

# Cleaning an Oil Spill Lab

## Summary

### Subject(s)

ESS2.C: Earth's System and Processes

### Grade/Level

Grade 6-8

### Activity Type

Designing solutions to engineering problems

### MN Science Standard

6E.3.2.1.3

### SEP / CCC

SEP: Constructing explanations & designing solutions

CC: Cause & Effect

### Est. Lesson Time

60 minute

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## Implementation

### Introduction

Oil is a nonrenewable resource found beneath the earth's surface and under the seafloor. It can be used to make a wide range of fuels and products including plastic. It needs to be drilled from the earth and transported across the land or ocean via pipelines and tanker trucks which bring the oil to refineries. Oil spills occur when ships, tanker trucks, or pipelines dump or spill oil into the environment. Such disasters disrupt the ecosystem, killing plants and animals in the surrounding area. Fishing companies may be forced to shut down and people can get sick from consuming fish and birds exposed to the oil. The efficiency in cleaning up this disaster is critical to the long term survival of the plant and animal species.

There are 4 main methods for cleaning up oil spills:

**Boomers/Skimmers:** Boomers are barriers that contain the oil within them. Skimmers collect the oil that has been contained by the boomer.

**Sorbents** - Sorbents attract oil to the surface of the water.

**Dispersant** - Dispersants break the oil up into tiny droplets, which are then left to sink, and be decomposed by bacteria.

**Burning** - Freshly spilled oil can be burned while it floats on the surface water.

On April 20, 2010 the Deepwater Horizon oil rig exploded and sent 134 million gallons of crude oil straight into the waters of the Gulf of Mexico. This is the largest ocean oil spill on record. It is encouraged to research this disaster and to show your students pictures of the effects of oil spills on marine plants and animals in an effort to help students connect the real world application to this experiment.

Earth day is a day to show support for environmental protection and is annually held on April 22. You might consider studying this topic on or near Earth Day. Students can learn more about how humans impact our environment and get inspired to be a part of the solution.

### Key Terms

- **Hydrophobic** - Something that does not mix with water, or repels it.
- **Fossil Fuel** - A natural non-renewable energy source made of carbon from long decomposed organic material extracted from the earth (e.g. coal, oil, natural gas, gasoline, petroleum)
- **Nonrenewable** - A natural resource that is used faster than it is created, causing a limited supply.
- **Oil Spill** - An event where oil enters the environment due to human accident in extracting, transporting, or storing it. The spill pollutes the environment and harms the animal and plant populations. Oil spills are currently very hard to clean up without causing further pollution.
- **Petroleum** - A fossil fuel that is formed from the remains of dead animals and plants.

### Objective

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

### Essential Questions

- How is the oil found below the earth's crust or beneath the seafloor used as a resource?
- What happens to the land and habitat when oil is spilled?
- What are the effects of both the spill and cleanup?
- How can oil be separated from water and cleaned off animals in the event of an oil spill? What was the best way to clean the oil from the water and habitat?
- What can we do to minimize the impact of oil spills and to avoid these problems in the future?

### Materials & Resources (Per Group)

- Containers to hold about 1 liter of water
- Water to fill containers half full
- Cooking Oil, 3-4 tablespoons
- 2 Test tubes
- Booms: Pipe cleaner or 12" heavier string to gather oil
- Skimmer: spoon, pipette or eyedropper
- Absorbent: sponge, cotton balls
- Dispersant: dish soap
- Feathers - represent marine life
- Paper Towels- one per student plus extra to wipe hands
- Waterproof waste container
- Timer
- **(Optional)** Blue food coloring
- **(Optional)** Habitat items - a few large and small rocks to simulate the shoreline, sticks, moss, toy animals

### Pre-Experiment

This lab is set up for your class to be split into groups of 4-8 and to have each group compare 4 different ways to clean up the oil. Teachers may also set this up as a class demonstration. Begin by introducing a habitat that might be affected by oil spills. How is petroleum collected, processed and distributed? Show pictures or videos of habits and animals affected by oil spills and how oil disrupts wild life. Discuss how petroleum is used in our society. The procedure is written as instruction for one group.

### Procedure

- A. Prepare the "ocean". Fill the container half full with water Add blue food dye to color the water.
- B. Premeasure the oil and soap.
- C. Explain the three methods to remove oil from water: boomers/skimmers, absorbent materials, and dispersants.
  - a. Determine which method the group will use. The 4 methods are:
    - i. Boomers/Skimmers
    - ii. Boomers/Skimmers & Dispersant
    - iii. Absorbents
    - iv. Absorbents and Dispersants
- D. Label each container/station with the method used and place a test tube by each station to collect the oil extracted.
- E. Have the students hypothesize about how their method's effectiveness will compare to the other methods of oil clean up.
- F. **(Optional)** Use a timer to record how long it takes to gather the oil.

- G. Over a 5 or 10 minute period have the students test their method by using it to try to remove the cooking oil from the water.
- Boomers & Skimmers method.** To use a boomer, hold the string/pipe cleaner on both sides and drag it across the water, collecting as much oil as possible. Then tie/twist the ends together to form a circle, corralling the oil into one spot. Once corralled, use the spoon, pipette, or eye dropper to skim the oil from the surface.. Put the gathered oil in the test tube to measure the amount collected.
  - Absorption method:** Use either the sponge and/or cotton balls to absorb the oil from the surface. If possible, extract the oil from the absorbents and gather it in the test tube to measure the amount collected.
  - Dispersing method:** Add dish soap to the oil and water. Mix the dish soap thoroughly. Use the other method to remove the cooking oil from the water.
- H. Have the students deposit any collected waste into the waste container.
- I. **[Extension]** Habitat items may be added to the simulated oceans so students can observe which items are the hardest to get the oil off of.
- J. **[Extension]** Dip the feather in the oil. Observe how the oil changes the feather. This represents how oil spills can affect birds. Dispersants are valuable in cleaning up bird feathers.
- K. **[Extension]** Lay the toy animal in the oil. Remove it from the oil. Observe how much work it takes to clean the oil off the toy..

**Small Group Discussion** (5 Minutes): Pair off with another student and discuss the following questions:

- Which method did you use? How well did it clean up oil? What about the method worked, and what didn't?
- What would change about this method to improve its effectiveness at cleaning up oil?

**Large Group Discussion** (10 Minutes): As a whole class, have some pairs share their answers with the group. The discuss the following questions/topics:

- Did your findings prove or disprove your hypothesis based on the results of your experiment? Explain why.
- What are the pros and cons of each method?
- What does the dispersant do to the oil? (It only separates the oil but does not get rid of it). What are the consequences of adding chemicals to oil spills?
- Did the use of dispersants make it easier to remove the oil with either boomers & skimmers, or the absorbents?
- Which method do you think an environmental engineer would prefer? Why?

**Wrap-up** (5 Minutes): The Key Ideas from the lesson are:

- Engineers have developed a number of methods to clean up oil spills including using boomer/skimmers, absorbents, and dispersants, all of which have their own pros and cons.
- Oil, and similar chemicals, are hydrophobic, meaning they do not mix with water.
- Oil spills have a devastating effect on natural environments and organisms, and are difficult to fully clean up.
- Oil spills are a result of a breakdown in the process of extracting fossil fuels from the ground (extraction, transportation, refining).

