Activity: How Do We Clean Up an Oil Spill?

Submitted by:
Tiska Rodgers
Dexter High School
Dexter, Missouri

Summary
In this activity, students simulate an oil spill and test different materials' abilities to "clean" the oil spill.

Grade Level
High or middle school

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:

- **MS-ETS1-1**: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-3**: Analyze data from tests to determine similarities and difference among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **HS-ETS1-1**: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2**: Design a solution to a complex real-world problem by breaking it down into small, more manageable problems that can be solved through engineering.
- **Scientific and Engineering Practices**:
    - Developing and Using Models
    - Analyzing and Interpreting Data
    - Constructing Explanations and Designing Solutions

Objectives
By the end of this activity, students should be able to

- Determine which sorbents best absorb oil from fresh and salt water.
- Make careful observations.
- Draw conclusions based on their observations.

Chemistry Topics
This activity supports students' understanding of

- Observations
- Separating mixtures

Time
Teacher Preparation: 30 minutes
Lesson: 60-90 minutes

Materials
For each group:

- 28-cm x 19-cm x 4-cm clear glass baking dish (or equivalent)
- water
- blue food coloring
- 12 Tbsp vegetable oil
- 8 Tbsp pure cocoa powder
- 1 tsp sea salt (use table salt if sea salt is unavailable)
- a tablespoon
- a teaspoon
- 5 wooden stirring rods
- a coffee mug

- sorbents (paper towel, cotton balls, rag, string, nylon pot scrubber, sponge, Styrofoam cup, garden peat moss)
- droppers
- liquid dishwashing detergent
- tweezers or tongs
- bird feathers

Safety

- Always wear safety goggles when working with chemicals in a lab setting.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes

- This activity can get messy, so keep extra paper towels on hand.
- Adapted from Australian Maritime Safety Authority

For the Student

Lesson

How Do We Clean-up an Oil Spill?

Background

Do you want to try cleaning up an oil spill yourself? This experiment will help you understand why it is such a difficult task. All of the tools you will need are environmentally friendly and easy to find.

Safety

- Goggles
- Gloves (optional)
- Proper disposal of contaminated wastes

Materials

- 28-cm x 19-cm x 4-cm clear glass baking dish (or equivalent)
- water
- blue food coloring
- 12 Tbsp vegetable oil
- 8 Tbsp pure cocoa powder
- salt
- a tablespoon
- a teaspoon
- 5 wooden stirring rods
- a coffee mug
- sorbents (paper towel, cotton balls, rag, string, nylon pot scrubber, sponge, Styrofoam cup, garden peat moss)
- droppers
- liquid dishwashing detergent
- tweezers or tongs
- bird feathers

Procedure

To prepare the fresh water:

1. Fill baking dish with cold tap water within 1 cm of rim.
2. Add five or six drops of food dye.
3. Mix dye and water with a stirring rod. Let solution settle.
4. Record your observations in Table 1.

To simulate the ocean water:

1. Fill baking dish with cold water within 1 cm of rim.
2. Add 8 tsp of sea salt slowly and stir until dissolved (if you have a hygrometer, keep adding salt until you reach a salinity of 1.024–1.026).
3. Add five or six drops of food dye.
4. Mix dye and ocean water with a stirring rod.
5. Record your observations in Table 1.

To simulate crude oil:

1. Place 3 Tbsp of vegetable oil in mug.
2. Add 2 Tbsp of cocoa powder.
3. Mix cocoa powder and oil thoroughly with a paddle pop stick.

To contaminate each fresh water and ocean water container:

1. Very slowly pour simulated crude oil from a height of 1 cm onto the top of the fresh water dish. If you pour the oil too quickly, the experiment won't work.
2. What happened to the oil when you dropped it on the fresh water/ocean? Did it sink? Float? Mix in?
3. Wait 3 minutes. Record your observations in Table 1.
4. Repeat these steps with ocean water.

To test the sorbents:

1. Place a small sorbent sample into the center top of the contaminated fresh water.
2. Record your observations in Table 1. Include all of the following information:
    a. How much oil did the sorbent clean up? How quickly?
    b. Does the sorbent pick up water too? If so, how can you tell?
    c. Does the sorbent sink or float?
    d. What is the condition of the contaminated sorbent?
3. Remove sorbent with tweezers or tongs.
4. Repeat step one with other sorbent samples, recording your observations in Table 1.
5. Clean out contaminated fresh water.
6. Prepare new contaminated fresh water following the same procedure as before.
7. Add detergent to the oil-contaminated fresh water.
8. What happened when the detergent was added to the contaminated fresh water/ocean?
9. Where would the oil go in "real" fresh water/ocean after a dispersant (like the dishwashing detergent) is used?
10. How clean is the fresh water/ocean now that it has dishwashing liquid in it?
11. Repeat steps 1-7 with ocean water and compare those results with your fresh water results.

To determine how oil affects feathers:

1. Dip feather into oil-contaminated fresh water.

2. What happens when a feather gets oil on it?
3. How might an oiled feather affect a bird?
4. Repeat the above procedures substituting ocean water for the fresh water.

To determine how oil affects soil:

1. Use five plastic petri dishes.
2. Fill one petri dish with fine grained sand.
3. Fill one petri dish with medium grained sand.
4. Fill one petri dish with coarse grained sand.
5. Fill one petri dish with "mud" created by adding enough water to potting soil to create a paste.
6. Fill one petri dish with dry potting soil.
7. Place three droppers full of oil onto each the petri dishes.
8. Record observations in *Table 2* each time the oil is added to the different soil substrates.

Data and Observations

Table 1: Freshwater and Simulated Ocean Water Observations

	Freshwater	Simulated Ocean Water
Noncontaminated		
Contaminated		
Paper towel		
Cotton ball		
Wash cloth		
String		
Nylon pot scrubber		
Sponge		

Styrofoam cup		
Garden peat moss		
Panty hose		
Aquarium net		
Saw dust		

Table 2: Observations of oil added to different soil substrates	
Soil	**Observations**
Fine sand	
Med. sand	
Coarse sand	
"Mud"	
Potting Soil	

Analysis

Based on your observations recorded above, answer the following questions:

1. How is fresh water/ocean different from tap water?
2. How would you pick up the oil-contaminated material in a "real" oil spill in fresh water/the ocean?
3. How would you dispose of the oil-contaminated material in a real oil spill?
4. Of the sorbents you tested, which one worked the fastest? The best?
5. What other materials could you use as sorbents?
6. Are the results of the experiment different when you use fresh water instead of an ocean?
7. Which soil absorbs the most oil?
8. Which soil repels the most oil?
9. Which soil would be the easiest to clean?
10. Which soil would be the hardest to clean?