the cup, using various earth materials.

Group Formation
Divide the class into small groups (3-4 students each).
Assign roles within each group (e.g., recorder, measurer, sampler).

Core Sample Collection

- Instruct each group to carefully extract a core sample from the provided soil materials.
- Remind students to maintain the integrity of the sample, avoiding disturbance of the layers.

Observation and Measurement

- Measure the total length of the core sample using rulers.
- Identify and record the distinct layers visible in the core.
- Note the color, texture, and composition of each layer (e.g., sand, clay, organic material).

Data Recording
Have students document their observations in lab notebooks, including:

- A labeled diagram of their core sample.
- Descriptions of each layer's characteristics.
- Any hypotheses about the environmental conditions that may have formed these layers.

After completing the core sampling,

- Encourage each group to present their findings, sharing insights about the layers they discovered.

Facilitate a discussion on:

- Variations in core samples among different groups.
- What these findings might indicate about the environment from which the samples were taken.

Explanation

Drilling is the only way to be sure that an oil or gas field exists, and exactly what kind of oil is present. Once an exploratory well has been bored, the engineers use downhole logging equipment, which detects the physical and chemical nature of the rocks and fluids. Rock samples are brought to the surface for detailed analysis in the laboratory.

Core Sampling Experiment
Lab Packet

Reporter____

Recorder____

Material Getter___________________________________

Facilitator______________________________________

Presented by
Society of Petroleum Engineers

Core Sampling

Lab Packet

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ALL GRADE LEVELS

BACKGROUND

Core sampling is one way that geologists determine the geologic formation of rocks and sediments when exploring for oil and gas. Some students will hit rock and find it difficult to continue. Relate this to real-world drilling and why drill bits are used to churn up and break up rock in the sampling path.

This activity demonstrates the different ways sediments and rocks are formed in layers.

Materials Provided in the Kit

- ❑ Colored Sands
- ❑ Soil
- ❑ Ruler
- ❑ Small cups
- ❑ Clear Plastic Straws

INSTRUCTIONS

1. Use a straw to extract a core sample by pushing the straw straight down through the layers of the cup. The layers should be a total of 4 cm deep in the cup.
2. Place your finger tightly over the top end of the straw and withdraw it from the cup. Observe the layers in the straw core sample.
3. Lay several core samples side by side. Compare results.

EXIT QUESTIONS

1. Was there a difference in each of the core samples? Describe.

____

____

2. Were there certain areas that were difficult to sample? How so?

____

____

3. What do you think petroleum geologists are looking for when they examine core samples? ____________

____

____

MODULE III

How do we get the oil out of the ground?

Hands-on Activities

Getting the oil out

Perforated well casing

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Give It a Lift

Lesson Plan - Page 1

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ALL GRADE LEVELS

Topic

Getting the oil out

Source

Oil and Natural Gas, pages 32-33, 34-35, 38-39

Objective

Students will gain an overall picture of how oil can be recovered from a rock formation using artificial lifting equipment, such as a pumping unit.

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each group
3. Make copies of the exit questions, one for each student
4. Read through the "Member Information" section

U.S. National Science Education Standards

Process Standards
(Grades 3-6)

Physical Science Content Standards
(Grade 4)

Physical Science
(Grades K-4)

Engagement

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

Exploration

1. Split the students into groups of four. Assign each student a job from the list below.

   Recorder: the student who writes down the information from the experiment

   Reporter: the student who presents their group's findings to the class

   Material Getter: the student who gathers and puts away the materials for the experiment

   Facilitator: the student who oversees the experiment and ensures their group stays on task.
2. Pass out one "Give it a Lift" lab packet to each group. Have the students read through the lab instructions once.
3. Member says: "Today we are going to learn how oil can be recovered from a rock formation using artificial lifting equipment."
4. Have the students begin the experiment. Monitor the students to make sure that everyone is participating.
5. Once the students have completed the experiment, explain how this experiment is related to getting the oil out of ground.
6. Have each student complete the "Give It a Lift" exit questionnaire individually.

Explanation

Member Information

Read to students from Oil and Natural Gas pages 32-33

Locating a suitable site for drilling is just the first step in extracting oil. Before drilling can begin, companies must make sure that they have the legal right to drill, and that the impact of drilling on the environment is acceptable. This can take years. Once they finally have the go ahead, drilling begins. The exact procedure varies, but the idea is first to drill down to just above where the oil is located. Then they insert a casing of concrete into the newly drilled hole to make it stronger. Next, they make little holes in the casing near the bottom, which will let oil in, and top the well with a special assembly of control and safety valves called a "Christmas tree." Finally, they may send down acid or pressurized sand to break through the last layer of rock and start the oil flowing into the well.

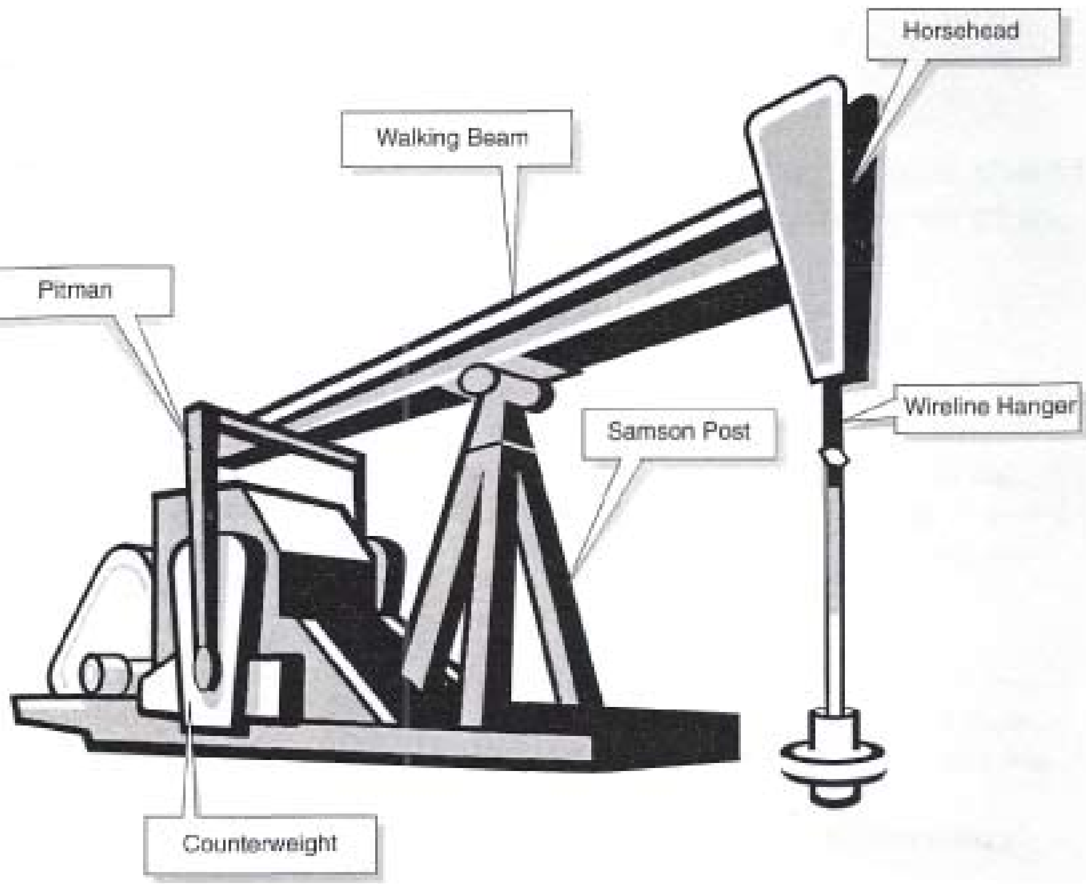
Read to students from *Oil and Natural Gas*, pages 34-35

