Name That Tune

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Lesson Plan - Page 1

INTERMEDIATE STUDENTS

This lesson requires three sessions of activities

Topic

How oil is found

Source

Oil and Natural Gas, pages 28-29, 30-31

Objective

Students will learn that scientists use seismic technology to map patterns of rock formations below the surface of the earth. The students will learn that geologists use sound waves to locate rocks that may contain oil and/or natural gas. Different types of rocks affect sound waves.

Lesson Preparations

1. Collect materials needed for activities one, two and three.
2. Read over the Lesson and become familiar with the information.
3. Make copies of Lab Packet which includes: Fingerprint Lab Worksheet, Fingerprint Patterns Handout, Rock Ages Lab Worksheet, "Oil King" Lab Worksheet, and Exit Questionnaire for each student.

National Science Education Standards

NS.5-8.1
Science As Inquiry
Students should develop

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

NS.5-8.2
Physical Science

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

NS.5-8.4
Earth and Space Science

- Structure of the earth system
- Earth's history
- Earth in the solar system

NS.5-8.5
Science and Technology

- Abilities of technological design
- Understanding about science and technology

NS.5-8.6
Personal and Social Perspectives

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

Reading topics are also included.

Materials

Engagement

- Tuning Fork
- Rocks

Exploration

- Day One
  - Pencil
  - Paper
  - Index cards
  - Transparent tape
  - Fingerprint lab worksheet
  - Fingerprint lab handout
- Day Two
  - Scissors
  - Tape
  - Set of color marker or pencils (9 different colors)
  - Map of Mid-Ocean Ridge worksheets
- Day Thee
  - A cardboard box or other opaque container with cardboard lid
  - Sand
  - Marker pens
  - Clear plastic drinking straws
  - Graph paper
  - Small rock samples
  - Balloon with water
  - Food coloring
  - Masking tape
  - Bamboo kebab skewer

Elaboration

- Set of map pencils
- Seismic maps

Engagement

Using a tuning fork, gently strike the fork against a variety of objects around the room. Note variations in sounds produced by different objects. Strike the fork against a variety of rocks. Note variations in sounds produced by different rocks. Discuss with the students the differences in the sounds produced from different objects. Ask the students why they think there are differences in the sounds produced from different objects and rocks. Ask them how scientists could use this information to help map the rock layers beneath the earth?

Tell the students that sound waves are one way that scientists find oil beneath the surface. Over the next few days we are going to explore different ways scientists find oil beneath the earth's surface.

Exploration

Day One

1. Give each student a handout of the "Fingerprint Pattern" lab worksheet.
2. Place transparent tape and scissors on a desk for the students to collect when needed during the experiment.
3. Tell the students to follow instructions carefully.
4. Once the students have complete the lab, have them turn in a copy of their thumbprint to you. Write a number on each thumbprint as they are turned in. This number is in place of the student's name. On a separate sheet of paper have the students name written with the number that you have assigned to their thumbprint.
5. Tape numbered thumbprints to the corner of lab tables.
6. Using their Fingerprint lab worksheet have the students identify their matching thumbprints that are taped to the lab tables. As the students are walking around looking for their matching fingerprint, tell them to look at the other student's prints. What are the similarities and differences?
7. Distribute the "Fingerprint Pattern" handout located at the back of this lesson.
8. Discuss the similarities and differences in the students' prints the students saw as they walked around the lab. Then discuss the similarities and differences in the students' prints and the fingerprint patterns handout.
9. Review and discuss the following
   a. Think about the patterns you saw in the thumbprints. The sound waves that scientist use to "see" inside the earth produce maps that also have patterns.

   b. There are several types of geologic features of particular interest to petroleum geologists. The most common are "faults," "anticlines" and "stratigraphic traps."
10. After completion of this activity, teach students about seismic technology and how sound waves help predict where oil can be found. This information can be found in the "explanation" section of this lesson.

Exploration

Day Two

Give each student a handout of the "Fingerprint Pattern" lab worksheet.

