# Oil Spill Cleanup

## Introduction

Set up a small scale oil spill and demonstrate the difficulties faced by those given the task of cleaning up the real thing. Cleanup attempts will be made using a variety of common materials under good and poor conditions. A brief examination of the effects of spilled oil on marine and aquatic life will also be performed.

## Concepts

- Oil spill
- Absorbency

## Background

The largest marine oil spill in history occurred in the Gulf of Mexico from April 20th to July 15th 2010. An estimated 200 million gallons of oil were released into the Gulf of Mexico during this time. The magnitude and circumstances of the spill, the devastation of human and aquatic life lost, the amount of coastline affected (over 1,000 miles of beaches and wetlands), and the long-term effects to the environment continue to be addressed. Much of the attention is now focused on the methods used to clean up oil from the ocean, affected beaches, and wetlands.

Briefly, some of the methods used to clean up oil spills are: (1) dispersants, chemicals that break down the oil into small droplets that are more easily degraded; (2) booms, floating "sausages" with skirts that hang a few feet below the surface and corral and contain the oil to facilitate mechanical removal; (3) skimmers, towed or self-propelled machines that collect the oil by skimming or vacuuming it from the surface, (4) hand scrubbing, blotting, or rinsing (with high pressure hoses) the oil from cobble or pebble beaches, and (5) enhanced biodegradation. Biodegradation is a naturally-occurring process in which microorganisms effectively "digest" the spilled oil. Enhanced biodegradation (also called bioremediation) involves the application of nitrogen- and phosphorus-containing fertilizers to accelerate these natural processes.

Wildlife affected by the spilled oil continues to be a magnet for a great deal of media attention, and mortality estimates vary widely. There is no question that everything from planktonic organisms to fish, seabirds, whales, and dolphins were adversely affected. Data from numerous research projects are still being analyzed and lingering effects of this event will be felt for some time.

## Materials (per lab team)

- Bird feather
- Cotton balls
- Drinking straw
- Foil pie or cake pan (or other shallow, flat dish)
- Liquid detergent
- Mineral oil or cooking oil, 10 mL
- Pieces of panty hose
- Pieces of paper towel
- Pieces of string
- Pieces of various fabrics with different degrees of absorbency

*Note:* The cleanup materials specified above are only suggestions. You and your students are strongly encouraged to experiment with a variety of other materials. This activity is purposely open-ended, leaving ample room for creativity and imagination.

## *Safety Precautions*

*Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Safety Data Sheets for additional safety, handling, and disposal information.*

## Procedure

1. Partially fill the pan with water.
2. Pour a small amount of oil in the center of the pan to create an oil spill. Approximately 20 drops or 1 mL will be adequate. Visualization of the spill can be enhanced by coloring the oil used with a small amount of a fat or oil soluble dye such as Sudan III, Sudan IV or Oil Red. Approximately 0.1 g of dye per 100 mL of oil should be more than adequate. Shake or stir the dye into the oil before creating the spill. Colored oils for decorative lamps are also available and will


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work quite well.

3. Attempt to clean up the spill using one material at a time. If the numbers work out, one or two materials may be assigned to each lab group. Have students record their observations regarding the effectiveness of each material tested.
4. Using the drinking straw, simulate windy or stormy conditions on the water surface. Retest selected materials under these "adverse weather" conditions.
5. Immerse the feather in the spill to simulate a seabird swimming or diving through a surface slick. Note the effects.
6. Add a small quantity of detergent solution to the spill and note the effects. Retest selected materials with the detergent added.

## Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Cleanup materials should be gathered in a plastic bag and disposed of as normal solid waste. Remaining oil/water mixture should be flushed down the drain with a copious amount of clean water. Materials to be reused can be washed with a mild detergent solution.

## NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

**Disciplinary Core Ideas: Middle School**
- MS-LS2 Ecosystems: Interactions, Energy, and Dynamics
  - LS2.A: Interdependent Relationships in Ecosystems
  - LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- MS-ESS3 Earth and Human Activity
  - ESS3.A: Natural Resources
  - ESS3.C: Human Impacts on Earth Systems

**Disciplinary Core Ideas: High School**
- HS-LS2 Ecosystems: Interactions, Energy, and Dynamics
  - LS2.A: Interdependent Relationships in Ecosystems
  - LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- HS-ESS3 Earth and Human Activity
  - ESS3.A: Natural Resources
  - ESS3.C: Human Impacts on Earth Systems

**Science and Engineering Practices**
- Asking questions and defining problems
- Developing and using models
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

**Crosscutting Concepts**
- Cause and effect
- Systems and system models
- Structure and function
- Stability and change

## Tip

- For an additional oil clean-up method, polymer Enviro-Bond™ 403 (Flinn Catalog No. FB1025) is an excellent example.
- This activity is available as a Flinn STEM Design Challenge™ kit (Catalog No. AP3829) with enough materials for 15 student groups.

## Discussion Questions

Your discussion should focus on the relative effectiveness of the materials tested. What did the most effective materials have in common? What did the least effective materials have in common? How would these methods translate into a larger, more realistic scale? Also discuss what effects weather might have. Point out that high winds and waves will inhibit cleanup efforts but may actually improve the actions of dispersants (analogous to the detergent tested) and hasten natural physical degradation.

Birds rely on air trapped in their layers of feathers to keep warm and buoyant. What effect does oil have on the feathers? What will happen to the bird under these circumstances?

This activity may be only a beginning. Students may be encouraged to further investigate large scale cleanup techniques and actual research done on the short- and long-term effects on wildlife and natural environments.

## Acknowledgments

Marta S. Hoffman, Woodland Park High School, Woodland Park, Colorado and DeWayne Lieneman, Glenbard South High School, Glen Ellyn, Illinois

## References

***Science World, September 8, 1989***
Chem Team 10 Binder, Woodrow Wilson National Fellowship Foundation, Presented by Kathy Kitzman, Detroit Catholic Central High School, Redford, Michigan
Easy Environmental Science Laboratories, presented by Becky Woods, Northwest High School, Omaha, Nebraska

## Materials for *Oil Spill Cleanup* are available from Flinn Scientific, Inc.

| Catalog No. | Description |
|---|---|
| M0064 | Mineral Oil, 500 mL |
| C0241 | Cleaner, Dishwashing, 22 oz |

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.