> *Sometimes large reserves of oil are found deep beneath the ocean bed. To get the oil out, huge platforms are built far out at sea to provide a base for drilling rigs that bore rights down into the rocks of the seafloor. After processing on the platform, oil is sent ashore via pipelines or held in separate floating storage facilities before being off-loaded into large tankers. Offshore oilrigs are gigantic structures. Many have legs that stretch hundreds of meters from the surface to the ocean flow. The Petronius Platform in the Gulf of Mexico, for example, is the world's tallest freestanding structure, standing some 2,000 ft above the seabed. Rigs have to be immensely strong, able to withstand gale-force winds and relentless pounding by huge waves.*

Read to students from *Oil and Natural Gas*, pages 38-39

> *In the early days of the oil industry, oil was carted laboriously away from oil wells in wooden barrels. The oil companies soon realized that the best way to move oil was to pump it through pipes. Today there are vast networks of pipelines around the world, both on land and under the sea. The US alone has about 190,000 miles (305,000 km) of oil pipes. The pipelines carry an array of different oil products, from gasoline to jet fuel, sometimes in "batches" within the same pipe separated by special plugs. Largest of all are the "trunk" pipelines that take crude oil from drilling regions to refineries or ports. Some are up to 48 inches (122 cm) in diameter and over 1,000 miles (1,600 km) long. Trunk lines are fed by smaller "gathering" lines that carry oil from individual wells.*

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 down hole pump in the well is connected to the pumping unit by steel rods, which are screwed together. The pump is activated from the up and down movement of the pumping unit of 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.

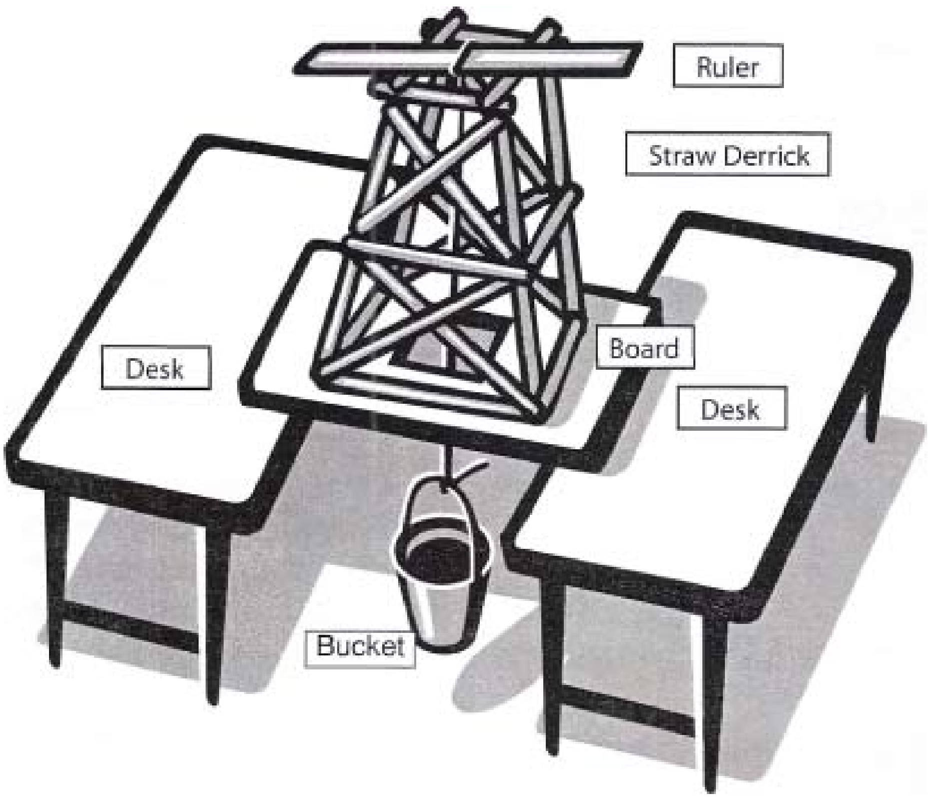
Evaluation

1. Students should complete the exit questionnaire worksheet.
2. After conducting the experiment and then listening to the explanation of the experiment, students will write a paragraph discussing how this experiment is related to getting the oil out of the ground.

Elaboration

1. Present students with the following problem. You are an oil and natural gas producer. At a site you have found, you believe petroleum is at 50,000 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. 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.



Exit Questionnaie Answer Key

1. Because oil, natural gas and saltwater are under extreme pressure below the surface, these fluids sometimes flow up a well ___________________ assistance, much like a soft drink that has been shaken and then opened.

   b. Without

2. _______________________________ are used to help pull the oil out of the reservoir rock and pump it up the well.

   Artificial lifting systems or pumping units

3. What is the first thing that oil companies must do in order to drill on a piece of property?

   Companies must make sure that they have the legal right to drill, and that the impact of drilling on the environment is acceptable .

Getting the Oil Out Experiment Lab Packet

Reporter____

Recorder____

Material Getter__________________________________

Facilitator______________________________________

Presented by
Society of Petroleum Engineers

Getting the Oil Out Experiment

Materials Provided in the Kit

- ❑ 8-10 drinking straws
- ❑ Masking tape
- ❑ Scissors
- ❑ Small Cups

Materials the member needs to provide

- ❑ Choose two liquids to compare:
  dark soda, chocolate syrup, chocolate milk,
  pancake syrup or honey
  preferred to demonstrate viscosity of liquids

Instructions

1. The material getter should get the materials listed above from the material workstation.
2. Using the scissors, cut a 1 centimeter slit at one end of each straw.
3. Join the straws end to end to form one long tube. Place the slit end of the straw into the inside of the adjoining straw.
4. Place masking tape over each connected end to secure the joint and create an air tight seal.
5. Place the cup of soda on the floor first. Insert the extended straw "tubing" into the cup. Try to bring the liquid to the top of the "tubing" using suction.
6. Now, decrease the number of straws used for the "tubing". Same student tries to bring the liquid to the top.
7. Repeat step 5 with the cup of second liquid.

Questions

1. Which length of straw required the most effort to bring the liquid to the top? Which length of straw required the least effort to bring the liquid to the top?