1. Tell the students to think about the patterns discussed so far. The sound waves that scientists use to "see" inside the earth produce maps that also have patterns. We will be looking at these patterns to find geologic features that are associated with oil and natural gas reservoirs.
2. Split the students into groups of three.
3. Read to the students this background information before beginning the lab.

   a. During World War II, Germans and Americans began using sonar (sound waves) in warfare. Sound waves emitted from a ship would pass through the water and bounce off solid objects such as other ships, submarines, or the ocean floor. By timing the sound waves and knowing the speed of sound in salt water, sailors could calculate the distance to the foreign object. In this way, the navy could more easily locate enemy targets in the dark.

   b. After the war, geologists looked at some of the data collected from these ships. They discovered that the ocean floor was not flat as most scientists had believed up until that point. A ridge of underwater mountains started to emerge down the center of the Atlantic Ocean. They also identified numerous volcanic peaks that did not reach the surface. They were curious about these features.

   c. During the 1960's, the Glomar Challenger began a drilling project on the Atlantic Ocean floor. Although it was as tedious process, the drilling pipe and drill bit that were lowered from the floating platform, eventually reached the ocean floor where the drilled rock chips were brought to the surface and studied. Through a variety of dating processes, geologists were able to assign ages to the underwater volcanic rocks that make up the ocean ridge.

   d. In this lesson you will make a model of the formation of igneous rocks on an ocean ridge.
4. Pass out the "Rock Ages" lab worksheet and have the students follow instructions.
5. Collect work sheets at the completion of the lab.
6. Review seismic technology information with students found in the explanation section of this lesson.

Exploration

Day Three

1. Spilt the students into groups of 4 and then pass out the "Oil King" lab worksheet. Before beginning the game give each student in the group 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. Monitor the students throughout the lab. After completing the lab, discuss with students their findings and what they thought about this activity.

Explanation

Teacher Information

Fault - a fracture in the rock formation created when one section of the formation moves in relation to another. When permeable rocks containing oil and natural gas are moved adjacent to impermeable rocks, the petroleum becomes trapped.

Anticlinal Trap - An anticline is formed when layers of rock are folded upward by earth's movement. Oil and natural gas within the reservoir will tend to migrate to the highest point within the structure. When a cap rock, an overlying layer of impermeable rock, exists above a reservoir rock in an anticline, a trap may form and prevent the upward escape of the oil and natural gas.

Stratigraphic Trap - These geologic features are formed by a change in the character or extent of the reservoir rock. For example, sand can become cemented into impermeable rock at one point in the formation, preventing the upward migration of petroleum from the reservoir rock. Underground water may leach out pockets where oil and natural gas can accumulate, or a permeable, petroleum bearing layer may be "pinched out", tapered to a disappearing edge, and sandwiched between layers of impermeable rock.

Sound waves travel at different speeds through different types of rock. Seismologists use special trucks equipped with high-tech equipment that read the speeds at which sound travels through various types of rocks. Geologists identify rock formations at a prospective drilling site and interpret this information. This helps them to determine if the site could be a good prospect to find oil and natural gas.

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

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

Read to students from *Oil and Natural Gas*, pages 28-29

In the past, finding oil except close to where it seeped visibly to the surface was largely a matter of guesswork and sheer luck. Today, oil prospectors' use their knowledge of the way geology creates oil traps to guide them to areas where oil is likely too occur. They know, for example, that oil is likely to be found in one of the 600 or so basins of sedimentary rock around the world, and it is these basins that oil exploration tends to be concentrated. So far, about 160 basins have yielded oil, and 240 have drawn a blank. Hunting for oil within sedimentary basins might begin by examining exposed rock outcrops for likely looking formations, or scanning satellite and radar images. Once a target area has been located, oil hunters carry out geophysical surveys that use sophisticated equipment to detect subtle clues such as variations in Earth's magnetic and gravitational fields created by the presence of oil.

Read to students from *Oil and Natural Gas*, pages 30-31

Energy companies are among the highest users of computing power and data of any industry except the military. Exploration specialist use data to interpret geologic structures miles beneath the earth's surface. Engineers can drill through more than five miles of rock to reach resources at extreme depths at high temperatures and pressures. Production engineers bring oil and gas to the surface through miles or production piping, also under extreme conditions, and deliver them through more miles of pipelines to refineries. Once there, increasingly "heavy" and sulfurous crude oils are refined into useful products. Advanced technologies like satellites, global positioning systems, remote sensing devices and 3-D and 4-D seismic make it possible to discover oil reserves while drilling fewer wells, resulting in a smaller environmental "footprint" and more economically than ever before. The answer to where oil is found –in computers!

