STEM Careers Coalition

CLASSROOM ACTIVITY

The Hunt for Oil

OBJECTIVES

Students will be able to:

- **Describe** the conditions necessary for the formation of oil.
- **Examine** what happens when plates meet at boundaries.
- **Predict** the types of plate boundaries that are conducive in oil formation.
- **Determine** where to drill for oil on a new planet.

OVERVIEW

In this activity, students will assume the role of a petroleum geologist to determine where oil deposits can be found. Students will determine why deserts and arctic areas seem to hold the largest hydrocarbon reserves on Earth. Working in small teams, they will discover how continental drift, subduction, and collision with other continents provide the movement of oil reservoirs from swamps, river deltas, and mild climates to the poles and deserts, where they have ended up today.

NATIONAL STANDARDS

Next Generation Science Standards

- **HS-ESS2-1 History of Earth**
  Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- **HS-ESS3-1 Human Sustainability**
  Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

BACKGROUND

Oil reserves are found in the topmost layer of the Earth called the crust. Various processes work together to generate an accumulation of oil and natural gas. Oil and natural gas are typically found in sedimentary rocks. Sedimentary rocks are formed by the accumulation of mineral or organic matter followed by cementation, a process in which the sediments are glued together by minerals that are deposited by water. Under the right conditions, sedimentary rocks can be porous enough to contain large volumes of hydrocarbons and are known as hydrocarbon reservoirs. A source rock is the main source from which hydrocarbons are generated from. These rocks are highly porous and permeable allowing the petroleum reserves to travel easily through them. In a marine environment (in anoxic conditions), the deposition and preservation of organic remains form these types of rocks. Oil and

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natural gas are light compared to other rock formations and can move up, striving to reach the Earth's surface. The upward movement of oil is stopped by an impermeable rock formation called a caprock. Rock formations sandwiched between the cap rock and source rocks are called reservoir rocks, where large quantities of hydrocarbons are trapped. The hydrocarbons leave the source rock and migrate into the reservoir rocks, where they become stored between the source and cap rocks.

KEY VOCABULARY

- Hydrocarbon Reservoirs
- Source Rock
- Reservoir Rock
- Cap Rock
- Subduction
- Tectonic Plates
- Divergent Boundary
- Convergent Boundary
- Transform Boundary

MATERIALS

- Scissors
- Computer
- Internet
- **Sequencing Crude Oil Formation** student handout
- **Exploring Plate Boundaries** student handout
- **Finding Oil on Another Planet** student handout

TEACHER PREPARATION

- Copies of **Sequencing Crude Oil Formation**—one per pair
- Copies of **Exploring Plate Boundaries** for each student
- Copies of **Finding Oil on Another Planet** for each student

PROCEDURE

1. Introduce the activity by asking students how long they think it takes oil to form. Invite students to share their ideas. Explain that most of the Earth's oil was formed between 60 million and 250 million years ago.
2. Explain to students that they will work with a partner to determine the process of oil formation by completing a sequencing activity. Distribute the **Sequencing Crude Oil Formation** student handout to each pair. Have them cut out each text box and picture. Give them 5 minutes to match each picture with its description and predict the sequence that each event would occur to form oil. Have two pairs combine into a larger group of four and collaboratively compare their answers and make any changes based on peer feedback. As a class, review the correct sequence of events before moving on.
3. Ask students where they think they would find the largest amounts of oil in the world today. After listening to their predictions, share that deserts and arctic regions are two of the four types of areas that hold the most oil found in the world today. Invite students to share predictions as to how this can be possible.
4. Explain that oil takes millions of years to form and that during this formation, the Earth was changing as well. Invite students to watch the video on Continental Drift to determine how oil moved from swamps, river deltas, and mild climates (where most organic material is deposited) to the poles and deserts where they have ended up today. Have them summarize main ideas from the animation on a sheet of paper.
5. Explain that students will work in pairs to explore the major geographic features that form because of the movement and interaction of tectonic plates and how these interactions provide conditions necessary for the formation of oil. Distribute the **Exploring Plate Boundaries** student worksheet to every student. Partners will work together and the Plate Tectonics exploration to complete the activity.
6. After the students finish the exploration, invite partners to form a larger group of four to share their observations and answers to the questions. Students can modify their responses based on peer discussion and feedback.
7. Share with the class that oil formation is associated with ancient divergent oceanic plate boundaries later affected by nearby oceanic and continental convergent boundaries. Explain that the divergent oceanic boundaries create the perfect environment that slowly matures the dead organic material into oil. Once these oceanic plates converge at a continental plate, collisions between plates can free the mature oil from deep within sedimentary rock and become trapped in a reservoir with cap rock above.
8. To close the activity, explain to students that they will demonstrate what they have learned in this lesson by assuming the role of a petroleum geologist. Distribute the **Finding Oil on Another Planet** student handout to every student. Read the background together and answer any clarifying questions before they begin.

EXTENSION

As an extension of this activity, students can research and investigate new technologies that are helping the offshore oil industry overcome challenges and improve exploration. They can create a 2–3 slide presentation that they can share with their peers in a science forum.

SEQUENCING CRUDE OIL FORMATION

Directions: Match the following picture with its description, then place them in the sequence in which oil is formed.