   ____
   ____
   ____

2. Does the length of the straw "tubing" make a difference in the amount of suction needed to lift the chocolate milk?

   ____
   ____
   ____

3. As a group, discuss and decide what kind of equipment would we need to lift oil from rock 7,500 feet (2286 meters) below the earth's surface.

Give It a Lift

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Exit Questionnaire

ALL GRADE LEVELS

Name:______________________

Questions

1. Because oil, natural gas and saltwater are under extreme pressure below the surface, these fluids sometimes flow up a well ___________________ assistance, much like a soft drink that has been shaken and then opened.
    a. With
    b. Without

2. _______________________________ are used to help pull the oil out of the reservoir rock and pump it up the well.

3. What is the first thing that oil companies must do in order to drill on a piece of property?

____

Perforated Well Casing

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Lesson Plan - Page 1

INTERMEDIATE & SECONDARY

Topic

Oil traps

Source

Oil and Natural Gas, pages 30-31

Objective

Students will analyze the advantages and disadvantages of using perforated well casing in various geological settings.
Students will design a simple model of a perforated well and demonstrate its function

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each group
3. Read through the "Member Information" section

Vocabulary Words

Perforated Well Casing
A type of piping that has holes or perforations to allow water to enter from the surrounding soil or rock into the well.

Aquifer
A geological formation that can store and transmit groundwater, supplying wells and springs.

Wellhead
The above-ground structure at the top of a well that provides access to the well and contains components for controlling water flow.

Perforation
Holes or openings made in the well casing to facilitate water entry; can vary in size and spacing depending on design.

Subsurface
The layer of soil and rock beneath the Earth's surface, where aquifers and groundwater are found.

U.S. National Science Education Standards

Process Standards
(Grades 3-6)

Earth/Space Science Content Standards
(Grade 3)

Physical Science Content Standards
(Grades 5-6)

Physical Science
(Grades K-4)

Engagement

Introduce the concept of oil extraction and the importance of well perforation in accessing oil reservoirs. Discuss how perforation allows oil to flow into the well from surrounding rock formations.

Exploration

Introduction (5 minutes): Introduce the various techniques used for perforating well casings in oil production. Explain the significance of these techniques in enhancing oil flow from reservoirs.
Preparation of Materials:

Preparation of Materials: Students will place two sponges horizontally within a sandwich bag, simulating a geological formation.

Creating the Well System: A hole will be made in the side of the sandwich bag between the sponges to insert a flexible straw, representing the well casing.

Insertion of Straw: The straw will be inserted through the hole, ensuring it is positioned correctly within the bag to allow for effective extraction of water.

Sealing for Integrity: Students will tape the hole to prevent leaks, emphasizing the engineering skills needed to avoid potential "oil spills."

Saturation of Sponges: Water will be poured into the bag to saturate the sponges, with students measuring the exact amount used for saturation.

Closure of the System: The top of the bag will be closed, and any remaining openings will be taped to ensure no further leakage occurs.

Simulating Oil Extraction with Non-Perforated Straw: The bag will be placed on a tray, and students will press down on the sponges to extract water through the straw into a measuring cylinder positioned below the table edge.

Measurement of Extracted "Oil" (Non-Perforated): Students will measure the volume of "oil" collected in the measuring cylinder, highlighting the efficiency of their extraction method.

Preparation of Perforated Straw: Using a push pin, students will poke several holes about 3-5 mm apart on both sides of the straw. If straws are striped, they can use the stripes as a guide for even spacing.

Repeating the Experiment with Perforated Straw: Students will repeat steps 1-8 using the newly perforated straw. They should ensure that the exact same amount of "oil" is added as was done in step 6.

Measurement of Extracted Water (Perforated): Students will measure the volume of "oil" collected in the measuring cylinder with the perforated straw.

Comparison of Results: Students will record and compare measurements between the perforated and non-perforated straw, analyzing the differences in "oil" extraction efficiency.

Explanation

1. Accessing Oil Reservoirs: In oil extraction, reservoirs often contain hydrocarbons trapped in porous rock formations. When a well is drilled, the casing must penetrate these formations effectively. By incorporating perforations, the well casing creates pathways for oil to enter the well from the surrounding rock. This is crucial in maximizing the volume of oil that can be extracted.

2. Enhancing Fluid Flow: Perforations in the casing increase the surface area through which oil can flow. This is particularly important in low-permeability formations where natural fluid flow may be restricted. By allowing oil to enter the casing more easily, perforated well casings improve the efficiency of extraction, reducing the time and resources needed to bring oil to the surface.

3. Minimizing Formation Damage: During drilling, the high-pressure environment can cause damage to the surrounding geological formations. Perforated well casings help mitigate this damage by allowing for controlled pressure release and fluid movement. This helps maintain the integrity of the reservoir and enhances long-term production.

4. Efficient Pressure Management: Oil extraction relies heavily on managing the pressure within the well. Perforated casings enable operators to control the pressure dynamics effectively. By allowing oil to flow in while also managing the back pressure, operators can optimize extraction rates and maintain a stable flow.

5. Environmental Considerations: Incorporating perforated casing design is essential for minimizing environmental impact. The perforations allow for better filtration of oil, reducing the risk of contaminants entering the well. This is particularly important in protecting groundwater resources and ensuring compliance with environmental regulations.

6. Adaptability to Geological Variability: Different geological formations present unique challenges, including varying porosity and permeability. Perforated well casings can be designed with specific perforation patterns and sizes tailored to the characteristics of the formation. This adaptability allows for more effective extraction strategies in diverse environments.

Case Study: Offshore Oil Extraction

In offshore drilling, perforated well casings are particularly vital due to the complex geological structures and high-pressure environments. For example, when drilling in the Gulf of Mexico, operators often encounter layers of salt and shale that can impede fluid flow. By using perforated casing, operators can effectively tap into oil reservoirs, allowing for significant extraction rates while managing the unique challenges of the underwater environment.

Perforated Well Casing Experiment Lab Packet

Reporter______________________________________

Recorder______________________________________

Material Getter_________________________________

Facilitator_____________________________________

Perforated Well Casing

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Lab Worksheet

INTERMEDIATE & SECONDARY

BACKGROUND

Petroleum engineers and geologists have developed technology to increase exposure of an oil and gas reservoir by drilling horizontally or at an angle. This method of drilling can produce three to five times more oil and gas than vertical drilling.

Perforation refers to a hole punched in the casing, or liner, of an oil well to connect it to a reservoir of oil or gas. These holes in the horizontal well casing allow oil and gas to flow easily into the wellbore, increasing production of a reservoir. This activity models the differences in production of a perforated and non-perforated well casing. After the activity, discuss with students the model limitations and ways to improve the experiment.

QUESTION

How do you think adding holes to a well casing will influence the amount of petroleum or natural gas that a well can produce?

