

Pollution Solution

More than 60 million gallons of oil enter the oceans every year, but it's not reported on the news.

That's because this oil seeps from oil-bearing rock layers into the ocean as part of a natural process. When tankers running aground spill oil, that's news, and currently these accidents deposit about 37 million gallons of oil into the ocean every year. The largest amount of oil entering the ocean through human activity is the 363 million gallons that come from industrial waste and automobiles. When people pour their used motor oil into the ground or into a septic system, it eventually seeps into the groundwater. Coupled with industrial waste discharged into rivers, oil becomes part of the run-off from waterways that empty into the ocean. All of this oil affects ocean ecosystems. When an oil spill occurs in the ocean, the oil may spread across miles of open water and up onto beaches, littering them with tar balls. The intertidal zones—

coastal areas that are the habitat for fish, birds, and other wildlife—are often the most vulnerable. Animals may perish when the oil slicks their fur or downy feathers, decreasing the surface area so they are no longer insulated from the cold water. Or the animals may ingest the oil, then become sick or unable to reproduce properly. When an oil spill occurs along a coastline, it affects the human population as well as wildlife. Emergency equipment and personnel must be rushed to the scene. The responsible party must be identified to determine who will pay for the cleanup. Usually the cleanup is a group effort by oil companies, government agencies, local groups, and volunteers. People rescue and clean birds and animals and painstakingly scrub the oil from the rocky shores with brushes and detergent. Coming in by sea and by air, crews skim the spreading oil from the water's surface. Oil that cannot be skimmed is emulsified—that is, droplets of oil are scattered into tiny particles that will then float away and disperse out to sea. Sometimes microscopic helpers are put to work. Genetic engineers have developed oil-eating bacteria that can be used to ingest the oil, to clean up long after the crews and volunteers have left. The experience gained from several well-publicized oil spills has ushered in an era of greater understanding and international cooperation with regard to containing spills and avoiding environmental disasters that affect our global ocean. One bright spot of news is that ecologists revisiting oil spill sites have found marine population recovery better than they had predicted.

Pollution Solution *Lesson Plan* Step 1

Objectives

Predict the effects of an oil spill on a marine environment.

Establish a list of solutions to avoid unnecessary oil pollution.

Materials

Copies of Student Page A

Optional: additional photographs or articles about oil spills

Subjects

biology, chemistry, social studies

Procedure

1. Introduce the topic of oil pollution and how it affects the global ocean. Make a pie chart to show the actual small percentage of oil (5 percent) that enters the ocean through oil spills. Then discuss oil spills with which students may be familiar, such as the spill off the coast of Rhode Island in January 1996 and the one in Prince William Sound in Alaska in 1989. You may wish to check your library or online sources for magazine and newspaper articles about actual oil spill events, perhaps an incident that occurred close to your region to make the topic more relevant to students.
2. Explain to students that crude oil is taken directly from its rocky source below ground or under the sea. It is often transported in huge tankers across vast distances to oil refineries. There the crude is distilled and refined into many familiar petroleum products. During the distillation process, petroleum is heated to extremely high temperatures to separate it into various components such as gasoline and kerosene. Students may not know that petroleum is

used for waxes contained in petroleum jelly, lipstick, and many personal care products. Each of these petroleum products has different chemical characteristics. In general, the molecules that make up oils and waxes adhere to one another and are less dense than water; thus, they float on the water's surface without mixing. However, the currents and wind out on the open ocean cause the oil in an oil spill to spread and travel away from the spill site.

3. After an initial discussion, hand out Student Page A. In this page students can use problem-solving skills to decide what strategies they would use if they were actually cleaning up an oil spill. They can work in small groups and brainstorm to come up with answers cooperatively.

Possible answers, page 38:

1. Problems: Currents and wind may carry the oil over a huge area of the sea.

Strategies: Bring in equipment by air or boat to skim the oil from the water's surface before it spreads.

Problems: Rocks will get covered with oil; animal habitats will be harmed.

Strategies: Have crews scrub the rocks with brushes and detergent.

Problems: The oil will wash up on shore, making cleanup difficult and affecting wildlife.

Strategies: Have crews take away or sift through oily sand and rescue wildlife.