Evaluation

1. Student will complete the Exit Questionnaire.
2. Student will complete the "Oil King" Lesson Questionnaire

Elaboration

1. Split the student into groups of three. The students will work in groups to study seismic maps and corresponding descriptions. The students should observe each seismic map for patterns of geologic features. Give each group two seismic maps to observe. Maps are found in the lab worksheet and handout section of this lesson.
2. After studying the maps have students shade in and describe the general patterns shown by each map. Have the students do the same procedure for each seismic map.
3. The group of students will report their findings in a presentation to the class.

Exit Questionnaire Answer Key

1. The use of sound waves to obtain a "picture" of the subsurface geology is known as:

   Answer: D Seismic survey

2. True/False. Drilling is the only sure way to prove the existence of oil or natural gas.

   Answer: True

3. A ____________________________ is a fracture in the rock formation created when one section of the formation moves in relation to another.

   Answer: Fault

4. Name at least two advanced pieces of technology that make it possible to discover oil:

   Answers: Satellites, global positioning systems, remote sensing devices, seismic maps

5. In seismic technology, sound waves created by _____________________ are recorded by seismographs.

   Answer: Thumper Trucks

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Lab Packet

Fingerprint Patterns

Three basic patterns are shown below:

Whorl-This pattern has lots of circles that do not leave either side of the print.

Arch-This pattern has lines that start on one side of the print, rise toward the center, and leave on the other side.

Loop-This pattern has lines that start on one side of the print, rise toward the center, then turn back and leave on the same side form which they started.

Name_____________________________

Fingerprint Patterns Lab Worksheet

Every person in the world has a unique set of fingerprints, unlike those of any other person who ever lived. Even though everyone's fingerprints are different, there are basic patters that are always found. There are three basic patterns: whorl, arch, and loop. In this lab you will determine what type pattern you have and discover the similarities and differences in your fingerprints that you have with other fellow classmates.

Follow instructions

1. Clear everything off of your desk except for a pencil.
2. Collect materials: two pieces of transparent tape and scissors.
3. In the box labeled "carbon pad"', rub your pencil across it many times to create a carbon pad.
4. Next, rub your thumb across the carbon pad a few times and then press your thumb print onto one piece of the transparent tape.
5. Place the tape with your thumb print on the box labeled #1.
6. Follow steps 4 and 5 again and place a second thumb print in the box labeled #2.
7. Cut the box labeled #2 and turn it into your teacher for an activity. Do not write your name on it.
8. Wait patiently on further instruction from your teacher.

Carbon pad

Fingerprint #1

Pattern name:____________________

Fingerprint #2

Name:_____________________

Rock Ages on the Ocean Floor Lab Worksheet

1. Study the attached map of the ocean floor. Notice that the contour lines represent "depths" of water in meters rather that surface contour lines that represent heights above sea level.

2. The bottom strip represents different age volcanic rocks that formed along the ocean ridge during the last 9 million years.

3. Cut out the map and the rock strips. Follow the directions along the "cut" lines. Tape the two strips together as instructed and cut a slit in the map.

4. Insert the open end of the rock ages strip into the slit from underneath. Carefully pull the strip onto the map until the first dark line is seen on either side of the slit.

5. Crease the strip along the dark line so that the first volcanic rock strip is showing. Label each side "9 mya." This means that this igneous rock formed 9 million years ago. Now, color both sections of the 9 million year old rock.

6. Pull up the second section of igneous rock. Color both matching sections and label these two sections "8 mya." Continue this process until all sections of the rock strip have been colored and labeled.

7. Replace the rock strip into the slit.

Answer the following questions in complete sentences:

1. What is the relationship between rock ages and distance from the center of the ridge? Predict what the ages of the rocks to the far west and east of this rock strip are.

2. The average speed of sound in salt water is 1,500 meters/second. How much time did the sonar wave leaving the ship need to record the 5,000 meter depth on the map?

