

Lab: Pollution Solution

(modified from smithsonian education)

Background:

The effect of petroleum on aquatic ecosystems can be severe and persistent. Oil destroys the insulating ability of fur-bearing mammals, such as sea otters, and the water repellency of a bird's feathers. Without the ability to repel water and insulate from the cold water, birds and mammals will die from hypothermia. Many birds and animals also ingest oil when they try to clean themselves, which can poison them. Fish and shellfish can come into contact with oil if it is mixed into the water column. When exposed to oil, adult fish may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion. Oil also adversely affects eggs and larval survival. (NOAA)

Historically, it was said that the "solution to pollution is dilution". However, most evidence now suggests that certain pollutants can persist in the environment for decades, centuries or longer. Prevention is obviously the first priority, but there are several cleanup methods available in the event of an oil spill:

Mechanical containment or recovery is the primary line of defense against oil spills in the United States. Equipment includes a variety of booms, barriers, and skimmers, as well as natural and synthetic sorbent materials. Mechanical containment is used to store the spilled oil until it can be disposed of properly. (EPA)

Chemical and *biological* methods can be used in conjunction with mechanical means for containing and cleaning up oil spills. Dispersing agents and gelling agents are most useful in helping to keep oil from reaching shorelines and other sensitive habitats. Biological agents have the potential to assist recovery in sensitive areas such as shorelines, marshes, and wetlands. (EPA)

Physical methods are used to clean up shorelines. Natural processes such as evaporation, oxidation, and biodegradation can start the cleanup process, but are generally too slow to provide adequate environmental recovery. Physical methods, such as wiping with sorbent materials, pressure washing, and raking and bulldozing can be used to assist these natural processes. (EPA)

Procedure:

1. Use the shallow plastic box filled halfway with water as your model ocean. Sand should be piled on one side in order to create a beach with sand in and out of the water.
2. Add 5 mL of vegetable oil to your ocean to simulate a blown oil well.
3. Gently blow the oil from offshore to make contact with the beach.
4. Begin cleanup of the oil using the available materials, attempting to retrieve all of the oil into the waste disposal beaker. Keep track of how much time is used.
5. Use the chart below to record your efforts and the approximate, though admittedly arbitrary, cost.

Data:

Equipment & Techniques	Cost (in millions)	Minutes of Use or # Used	Total Cost
Skimmer (pipet)	\$10/min		
Boom (cotton ball)	\$2 each		
Waste Disposal (cotton ball)	\$5 each		
Waste Disposal (beaker)	\$20 each		
Labor	\$50/person/min		
Total			

(continued on back)

Lab Group	Time Spent Cleaning	Total Cost
1		
2		
3		
4		
5		
6		
7		
8		
9		

Analysis:

1. How did you determine when cleanup was complete? (how clean was “clean enough”?)
2. Assuming you did not retrieve all the oil, how much more time do you think you would need to do so?
3. What methods worked best for cleaning up the oil?
4. What differentiated the costs of your cleanup with that of other groups?
5. Compare and contrast your cleanup experience with that of a real oil spill.
6. How is vegetable oil different than crude oil?
7. Compare and contrast the cost of your cleanup experience with that of real spills.
 - BP paid roughly \$15 billion in cleanup costs for the DeepWater Horizon oil spill (2010). Exxon paid roughly \$2.5 billion in cleanup costs for the Valdez spill (1989). Neither of these costs include the economic and ecological damage to the area.
8. In the BP oil spill cleanup, 1.8 million gallons of dispersant were used. Discuss the advantages and disadvantages of this technique.
9. How would cleanup efforts be different if oil did not reach the coast and stayed in the open ocean?
10. How would cleanup efforts be different on a rocky coastline?