2. These agencies have information about winds, currents, tides, and weather patterns affecting the area.

This agency has information about which species of fish and wildlife need protection.

3. Water is denser, so oil floats on it.

4. The oil will probably spread out away from the spill, staying on top of the water rather than sinking.

Pollution Solution Student Page A

Suppose you are in the business of cleaning up oil spills in the ocean. Your team has just received word of a tanker leaking oil in the Pacific Ocean. How will you use your resources to effectively clean up the oil and prevent it from spreading? Brainstorm in a small group to predict what will happen during the oil spill, then plan your cleanup strategies.

1. What special problems arise if an oil spill occurs in the open ocean, on a rocky coast, or near a sandy beach? (Hint: You might think about things like currents, surface area, and habitat for wildlife.) List the kinds of equipment and vehicles you might need to do the cleanup at each site in the data chart below.

<i>Oil Spill Site</i>	<i>Special Problems</i>	<i>Possible Strategies for Cleanup</i>
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Open ocean		
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Rocky coast		
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Sandy beach		
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2. What kind of information would be important to find out from these government services?

Weather Service or Coast Guard	
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U.S. Fish and Wildlife Service	
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3. Which do you think is denser, oil or water?

4. What do you think will happen to the oil (or other petroleum product) as it spills out of a tanker into the ocean?

Pollution Solution *Lesson Plan* Step 2

Objectives

Make a model of an ocean oil spill.

Evaluate the efficiency of oil spill cleanup methods.

Materials

For each group of four students, a shallow oblong pan, water, vegetable oil, cotton balls, teaspoon, medicine dropper, timer, plastic container for wastewater, and plastic bag for discarded cotton balls.

Student Page B

Optional: liquid detergent, brush, bird feather, wire whisk, pebbles

Subjects

physics, mathematics

Procedure

1. Advise students of the activity the day before so they can wear washable clothing. Divide students into groups of four. Each group can carry out the simulated oil spill and cleanup cooperatively. Arrange to have all the materials students need at each workstation. Guide students as they read through the directions on how to make an oil spill and then clean it up. Advise them to use their resources wisely, as they will be “charged” for each piece of equipment and the disposal of the oil.

2. In carrying out the activity, limit the “disaster” to a portion of the classroom or lab where surfaces can be wiped dry. Use clear plastic bags to collect the oil-soaked cotton balls so that students can count them and be charged accordingly. Use quart-

sized, wide-mouthed plastic containers for the wastewater, which can then be carried to a sink for disposal. Have paper towels on hand to clean up spilled water and advise students of slippery floors.

3. Options: Before students begin, demonstrate that “oil and water don’t mix” by pouring some oil into a clear container of water. Have students observe how the oil forms a layer on top of the water. Then use a wire whisk to stir up the oil and water. Students will see how oil can be made into smaller and smaller droplets that will disperse in the open ocean where there is room to spread out. This is similar to one of the techniques used in cleanup operations. If students use the whisk in their pans, it will make skimming the oil much more difficult, but you might challenge some students to do it anyway. Another interesting demonstration is to dip a bird feather in oily water and have students try to clean the feather using liquid detergent and a brush. You can also challenge one group to simulate an oil spill that hits a rocky coast by using pebbles at one end of the pan.

Have students compare the amount of surface area for that cleanup with an oil spill on the open ocean.

4. After the groups have worked on their oil spills for twenty minutes, have them tally the cost of their efforts and clean up their spill sites. Students can then answer the discussion questions and compare their results.

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Student Page B

In this activity you will make your own “ocean” in a pan of water. You can simulate your own very limited environmental disaster—and then clean it up! Work with your group to set up the materials shown below.



1. Use the shallow pan filled halfway with water as your model ocean. Add a teaspoon of vegetable oil to the middle of the pan to simulate a leaking oil tanker.
2. While one group member releases the oil in the center of your ocean, another begins timing.
3. After one minute has passed, observe what happens to the oil. See how the oil is affected as another team member blows on the oil, simulating the wind.

4. Begin the cleanup of the oil using the available materials. You may take twenty minutes.
5. Try to do the cleanup efficiently because you will be “charged” for the use of each piece of equipment. No cleanup effort is free! Keep track of the time each technique is used. Use the chart below to calculate the cost of your efforts.