3. Iceland is part of the Mid-Atlantic Ocean Ridge. What makes it different than the rest of the ridge?

4. What do the patterns of rock ages on the mid-ocean ridges tell geologists?

Name That Tune

Lab Worksheet 4

INTERMEDIATE STUDENTS

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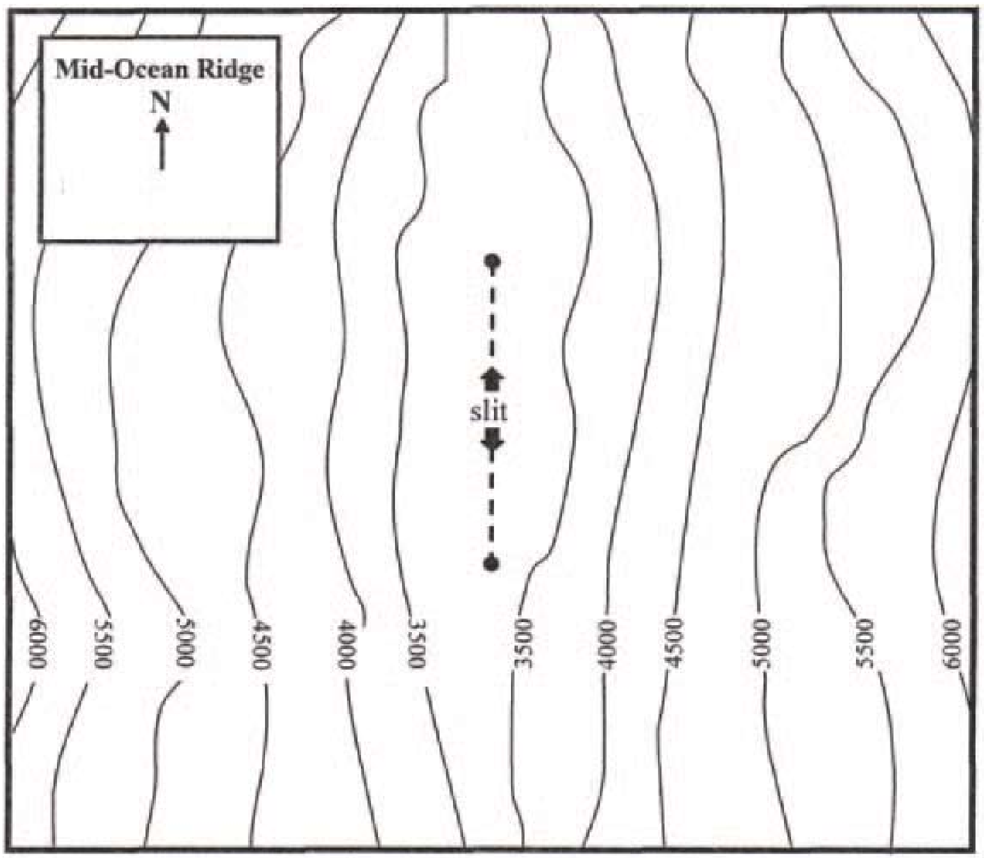
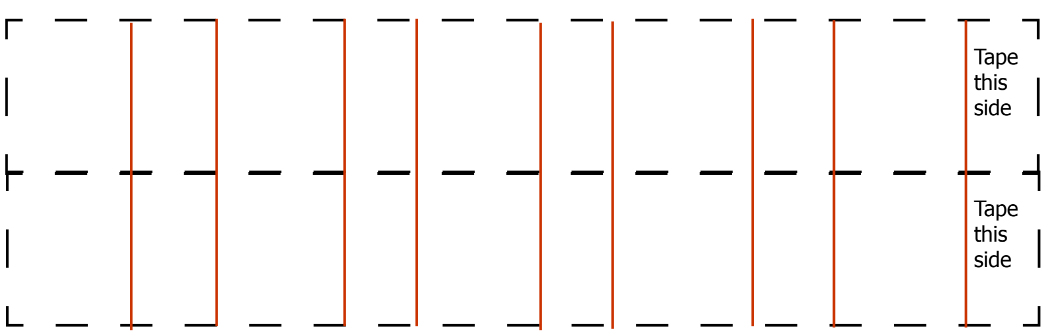
Map of Mid-Ocean Ridge



Cut out pattern



"Oil King" Lab Worksheet

In this game, you will be drilling for oil. Every centimeter of depth that you drill costs $150,000 USD*. In addition, each time you move to a new spot to drill, it costs $75,000 USD*.

