

CLEANING UP AN OIL SPILL

OVERVIEW

This is a simulation designed to help students understand how difficult it is to control and clean an oil spill in the ocean. The students will create an oil slick in a pie plate “ocean” and use different materials to develop a plan to clean the oil from the water.

CONCEPTS

- Oil spill cleanup is affected by the type of oil, its source, the currents that flow in the area, and the condition of the water surface due to weather.
- There are a variety of ways to clean up oil on the ocean. None of them is totally successful.
- Satellite technology can be used to track the movement of oil, the currents that move oil, and hazardous ocean conditions that can lead to oil spills.
- Satellites can track current patterns and warn oil platform workers of approaching hazardous conditions. This can help to prevent oil spills.

MATERIALS

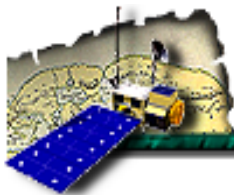


- Newspapers to cover the tables
- Bucket for waste
- Rubber gloves
- Worksheets (Table 1)
- Aluminum pie plate (a larger container, such as a plastic kiddie pool may also be used)
- Used motor oil (Vegetable oil can be substituted. It is less messy, but also has a less dramatic impact.)
- Absorbent pads
- Dish washing or other liquid detergent
- Paper towels
- Cotton balls, pieces of nylon net, nylon stockings, Styrofoam, string
- Spoon
- 2 Eye droppers
- Hay
- Watch or clock
- Drinking straw (to create simulated wind)
- Materials from home (optional)
- Sand or dirt (optional)

PREPARATION

This activity can be done either inside or outside the classroom, in teams of two or four students. One major difficulty lies in the proper disposal of the materials once the lesson is complete. For this reason, you can use vegetable oil.

Students may bring things from home to use for cleanup. Your students might want to use sand or dirt



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as a sinking agent to force the oil downward. Remember to discuss the impact that this has on bottom dwelling animals and plants. For this reason, this method of cleanup is prohibited in U.S. waters.

You can contact your local United States Coast Guard for current information and samples of materials that they use to clean up spills.

You might wish to set up an equipment tray for each group of students. The students can add materials from home to the tray.

PROCEDURE

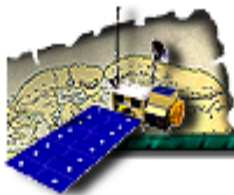
Engagement

Each year millions of gallons of oil enter the ocean, about 60% from industrial and non-industrial sources such as automotive and other urban run off as well as shipping. Approximately 30% comes from refineries, tanker accidents and offshore rigs, and 10% comes from natural seeps and atmospheric fallout. Although oil spills are relatively rare, their effects on local wildlife and ecosystems can be catastrophic.

If you had the job of cleaning up an oil spill, what would you try? How would you do it? Remember time is of the essence. The more an oil spill spreads, the more damage it can do and the harder it is to clean up.

Activity

1. Gather together the supplies that you will need to create your oil spill. Fill the pie plate with about an inch of water. This is your “ocean.” Add 5 drops of the motor oil to your “ocean.” Now you have an oil spill.
2. Your job is to clean up the spill. Think about which materials in the equipment tray might be most useful to clean up the oil slick and how will you use them. Pick one material or set of materials and a method to try first. Use a watch or clock to keep track of how much time you use to clean up your slick using this method. How successful were you? What percentage of the oil do you estimate you cleaned up? Make sure that you record your results in the Data Sheet (Table 1).
3. Repeat the simulation by adding a few more drops of oil to replace what you cleaned up. Try a different material or technique to try to clean up the spill. Try at least three different techniques and/or materials. Make sure that you keep a record of your results in Table 1.
4. Many oil spills occur during stormy weather. Use the straw to make wind waves in your ocean by blowing gently over the surface of your ocean. Add more oil and repeat several of the techniques in the “rough weather.” Record your results in Table 1.
5. Create another oil spill. This time add five drops of detergent directly on the oil. Stir the water to mix the oil and detergent. Record your observations.
6. With which method were you able to most thoroughly clean the oil? Which worked the fastest? Which method do you think was the most effective? Why?
7. Immediately following an oil spill, attempts are made to contain the oil. Containment keeps the oil from spreading. Which material worked better to contain the oil in your pie plate? Try containing some new oil in the water if you did not already use containment as one of your earlier methods. Ocean spills are often contained by *booms*. A boom is a barrier. Under what conditions would booms work best?



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8. Most oil removal techniques use materials that absorb the oil. The oil is picked up on other substances, like straw or nylon. The oil-soaked material is then removed from the water. Which of the techniques that you used removed the oil by absorption? Some people say that these techniques simply move the oil spill from the water to the land. What do they mean by this?
9. What effect did the detergent have on the oil spill? Under what conditions might the use of a *dispersant* (detergent) be advisable?
10. What are some factors that affect the clean up of oil in the ocean?

Explanation

After an oil spill occurs, the clean-up involves stopping the source of the spill, containing it, and finally removing the oil from the contained area. From log booms to floats with submerged skirts, the containment systems have met with mixed results, as have the clean-up methods. This activity illustrates some of the many challenges of cleaning up an oil spill, as well as some of the materials that have been used.

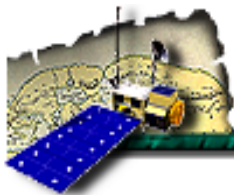
Once the oil is contained, a variety of removal techniques have been employed. Here's a list of these techniques and some of their benefits and drawbacks (source: FOR SEA Marine Science Project, Marine Science Center, Poulsbo, WA):

- Booms and skimmers to contain oil
- Vacuum
 - Limited to calm water conditions
- Absorbents such as straw, sawdust, and synthetic absorbents
 - Synthetic absorbents absorb oil but not water
 - Straw and sawdust can become waterlogged and difficult to remove
 - The contaminated absorbent materials must be treated as toxic waste and present disposal problems
- Sinking agents such as sand, clay, cement
 - Sink to sea floor and impact bottom dwellers
 - Natural degradation of oil retarded at depth
 - PROHIBITED in U.S. waters
- Burning
 - Leaves toxic residue
 - Pollutes air
- Chemical *dispersants*
 - The newest types of dispersants have greater effectiveness and less toxicity than before and are designed for very specific applications
 - New dispersant options include gelling agents, emulsifiers, elasticizers, or viscoelastic enhancing agents, and absorbents
 - Recent developments use nutrients to encourage growth of natural micro-organisms such as bacteria to disperse oil

EXTENSION

The students can put sand at the edge of the simulated ocean and attempt to clean up the beach once the oil has reached the sand and *intertidal* environment.

There are instruments that can (1) image oil slicks using radar technology, and (2) can track currents to help predict the movement of the slick from space. Have the students research these types of Earth-observing satellites and report why using satellites to image or track oil spills can be beneficial (for example, the Shuttle Imaging Radar instrument at <http://www.jpl.nasa.gov/radar/sircxsar> and the TOPEX/



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Poseidon satellite at <http://topex-www.jpl.nasa.gov>). Can the students think of other ways satellite technology can help lesson the damage from oil spills?

LINKS TO RELATED CD ACTIVITIES, IMAGES, AND MOVIES

Image of an *oil spill*.

Image of an *oil spill from space shuttle*.

VOCABULARY

boom

dispersant

intertidal

SOURCE

Adapted from the Marine Science Project FOR SEA, Marine Science Center, Poulsbo, WA.

Table 1: Data Sheet for "Cleaning Up an Oil Spill"

| Material | Calm or rough water | Time to clean spill | Estimated % of oil cleaned up | Comments: (i.e., not very effective, left with oily cotton, etc.) |
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