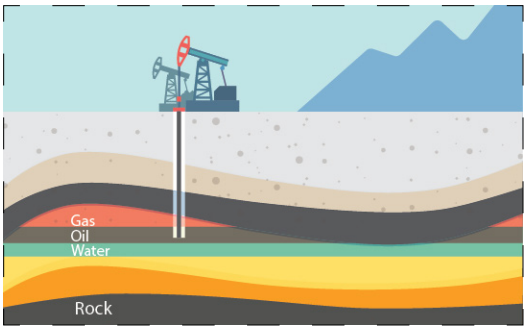
Over millions of years, the animal remains were buried deeper by the mud and sand.

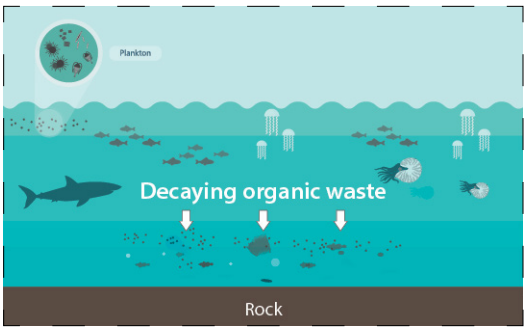
The temperature and pressure changed the mud and sand into rock and the organisms into crude oil.

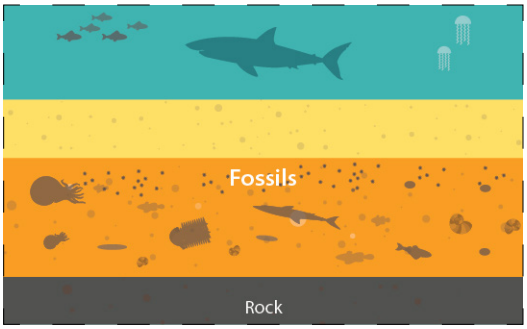
Millions of years ago, tiny marine organisms like plankton lived in the sea.

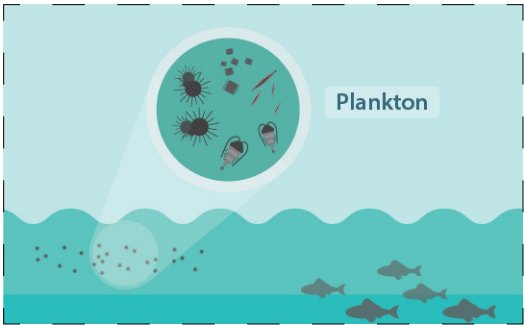
To extract crude oil from porous rocks where it is found, we can drill into the rocks.

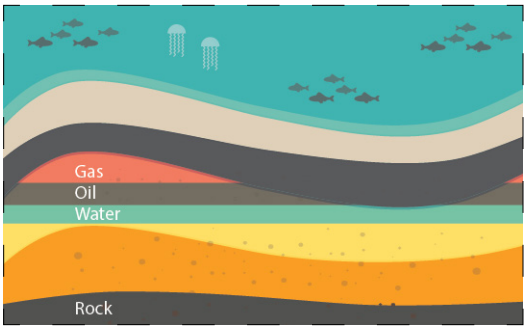
When the marine organisms died, they fell to the bottom of the sea where they took a great deal of time to decompose due to lack of oxygen.











EXPLORING PLATE BOUNDARIES

Directions: Use this link Plate Tectonics to explore the major geographic features that form because of the movement and interaction of tectonic plates.

1. In the exploration, select **Tectonic Plates**. Select the **Type of Boundary** and the **Direction of Plate Movement** to learn more about the different plate boundaries. Then, select **Plate Margins** to learn more about the types of interactions. Record your data in the chart below.

Type of Plate Boundary	Crust Types		
	Oceanic vs. Continental	**Oceanic vs. Oceanic**	**Continental vs. Continental**
Convergent	Notes Example	Notes Example	Notes Example
Divergent	Notes Example	Notes Example	Notes Example
Transform	Notes Example	Notes Example	Notes Example

2. Oil forms from ancient sea plants and animals that died and fell to the seabed where they were buried and heated. What type of plate boundary would provide these types of conditions?

3. Oil can be trapped in reservoirs by cap rocks, which are dome-shaped rocks that are impermeable to oil. These form by folding and faulting of the Earth's crust. What type of plate boundary would provide these types of conditions?

4. Oil formation is associated with ancient _____ boundaries later affected by nearby _____ boundaries.

FINDING OIL ON ANOTHER PLANET

Background:

The United Nations is sending a crew of petroleum geologists to a newly discovered planet in hopes of finding oil reserves. Petroleum geologists analyze geological information to identify sites that should be explored. They collect rock and sediment samples from sites through drilling and other methods and test the samples for the presence of oil and gas. They also estimate the size of oil and natural gas deposits and work to develop sites to extract oil and natural gas. Over 190 countries are putting the greatest minds together to provide industry, innovation, and infrastructure with the responsible production and consumption of oil on this new planet. Many scientists across the world are applying for this unique opportunity.

Mission:

1. You are going to take what you have learned today to determine where you would explore for oil. Satellite images and rock samples were taken, and your team believes this geographic area shows promise. On the map, place a large **X** over the area where you would explore.
2. Provide scientific reasoning for the location you selected.