MATERIALS

- 2 Kitchen sponges, the same size & shape
- Flexible straw
- Push pin
- 100 mL Graduated cylinder
- Sandwich plastic bag
- Masking tape
- Water
- Shallow tray (for sponges)

INSTRUCTIONS

1. Place both sponges in the sandwich bag. (Horizontally)
2. Make a hole on the side of the sandwich bag between the sponges where you will insert the flexible straw. The diameter should be about the same size as the straw.

3. Insert the straw in the hole between the sponges so that the elbow is outside of the sandwich bag. Make sure that the straw is at least 3 cm inside the bag and between the sponges. (see diagram).
4. Cover the hole with tape ensuring that there are no gaps for possible leaks. You will need good engineering skills to avoid any leakage (oil spills).
5. Place the bag with the sponges onto the tray.
6. Pour water into the bag via the open end until the sponges are saturated with water. Please make sure that you measure and note how much water was added to saturate the sponges.
7. Close the top of the bag and fold it over the sponges.
8. Close any open spaces by taping them to prevent any further water leakage.
9. Place the plate on the edge of the table and bend the flexible straw into the measuring cylinder (which should be below the table edge)
10. Press down on the sponges to try and get as much water out via the straw as possible. Only water that comes from the straw into the measuring cylinder should be measured.
11. Measure and record the amount of water collected in the measuring cylinder.
12. Disassemble the sandwich bag, sponges and straw and remove all the water from the sponges and plate.

13. Using a push pin, poke several holes about 3-5 mm apart on both sides of the straw. (If straws are striped, use the stripes as a guide).
14. **Now you are going to repeat steps 1-11 with the newly perforated straw**. Be sure to add the exact same amount of water as was done in step 6.
15. Record and compare measurements between the perforated and non-perforated straw.

CONCLUSIONS

1. How did perforating (poking holes in) the straw change the amount of water you collected?

____

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2. Using your observations, explain how perforating the well casing would be beneficial in a drilling scenario.

____

____

____

Oil and the Environment

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INTERMEDIATE & SECONDARY

Topic

What are the environmental impacts of petroleum production and consumption?

Objective

Students will discover the changes in the petroleum industry practices during the past 50 years. Students will learn of the controls and technological innovations that have been implemented to take better care of the natural environment, future concerns, and alternatives.

Lesson Preparations

1. Collect materials from the list provided
2. Make copies of the lab packets, one for each group
3. Make copies of the exit questions, one for each group
4. Read through the “Member Information” section

Vocabulary Words

Carbon Capture, Utilization, and Storage CCUS)

the fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes; also referred to as "carbon sequestration"

Carbon Cycle - All carbon sinks and exchanges of carbon from one sink to another by various chemical, physical, geological, and biological processes.

Carbon Dioxide (CO2)- colorless, odorless, non-poisonous gas that is a normal part of Earth's atmosphere; a product of fossil-fuel combustion as well as other processes; considered a greenhouse gas as it traps heat (infrared energy) radiated by the Earth into the atmosphere and thereby contributes to the potential for global warming; the global warming potential (GWP) of other greenhouse gases is measured in relation to that of carbon dioxide, which by international scientific convention is assigned a value of one (1)

Climate Change - a term used to refer to all forms of climatic inconsistency, but especially to significant change from one prevailing climatic condition to another; has been used synonymously with the term "global warming;" scientists tend to use the term in a wider sense inclusive of natural changes in climate, including climatic cooling

U.S. Next Generation Science Standards (NGSS)

HS-ESS3-3: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

U.S. National Science Education Standards (NSES)

Content Standard F: Science in Personal and Social Perspectives – Environmental Quality.

Engagement

Using the Carbon Dioxide and CCUS chart, ask the students if they've heard about carbon capture or any other environmental technologies.

Exploration

Industry Professional Presentations: Invite industry professionals to present PowerPoint slides on the following topics:

- Carbon Capture Technologies (e.g., direct air capture, post-combustion capture)
- Utilization of Captured Carbon (e.g., converting CO2 into fuels or chemicals)
- Storage Methods (e.g., geological storage, ocean storage)
- Case Studies of Existing CCUS Projects (e.g., Petra Nova, Sleipner)

Student Interaction: After each presentation, allow time for questions and discussions to deepen understanding.

- What are the advantages and disadvantages of this technology?
- How does this method contribute to reducing greenhouse gas emissions?
- What challenges does this method face in implementation?

Explanation

Carbon Capture, Utilization, and Storage (CCUS) refers to a set of technologies designed to capture carbon dioxide (CO2) emissions produced from the use of fossil fuels in electricity generation and industrial processes. The captured CO2 can then be utilized in various applications or stored underground to prevent its release into the atmosphere.

Components of CCUS:

Carbon Capture:

- Process: Carbon capture involves separating CO2 from other gases emitted during industrial processes. This can be achieved through several methods, including:
- Post-combustion capture: Capturing CO2 from flue gases after fossil fuels have been burned.
- Pre-combustion capture: Removing CO2 before combustion occurs, often through gasification processes.
- Direct air capture: Extracting CO2 directly from the atmosphere using chemical processes.
- Importance: By capturing CO2 before it enters the atmosphere, this technology helps mitigate climate change impacts.

Utilization:

- Applications: Once captured, CO2 can be re purposed in various ways, such as:
- Enhanced Oil Recovery (EOR): Injecting CO2 into oil fields to increase oil production.
- Chemical Production: Converting CO2 into useful products like methanol, urea, or other chemicals.
- Building Materials: Utilizing captured CO2 to produce concrete or other construction materials.
- Benefits: Utilizing CO2 not only helps reduce greenhouse gas emissions but also creates economic opportunities by turning waste into valuable products.

Explanation (continued)

Storage:

- Methods: Safe storage of CO_2 is crucial for ensuring that it does not re-enter the atmosphere. Common storage methods include:
- Geological Storage: Injecting CO_2 into deep underground rock formations, such as depleted oil and gas fields or deep saline aquifers.
- Ocean Storage: Exploring the potential of injecting CO_2 into ocean waters, although this method presents environmental concerns.
- Safety Measures: Storage sites are monitored for leakage and must be selected carefully to ensure that CO_2 remains contained for centuries.

Environmental Impact:
CCUS technologies have the potential to significantly reduce CO_2 emissions from industrial processes and power generation, contributing to the global effort to meet climate targets. By preventing large quantities of CO_2 from entering the atmosphere, CCUS helps mitigate climate change and its associated impacts on ecosystems, weather patterns, and human health.

Regulatory Framework:
The deployment of CCUS technologies is influenced by various policies and regulations. Governments around the world are beginning to create supportive frameworks that promote research, development, and investment in CCUS, recognizing its role in achieving climate goals.

Challenges and Misconceptions:
Despite its potential, CCUS faces challenges such as high implementation costs, public perception, and the need for extensive infrastructure. Common misconceptions include the belief that CCUS is not economically viable or that it offers a "license to continue polluting," which underscores the importance of integrating CCUS with broader sustainability efforts.

Evaluation

Facilitate aclass discussion to evaluate understanding and address lingering questions about CCUS. Prompt students with questions such as:

What are the most significant benefits of CCUS?
What challenges do you foresee in the widespread adoption of CCUS technologies?