Pollution Solution Cost Sheet

<i>Equipment and Techniques</i>	<i>Cost</i>	<i>Minutes of Use or Number Used</i>	<i>Total Cost</i>
Medicine dropper “skimmer”	\$100/minute		
Cotton ball	\$20/piece		
Waste disposal:			
Discarded cotton ball	\$50/each		
Container for wastewater	\$1,000/each		
Labor	\$1,000/person/minute		
<i>Total cost</i>			

Pollution Solution

Student Page B

Use the back of this page or a separate sheet to answer these discussion questions.

1. Did you clean up your oil spill within twenty minutes? Did everyone agree on how clean the pan was?

2. Which technique seemed to work best?

3. Make a chart of your class results. Which group cleaned its ocean at the lowest price?

4. What importance does immediate response have in cleanup efforts?

5. Suppose class members used different kinds of oil. Would their results be the same? Do you think all petroleum spills behave the way vegetable oil does? Why or why not?

*Pollution Solution*²

Lesson Plan Step 3

Objectives

Identify the problems caused to the environment and society by an oil spill and the subsequent cleanup operations.

Materials

List of fictitious characters (on page 44)

Optional: newspaper or magazine articles about oil spills

Subjects

social studies, language arts

Procedure

Fictitious characters

Captain Shipley: captain of the tanker that went aground

Ms. Petrol: spokesperson for the Giant Oil Corporation

Mr. Swab: head of cleanup operations

Ms. Cirrus: spokesperson for the U.S. Weather Service

Mr. Marchand: president of the local merchants' association

Ms. Greene: spokesperson for a national conservation group

Mr. Hook: spokesperson for the local fishing community

Ms. Wright: president of the Town Council

Mr. Labb: scientist at Innovate Corp., a bioengineering firm

Ms. Ivory: salesperson for Kleen-Up Supplies, Inc.

Mr. Byrd: conservationist from the U.S. Fish and Wildlife Service office

Ms. Goodley: spokesperson for volunteers

1. To get a sense of the impact of an oil spill, have a role-playing discussion. Ask students to play the parts of some or all of the fictitious characters listed here. Have each character write some notes that would be taken to a press conference held to find out what happened when a tanker went aground and caused an oil spill along a coastline. Some members of the class can be reporters, directing questions to any of the participants. Other members of the class can record the discussion in writing or videotape it.

2. The reporters should ask questions about (a) the chain of events that led to the oil spill, (b) how each party helped with the cleanup operation, and (c) how the spill affected their lives. Student responses will vary widely but should be consistent with the attitude and professional knowledge suggested by each fictitious character's name and position. Students should be able to conclude that the responsibilities for cleanup must be shared and that local people are affected by the oil spill long after the cleanup crews have left.

3. Optional: Have students use their library to access articles about recent oil spills. Encourage students to become aware of local or regional events that are similar, if not as large.

Resources

Resources for students

Anderson,
M. K. *Oil
Spills*. New
York: Franklin
Watts, 1990.

Carr, Terry. *Spill! The Story of the
Exxon Valdez*. New York: Franklin
Watts, 1991.

Resources for teachers

Benchley, Peter. *Ocean Planet:
Writings and Images of the Sea*.
Edited by Judith Gradwohl. New
York: Harry Abrams, in associa-
tion with the Smithsonian
Institution, 1995.

Bulloch, David K. *The Wasted
Ocean*. New York: Lyons and
Burford, 1989.

Earle, Sylvia A. *Sea Change, A
Message of the Oceans*. New York:
G.P. Putnam's Sons, 1995.

Keeble, John. *Out of the Channel:
The Exxon Valdez Spill in Prince
William Sound*. New York:
HarperCollins, 1991.

"Rescuers Create a MASH Unit
for Hundreds of Stricken
Animals." *New York Times*,
4 April 1989.

Online resources

Visit
Ocean Planet
online at
[http://seawifs.gsfc.nasa.gov/
ocean_planet.html](http://seawifs.gsfc.nasa.gov/ocean_planet.html)

Using the Exhibition Topic
Outline, go to Oil Pollution
under Oceans in Peril for graphs
showing oil pollution data.
Under Resource Room, go to
the Image Catalog to get
photographs and illustrations
of specific images suggested by
the topics in the activity.