Keep a record on the chart at the end of this lab of how many centimeters you drill and how many times you move the skewer to a new spot, so you can calculate the total cost of your exploration. Continue drilling until you find "oil." The team that finds the oil for the least cost is the winner.

Name of Group Members: ______________________________

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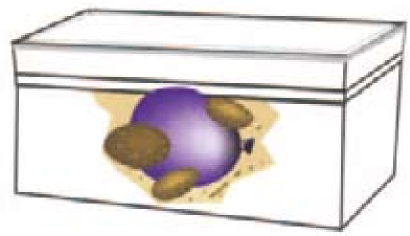

Since 1970, oil and natural gas have provided more than half of the energy used each year in the United States to produce electricity, heat, transportation fuels, and many everyday products from balloon to vitamins. Oil and natural gas are forms of petroleum, a word that literally means "oily rock." Petroleum is called a fossil fuel because it is geologically very old and is found in the ground, like fossils. Abundant oil and natural gas form only where conditions in the Earth are just right. Doing this investigation will help you understand how geoscientists identify and explore petroleum-rich reserves.

1. In a small box or opaque container, set up model similar to the one show in the illustration. Place a small balloon containing colored water (to represent oil) into the layers. Think carefully about where to place your oil reserves in the model. Putting it in the middle might be too obvious or putting it against the side of the box might be too confusing! Have placing the oil reserve fill the box with sand.

   Mark the sides of the box "North," "South," "East," and "West." Make a map of your model to show the location of the water-balloon "oil reserve."

   Place a lid securely on the box and fasten it with masking tape. Exchange your model with another group.

2. With the other group's box, you will model the method used by exploration geologists in the field. You may not move the box, and you may not look inside it. Attach graph paper to the lid of the box. Tap on the box and listen for an area that sounds different. Use the graph paper to record the locations of areas that sound different and seem like good candidates for oil exploration.

* You may convert this figure into your local currency if desired.

3. Probe the box to search for “oil” (the water balloon) in the places you identified. Mark off divisions of one centimeter on a bamboo skewer, beginning at the bottom. Use the bamboo skewer to penetrate the box lid at the location where you think the oil may be located.

   Probe gently though the sand. Look at the skewer for evidence of “oil.” This models the drilling process. Remember: every centimeter of depth that you drill costs $150,000*. In addition, each time you move to a new spot to drill, it costs $75,000*.

   Keep a record of how many centimeters you drill and how many times you move the skewer to a new spot, so you can calculate the total cost of your exploration. Continue drilling until you find “oil.” After finding oil and adding up your cost of drilling complete the “Oil King” lesson questionnaire found at the end of this lab.

   * You may convert this figure into your local currency if desired.

	Drill Site #1	Drill Site #2	Drill Site #3	Drill Site #4	Drill Site #5	Drill Site #6	TOTAL SITES
Centimeters Drilled Down							
Centimeters Drilled Over							
Cost to Drill each New Site							

"Oil King" Evaluation

Name of Group Members: ______________________________

____

____

____

____

1. What was the total cost of your exploration? _________________________

2. If you were to start over, how would you change your exploration procedure to save money?

3. Compare your results with the group that constructed the model. Look at their map. Was your oil deposit where they said it should be?

Seismic Surveys

Seismic Survey 1

Seismic Survey 2

Seismic Survey 3

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Lab Worksheet 8

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Seismic Surveys

Seismic Survey 1	Seismic Survey 2	Seismic Survey 3

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Exit Questionnaire

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Name:______________________

Questions

Exit Questionnaire Answer Key

1. The use of sound waves to obtain a "picture" of the subsurface geology is known as:
   a. Magnetometer technology
   b. Remote sensing
   c. Gravitational measurement
   d. Seismic survey

2. True/False. Drilling is the only sure way to prove the existence of oil or natural gas.

3. A ______________________________ is a fracture in the rock formation created when one section of the formation moves in relation to another.

4. Name at least two advanced pieces of technology that make it possible to discover oil:
   a. _________________________
   b. _________________________
   c. _________________________

5. In seismic technology, sound waves created by ______________________ are recorded by seismographs.