Name:______________________

Questions

1. Based on the information presented by classmates, what is your strongest concern that was presented and why?.

2. In your opinion, what needs to be done about your concerns about our environment? State at least three reasons that support your view.

Enhanced Oil Recovery Experiment Lab Packet

Reporter____

Recorder____

Material Getter___________________________________

Facilitator_______________________________________

MODULE IV
Oil and the Environment

Hands-on Activities

Enhanced Oil Recovery (EOR)

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Enhanced Oil Recovery

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Lab Worksheet

INTERMEDIATE & SECONDARY

QUESTION

How does using carbon dioxide allow additional oil and gas to be recovered from reservoirs that are slowing production?

HYPOTHESIS

Make a hypothesis to address the question using the following format: If (independent variable) then (dependent variable) because ...

____.

Materials Provided in the Kit

- ☐ 1 Mason jar lid with two ¼" holes
- ☐ 1 Mason jar lid with one ¼" hole
- ☐ Two ¼ tubing (1 short/1 long)
- ☐ Clay

Materials the Member needs to Provide

- ☐ 6 Effervescent tablets
- ☐ 350 ml Water
- ☐ 1ply tissue
- ☐ 1 Empty cup/water bottle

INSTRUCTIONS

Jar with two holes on the lid and with rock = **Reservoir Jar**
Empty Jar with one hole = **Co2 Injection Jar**
Empty Cup/Bottle = **Production Jar**

1. Put one piece of tubing through the lid with two holes. Slide the tubing all of the way down into the bottom of one jar. This jar will serve as your **reservoir jar**. Place the other end of this tube into the empty cup/bottle. The empty cup/bottle will serve as your **production jar**.
2. Insert the second piece of tubing about 5 cm through the second hole in the lid for the **reservoir jar**. Insert the other end of this tubing about 5 cm into the lid with one hole for the other empty mason jar. The jar with one hole in the lid will serve as your **CO2 injection jar**.
3. Secure the lid with two holes on the **reservoir jar** tightly.
4. Pinch off the tubing and gently rotate and mix the **reservoir jar**.
5. Pour 300 mL of water into the **CO2 injection jar**.
6. Make a packet for the six (6) effervescent tablets out of a single piece of tissue paper and twist it closed.
7. Holding the lid set-up of the **CO2 injection jar** close to the mouth of the jar, quickly drop the tissue paper packet into the **CO2 injection jar**.
8. Immediately secure and tighten the lid of the **CO2 injection jar**. The tissue paper will get wet, permitting the tablets to fizz. Swirl the jar around gently to encourage all the tablets to dissolve. Be prepared for the **production bottle** to start filling up with recovered oil and water from the reservoir.

Enhanced Oil Recovery

Lab Worksheet

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INTERMEDIATE & SECONDARY

OBSERVATIONS

Draw a diagram of your reservoir model. Describe what is happening. Where is the CO_2 going? Where is the oil going? How much oil were you able to recover?

CONCLUSIONS

1. How does carbon dioxide allow for enhanced hydrocarbon recovery?

2. What are some of the benefits? What are some of the challenges?

FUN & GAMES

Great Energy Debate

Peak Oil Game

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Great Energy Debate

Preparation

- Make one set of *Energy Source Debate Sheets* for each student, plus an additional set for each group.
- Make a copy of the *Great Energy Debate Game Board,* or download the Excel file from shop.NEED.org to project.
- Make a copy of one of the debate sheets to project and explain the procedure, if necessary.
- Make sets of YES/NO cards for the judges.

✔ Procedure

Step One: Introduce Unit to the Class

- Introduce the *Great Energy Debate* to the class, using the concepts as a guide.
- Distribute one set of debate sheets to each student. Explain the procedure for completing the sheets, projecting a sample, if necessary.
- Instruct the students to complete all of the debate sheets individually as classwork or homework.

Step Two: Monitor Group Work

- Decide who will be in each of the groups. If your students are not used to working in groups, you may want to give them guidelines for group work.
- Place students into groups. Distribute a set of debate sheets to each group. Have the students complete the debate sheets as a group, using their individual sheets as guides. This should take about thirty minutes. Let students know which source they will tackle as a group.

Step Three: Debate

- Use the instructions set forth under Step Three on page 6.

Step Four: Interpret the Debate Results

- Use the instructions set forth under Step Four on page 6.

SAMPLE

Coal

	RELEVANT		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Coal is an abundant fuel. Coal is found on every continent.		x	
2. Although coal is still being formed today, we use it thousands of times faster than it is formed.			x
3. Coal generates over 33 % of global electricity generation.	x		

Great Energy Debate Game Board

ADVANTAGES ↑

START HERE

DISADVANTAGES ↓

Biomass	Coal	Geothermal	Hydropower	Natural Gas	Petroleum	Propane	Solar	Uranium	Wind

Biomass

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Biomass is a source of energy from plant materials and animal waste.			
2. Biomass is a renewable energy source; we can grow more biomass.			
3. Biomass is difficult to store and transport because it decays.			
4. As biomass decays, more of its energy is available for use as fuel.			
5. Biomass was the first source of energy harvested and used by humans.			
6. Some of the carbon dioxide created by burning biomass can be absorbed by planting new biomass.			
7. The amount of energy stored in biomass is less than the amount of energy stored in an equivalent weight of a fossil fuel.			
8. Biomass can be used as a fuel because it captures and stores radiant energy from the sun through the process of photosynthesis.			
9. Over two billion people across the world burn biomass for home heating and cooking.			
10. Biomass is abundant and can be produced almost everywhere.			
11. Burning biomass can produce odors and emissions.			
12. Burning biomass in a waste-to-energy plant produces a small amount of a global electricity.			
13. Biomass provides 6% of global energy supply.			
14. Today, the majority of biomass energy comes from wood, wood pellets, or forestry products.			
15. The pulp and paper industries can use waste wood to generate steam and electricity, which saves money because it reduces the amount of other fuels and electricity they purchase to operate their facilities.			
16. Biomass can be made into ethanol, biodiesel, and other transportation fuels that are cleaner-burning than unleaded gasoline/petrol and traditional diesel.			
17. Sugars, corn, plant oils, and animal fats can be used to create biofuels. Waste oils (nonfood) make up 10% of global biofuel feedstock.			
18. Renewable diesel fuel is a hydrocarbon fuel just like low-sulfur diesel that is made from used cooking oil, waste animal fats, and inedible corn oil.			
19. Burning biomass in a waste-to-energy plant reduces the amount of garbage sent to landfills.			
20. Waste-to-energy plants use scrubbers and other technologies to reduce emissions and odors.			

Coal

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Coal is an abundant fuel. Coal is found on every continent.			
2. Although coal is still being formed today, we use it thousands of times faster than it is formed.			
3. Coal generates over 33% of global electricity generation.			
4. Indonesia and Australia are the largest exporters of coal.			
5. Coal has been burned to cook food and heat living spaces and water for thousands of years.			
6. The majority of coal consumed globally is used to generate electricity. However, coal plays a major role in the production of steel and iron.			
7. When coal is burned, carbon dioxide, sulfur dioxide, nitrous oxide, and other pollutants are produced.			
8. To remove coal buried deep in the earth, mine shafts are constructed to bring the coal to the surface.			
9. An easier way to mine coal near the earth's surface is to remove the layers of earth to uncover the coal. This is called surface mining.			
10. Large amounts of land are disturbed in the process of surface mining.			
11. China and India are the largest importers of coal.			
12. The U.S. and Russia have the largest coal reserves.			
13. The water that filters through abandoned mines can pick up chemicals that pollute water if the mines are not closed correctly.			
14. Coal is used to smelt iron into steel and by the paper and building supply industries.			
15. Coal can be turned into a gas to make it burn cleaner. This process can be expensive and energy intensive.			
16. Coal mining can be dangerous for miners due to gases and explosion hazards.			
17. Ash from coal plants can be recycled and used for cement additives, roadway materials, and even in habitat restoration for oysters.			
18. Some cleaner coal technologies require less coal to produce the same amount of electricity.			
19. Coal plants can be combined with carbon capture facilities to limit the release of excess CO_2.			
20. Coal plants often use items like scrubbers to lower the amount of harmful emissions from being released.			

Geothermal

	Statement	RELEVANCE: NEUTRAL	ADVANTAGE	DISADVANTAGE
1.	Geothermal energy comes from heat within the Earth.			
2.	Examples of geothermal energy are hot springs, volcanoes, and geysers.			
3.	Geothermal energy is generated in Earth's core, which is made of magma (molten iron) surrounding a solid, mostly iron core.			
4.	Red hot temperatures are maintained inside the Earth because of the slow decay of radioactive particles found in all rocks, and the immense pressure on the core.			
5.	Geothermal energy is renewable. The hot water used by power plants is replenished by precipitation and the geothermal heat is continually produced.			
6.	Wells can be built to pump super-heated water to the surface.			
7.	Geothermal energy is used to produce electricity and to heat and cool buildings.			
8.	Geothermal energy was used by ancient people for heating and bathing. Hot springs are said to have therapeutic effects today.			
9.	In 1904, the Italians first used steam erupting from the earth to power a turbine generator.			
10.	Dry steam reservoirs are the most efficient for producing electricity, but they are very rare.			
11.	The United States generates more electricity from geothermal than any other country in the world, with other leaders including Indonesia, The Philippines, Turkey, and New Zealand.			
12.	Iceland heats over 90% of its homes and businesses with geothermal water using a direct use system of pipelines.			
13.	The most active geothermal resources are found along major tectonic plate boundaries or geothermal hot spots, where magma comes very near Earth's surface. Geothermal energy is generated in over 20 countries.			
14.	Kenya's East African Rift provides Kenya with relatively easy access to geothermal resources that may someday provide over 50% of its total energy.			
15.	Geothermal energy does little damage to the environment because geothermal power plants sit on or near the geothermal reservoirs and do not burn any fuel.			
16.	Geothermal steam and hot water contain traces of hydrogen sulfide and other gases, as well as chemicals that are harmful at high concentrations.			
17.	The gases and chemicals from geothermal power plants are usually reinjected into the Earth.			
18.	The temperature of the earth a few feet underground remains constant year round—about 52 degrees Fahrenheit in moderate climates.			
19.	Low temperature geothermal energy is available almost everywhere in the world as a source of heat.			
20.	Geothermal heat pumps use the Earth's constant temperature as an energy source to heat buildings in winter and cool them in summer.			

Hydropower

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Moving water has been used as a source of energy for thousands of years.			
2. Hydropower is considered one of the cleanest and cheapest energy sources in widespread use today.			
3. Moving water is a renewable energy source.			
4. Moving water can turn a turbine to generate electricity.			
5. Hydropower was first used to turn water wheels to grind grain.			
6. Hydroelectric power is reliable because dams can be built to store water. Controlling the flow of the stored water allows a power plant to operate in all weather conditions and at times of greater electrical demand.			
7. Globally, hydropower currently generates more electricity than all other renewable energy technologies combined.			
8. Hydropower provides the world with about 15.5% of its electricity generation.			
9. Low-impact, conduit, run-of-river, and other conventional hydropower technologies coupled with pumped storage hydropower could help to expand the use of hydropower in the future.			
10. China is the world's largest producer of hydroelectricity. Other top producers include Canada, Brazil, the U.S., Russia, and India.			
11. Congo-Kinshasa, Paraguay, Sierra Leone, and Lesotho all generate 100% of their electricity from hydropower.			
12. There are over 60,000 power plants in the world, and nine of the largest facilities are hydroelectric.			
13. Pumped storage projects store 9,000 gigawatt-hours of electricity globally.			
14. When a hydropower dam is built, thousands of acres of nearby land are flooded to create a reservoir.			
15. Projects using the energy in waves, tides, and currents for electricity generation are being tested and used in several locations around the world.			
16. Dams can disturb the migration and spawning of fish populations in the river.			
17. Dams can alter the natural flow of the river and change the amount of water that reaches communities downstream.			
18. Reservoirs that result from construction of a dam are often developed for recreational purposes, such as boating and fishing.			
19. The Three Gorges Dam in China is the world's largest hydropower facility, generating 22.5 Gigawatts of power for 70-80 million households.			
20. Some countries use hydropower as their main source to produce electricity. Several countries generate 80% or more of their electricity from hydropower.			

Natural Gas

	RELEVANCE: NEUTRAL	RELEVANCE: ADVANTAGE	RELEVANCE: DISADVANTAGE
1. Natural gas was formed from the decomposition of tiny sea plants and animals that lived hundreds of millions of years ago.			
2. Natural gas is mostly made of a chemical called methane.			
3. Natural gas is odorless; an odorant called mercaptan is added for safety.			
4. Natural gas can be processed and other products, like propane and the materials in plastics, can be recovered from it.			
5. Natural gas is considered to be the cleanest-burning fossil fuel. It produces almost no sulfur or nitrogen oxides.			
6. Natural gas and petroleum are often found together in underground deposits.			
7. In the past, oil drillers were not interested in the natural gas that was found at the site of an oil well. Today, it is as valuable as the oil.			
8. The invention of high pressure pipelines has made it possible to transport natural gas all over the world.			
9. Leaks can occur in natural gas pipelines. Fires and explosions can result from these leaks if proper safety precautions are not taken.			
10. The U.S., Russia, China, Iran, and Canada are the biggest producers of natural gas globally.			
11. Natural gas is a nonrenewable resource.			
12. Russia, Iran, Qatar, Turkmenistan, and the U.S. have the largest proved reserves of natural gas.			
13. Natural gas is used by homes and businesses, industry, transportation, and for electric power generation. It accounts for 25% of global electric power.			
14. Natural gas can be used as a cleaner-burning transportation fuel in place of gasoline/petrol or diesel.			
15. The U.S., Russia, Qatar, and Norway are the top exporters of natural gas.			
16. Natural gas can be exported by pipeline as it is done most commonly through Russia and Europe and the U.S. To move natural gas by ship it must be cooled and liquefied into LNG to reduce its volume.			
17. Demand for natural gas changes daily and seasonally. Storing extra natural gas during times of low demand ensures natural gas will be available when it is needed during periods of high demand. It is stored in large underground storage facilities, like depleted oil fields, or above ground in small tanks.			
18. Roughly 40 percent of buildings around the world use natural gas as their main heating fuel.			
19. Natural gas is used to produce peak load electricity because natural gas furnaces can be brought on line and shut down quickly and efficiently to generate steam for electricity.			
20. Burning methane produces carbon dioxide. Both methane and carbon dioxide are greenhouse gases that trap heat energy. Increasing the levels of greenhouse gases in the atmosphere can affect the global climate.			

Oil (Petroleum)

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. The word petroleum is derived from the word *petro,* meaning rock, and the word *oleum,* meaning oil.			
2. Petroleum deposits were formed over hundreds of millions of years from the remains of marine plants and animals.			
3. Oil is a nonrenewable energy source.			
4. Oil deposits are found in many areas, onshore and offshore.			
5. Ninety-eight countries produce oil. The top five producers account for over 50% of the total global production.			
6. The largest oil producing nations include the U.S., Saudi Arabia, Russia, Canada, and Iraq.			
7. The Organization of Petroleum Exporting Countries (OPEC) is a coalition that includes some of the world's largest oil producers and exporters. This group works to regulate oil markets.			
8. About 30% of the oil the world produces comes from offshore wells.			
9. Petroleum straight from the well—crude oil—is refined into gasoline and other products.			
10. Oil refining uses the boiling points of different hydrocarbon molecules to separate them for different uses.			
11. We get many fuels from refining oil—gasoline, kerosene, jet fuel—that can be burned to produce heat, light, electricity, or motion.			
12. Many chemical products from oil can be used to make plastics, medicines, fertilizers, and other products.			
13. When petroleum products are burned, harmful emissions are produced.			
14. Oil drilling and production are regulated by each individual country's laws and regulations.			
15. Oil is transported by pipeline, truck, or tanker to where it is refined and/or used.			
16. If oil is spilled into the water or onto the land, it can cause damage to the environment.			
17. Petroleum products are efficient, economical transportation fuels. Most transportation globally is fueled by petroleum products.			
18. Today, gasoline/petrol powered vehicles produce fewer emissions than they used to, due to advances in engine design and fuel formulation.			
19. Oil is the leading source of primary energy in the world. It supplies about 30 % of the world's total energy use.			
20. At current rates of consumption, the global supply of crude oil, other liquid hydrocarbons, and biofuels is expected to be adequate to meet the world's demand for liquid fuels through 2050.			

Propane

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Propane comes from natural gas processing and oil refining.			
2. Under normal conditions propane is a gas, but under moderate pressure or low temperature, propane becomes a liquid.			
3. Propane is stored as a liquid in pressurized tanks because it takes up 1/270 of the space it occupies as a gas, and is very portable. It is also called LPG.			
4. Propane becomes a gas when it is released from the pressure in the tank. As a gas, it can be used to fuel appliances, vehicles, and buildings.			
5. Like natural gas, propane is colorless and odorless. An odorant called mercaptan can be added as a safety measure.			
6. Propane is a nonrenewable energy source.			
7. Propane is a cleaner-burning fossil fuel.			
8. Propane is moved through pipelines to distribution terminals.			
9. Propane is taken from distribution terminals to bulk plants by trains, trucks, barges, and supertankers. Local dealers fill their small tank trucks and distribute it to their clients.			
10. Propane can be used in homes and businesses for heating, hot water, cooking, and clothes drying.			
11. Farms rely on propane to dry crops, power tractors, heat greenhouses, and warm animals.			
12. Propane can be used for transportation by delivery companies, government agencies, and businesses to fuel their fleet vehicles. Propane autogas fuels roughly 28 million vehicles on the road globally.			
13. As a vehicle fuel, propane is cleaner-burning than diesel and gasoline/petrol and leaves car engines free of deposits. Engines fueled by propane also have fewer emissions.			
14. The U.S. and China are the top producers of propane globally.			
15. Propane is not widely used as a transportation fuel because it is not as conveniently available as gasoline or diesel.			
16. An automobile engine must be adjusted to use propane.			
17. Propane gas is heavier than air and can explode if the propane is ignited.			
18. Propane is more expensive than natural gas, heating oil, or kerosene.			
19. Propane is often used to power indoor vehicles such as forklifts.			
20. Propane supplies and price are tied to oil and natural gas supplies and costs.			

Solar

	Relevance		
	Neutral	Advantage	Disadvantage
1. The sun radiates more energy in one day than the world can use in a year.			
2. The sun is a star made up mostly of hydrogen and helium gas. It produces radiant energy in a process called nuclear fusion.			
3. Harnessing radiant energy from the sun is difficult because the energy that reaches the Earth is very spread out.			
4. Only a small part of the solar energy radiated ever reaches the Earth.			
5. It takes the sun's energy just over eight minutes to travel 93 million miles to the Earth.			
6. Solar energy is a renewable energy source.			
7. Solar energy is used to passively heat buildings, heat water, and generate about 5% of total global electricity.			
8. The amount of solar energy reaching an area depends on the time of day, season of the year, cloud coverage, and geographic location.			
9. Solar water heaters can reduce energy bills when installed.			
10. A solar collector can be used to capture sunlight and change it into usable heat energy.			
11. China, the U.S., Germany, Japan, and India are the top solar producers in the world.			
12. Passive solar homes do not depend on mechanical equipment to transform radiant energy into thermal energy.			
13. Photovoltaic cells can convert radiant energy from the sun directly into electricity.			
14. Concentrated solar power technology uses reflective mirrors to focus solar energy, producing high temperatures and generating electricity. The world's largest CSP facilities are located in Morocco, The U.S and the United Arab Emirates.			
15. Photovoltaic—or PV—systems have a long payback period because of their initial cost.			
16. Small PV systems power calculators, wrist-watches, or small electronics. Larger systems pump water to power communications equipment and to supply electricity to single homes or businesses.			
17. Some toxic materials and chemicals are used to make PV cells. Some solar thermal systems use potentially hazardous fluids to transfer heat. Leaks of these materials could harm the environment.			
18. PV systems can supply electricity in remote areas without power lines.			
19. Large solar systems can take up a large amount of land or can be placed on large, flat roofs.			
20. Solar energy systems do not pollute the air or produce carbon dioxide.			

Nuclear

	Statement	RELEVANCE: NEUTRAL	RELEVANCE: ADVANTAGE	RELEVANCE: DISADVANTAGE
1.	In 1939, scientists discovered that certain atoms could be split. The splitting of these atoms releases a great amount of energy.			
2.	A total of 436 nuclear power reactors operate in 32 countries across the globe.			
3.	Nuclear plants provide roughly 10% of the electricity generated globally.			
4.	A nuclear reactor can supply a large amount of energy using a very small amount of fuel. The most common fuels used are Uranium -235 and Plutonium - 239.			
5.	The construction of nuclear power plants can be very expensive compared to fossil fuel plants.			
6.	Nuclear reactors do not burn uranium or fuel to generate electrical power. They capture thermal energy produced from the splitting of atomic nuclei —so their emissions are minimal.			
7.	Nuclear fuel, such as uranium, can be easy to transport by truck or train. Regulations vary by country depending on the fuel.			
8.	Nuclear power is cost-competitive with other energy sources, except where low-cost fossil fuels can be directly accessed. .			
9.	Australia, Kazakhstan, Canada, and Russia have top reserves of Uranium.			
10.	Nuclear power plants produce electricity by heating water into steam in the same way as fossil fuel plants.			
11.	Workers at nuclear power plants receive less radiation from the plant than they do from other sources like medical x-rays or airplane trips.			
12.	Some parts of reactors become radioactive after they have been used.			
13.	Radioactive waste at a nuclear power plant can be stored in spent fuel pools on-site or moved to a dry cask storage facility. Each country sets their own regulations for nuclear waste disposal.			
14.	Nuclear fuel has a very high energy density, producing a large amount of energy from a small amount of mass or space.			
15.	Nuclear fuel is considered a nonrenewable energy source.			
16.	A nuclear power plant produces a lot of waste heat. If this heat is put into a moving water system, the water temperature can increase.			
17.	The main health risk from a nuclear power plant is potential radiation exposure.			
18.	Nuclear policies in every country can have geopolitical implications. The International Atomic Energy Agency helps to create operational policy and safety standards for all facilities.			
19.	An accident at a nuclear power plant could cause widespread damage if people or the environment were exposed to high levels of radioactivity.			
20.	There has been renewed interest in nuclear power in countries where it is accepted, as it is a low-emission source of energy for electricity, heat, and hydrogen production.			

Wind

	Statement	Relevance: Neutral	Relevance: Advantage	Relevance: Disadvantage
1.	Wind is air in motion caused by the uneven heating of the Earth's surface by the sun.			
2.	Wind turbines do not cause air or water pollution because no fuel is burned to generate electricity.			
3.	Wind is a renewable source of energy.			
4.	Over the course of a year, modern wind turbines can generate usable amounts of electricity over 90 percent of the time.			
5.	For hundreds of years, windmills were used to grind wheat and corn, to pump water, and to cut wood at sawmills.			
6.	Wind turbines have turning blades to harness the wind's kinetic energy. The blades are connected to drive shafts that turn generators to make electricity.			
7.	Wind plants can typically convert 25-45 percent of the wind's kinetic energy into electricity.			
8.	When the wind is not blowing, other sources of energy must be used to generate needed electricity.			
9.	The locations of wind farms are carefully planned—good sites include the tops of smooth, rounded hills, open plains, mountain gaps, and on lakes or oceans.			
10.	Offshore turbines produce more electricity than turbines on land because offshore turbines are often larger.			
11.	Wind power plants, or wind farms, are clusters of several wind turbines spread over a large area. The area around the wind turbines can also be used for grazing, and growing crops on land, or fishing offshore.			
12.	Wind farms are often owned and operated by businesses who sell the electricity to utility companies because they can be expensive to build.			
13.	Wind turbines can be used in remote areas that do not otherwise have access to electricity.			
14.	Many countries have the capacity to produce electricity from wind. Some countries situated near the equator have less access to wind resources.			
15.	China, the U.S., Germany, India, and Brazil are the top wind energy generators.			
16.	Older wind turbines are very noisy; new technologies have eliminated most noise.			
17.	Wind turbine construction must consider wildlife and how they may be impacted by spinning blades.			
18.	New technologies have decreased the cost of producing electricity from wind.			
19.	Wind turbines provide energy in 128 countries and generate over 1,800 billion kilowatt-hours of electricity.			
20.	Offshore turbines cost more money to build and operate than turbines on land.			

Peak Oil Game

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Lab Worksheet

SECONDARY STUDENTS

BACKGROUND

Oil production is a complex process that uses precise technology to extract, separate, and clean petroleum brought to the surface. Refineries have specific standards that they require suppliers to meet before they will accept the petroleum. The production of petroleum and natural gas is strictly regulated to minimize the negative effects on the environment and people.

This activity aims to explore the production process and its advancing technologies to better extract petroleum for products and energy use.

QUESTION

What happens to production as the amount of oil in the ground decreases?

MATERIALS

- ❑ Team notebook
- ❑ Jars of beans ("oil field")
- ❑ Three containers (such as tubs or paper bags) labeled Processing Oil, Refined Oil, and Accumulated Oil
- ❑ Small spoons
- ❑ Digital kitchen balance
- ❑ Optional: Big spoons or spoons with varied handle lengths for purchase in later rounds

INSTRUCTIONS

1. Form teams of 3-5 students on each team.
2. One person will be the driller, and one person will be the processor.
3. You will receive a set of jars which represent your oil field, one very small spoon, and three containers. One container is for processing oil, one is for refined oil, and the third is for accumulated oil.
4. Each jar contains a mixture of black beans (oil), pinto beans (dirt and other contaminates), and rocks.
5. You may mine the oil from any jar in any order. However, you may not pick up the jars, lean them over, use your fingers to extract beans, or pull out the rocks. You may only use your spoons to scoop beans out of the jars. The jars may not move.
6. Your teacher will set the timer for 30 seconds (one "year") and tell you to begin.
7. During each timed period of 30 seconds, your goal is to get as much clean oil into the team's refined oil container as possible. You will be penalized for contaminated oil and for any material outside of the containers.
8. One container can be used as an intermediate processing plant in which you may remove pinto beans. and rocks, before placing in the refined container.
9. The processing and drilling must take place at the same time, and stop after the timer goes off. All activity stops immediately, and scoring occurs.
10. For each pinto bean (dirt) in the refined oil container, two black beans are removed. Also remove the pinto beans.
11. For each black bean spilled outside the containers, two black beans are removed from the refined oil container.
12. All spilled and unprocessed oil must be discarded into the communal waste container for the classroom.

13. Measure that year's production by weighing the beans that remain in the refined oil container after penalties. Record the production in the team's notebook.
14. Add the current year's harvest to the team's accumulated oil storage container. You will use this stored oil to purchase tools and employees.
15. You may purchase better tools and hire more staff in between 30-second rounds. Your teacher will tell you how much each item costs.

Be careful! The price of tools and staff will likely rise as the game continues.

CONCLUSIONS

1. Use a computer or graph paper to graph your team's yearly production. How does your graph compare to the real global oil production? **www.iea.org/aboutus/faqs/oil**

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2. Did the oil in your oil field really run out? _______________________________

____

3. Estimate the percent of the original oil left in your oil field. _______________________

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4. How is this model similar to the real world? _______________________________

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____
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5. How is this model different to the real world? _____________________________

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Activity Report

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