

## Human Use Chapter Teacher Sheet



### Activity #2: Marine Oil Spills

*Adapted from "Oil Bioremediation Module for High School Students," WSU/NSF Teaching Institute Summer Modules, Washington State University - School of Chemical Engineering and Bioengineering.*

#### Objectives:

To research sources of oil pollution in estuaries, and attempt to clean up an oil spill in the classroom using various materials.

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#### Time:

The first part of this activity requires two 55-minute class periods. The second part of this activity will require another class period. You might also want to schedule one additional class period for discussion and follow-up.

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#### Background:

When we think of an oil spill, many people picture the accident involving the Exxon-Valdez oil tanker that dumped millions of gallons of oil into the ocean off the coast of Alaska. However, there are many other sources of oil in our estuaries, such as sewer runoff, gas stations, improper disposal of used motor oil, industrial wastes, etc., that contribute even greater amounts of oil pollution into the marine environment.

Any oil spill, regardless of origin, will have a negative effect on the plants and animals living in the area. Numerous methods have been devised to clean up these spills, but each creates additional problems. For instance, an oil spill can be destroyed by burning, but the smoke and fumes can disperse over large areas, polluting the air.

The threats for oil spills at Tijuana Estuary are from three main areas- two in Baja California, Mexico and one in the U.S. At the Rosarito Power Plant, in Baja California, tankers deliver special power plant oil. In Ensenada, Baja California tankers deliver gas up from Oaxaca. At Point Loma off Shelter Island, tankers deliver diesel and bunker oil to the Navy Base. If there

is a spill or accident in Baja California during the summer especially, when the Davidson current goes north, the spill can come right into the river mouth. The California current goes south and is the strongest in the fall, winter, spring. An oil spill from Point Loma or even from the major tankers at Catalina Island during those seasons can make its way to the mouth and then estuary from this current. In addition, a gyre from Point Loma to Playas de Tijuana goes counter clockwise all year round.

In these activities, students will identify sources of oil pollution, and then devise ways to clean up an oil "spill" in the classroom.

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**Materials:**

For the clean-up activity, you should provide newspapers, clear glass or plastic bowls, vegetable oil, paper towels, paper cups, pieces of Styrofoam, 3 X 5 index cards, cotton balls, pieces of cotton rags, sponges, peat moss, tweezers or tongs, feathers, dish detergent, sawdust, sand, gauze, string, diatomaceous earth, and water.

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**Procedure:**

For the first part of this activity, show the students a video about the Exxon-Valdez oil spill, or have students read an article about the spill. A short Quick-Time video is available at the CNN archives website at: <http://www.cnn.com/resources/video.almanac/1989/>

Alternatively, you can have students read one of the following articles online, or print one out for them to read:

<http://www.evostc.state.ak.us/facts/qanda.html>

<http://edition.cnn.com/NATURE/9903/04/valdez.enn/>

While they are viewing the film or reading the article, ask the students to write down any questions they can think of about oil spill effects on the environment and how the spills are cleaned up. When they are finished, students should brainstorm with a partner to come up with a larger number of questions. Finally, the students should work in groups of 4 to generate one list of questions they would like answered about oil spills and how they are cleaned up.

Next, distribute the attached article [Oil Pollution in Estuaries](#) to the students. Students can read this article individually, in groups, or as a whole class. After reading, ask the students to brainstorm with their groups about possible ways the Tijuana Estuary may be polluted by environmental oil. Lead a whole-class discussion about possible oil contamination in the Tijuana Estuary.

Finally, explain to the students that their team will be in charge of cleaning up an "oil spill" in the classroom. Hand out the student sheets. Tell the students their job is to contain and clean up the spill using the materials you will provide. Each team of students should keep detailed notes about the methods they have tried, and the results of each method. Remind

the students that they should test their methods in both "calm seas" and "choppy seas" (note: gently stirring the water with your finger will simulate a "choppy sea").

The first thing students need to do is find a way to contain the oil. After they have contained the spill, the students should work on methods to remove the oil from the water. Remind students that they can try any combination of methods. After assessing the results, each group should share its finding with the class. Try to reach a consensus on which method works best under calm conditions, and which works best in choppy water.

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### Answers to student questions:

1. List three or four of the sources of oil pollution that your class discussed at the beginning of this activity.

*Student answers will depend on the class discussion at the beginning of this lesson. The threats for oil spills at Tijuana Estuary are from three main areas- two in Baja California, Mexico and one in the U.S. At the Rosarito Power Plant, in Baja California, tankers deliver special power plant oil. In Ensenada, Baja California tankers deliver gas up from Oaxaca. At Point Loma off Shelter Island, tankers deliver diesel and bunker oil to the Navy Base. If there is a spill or accident in Baja California during the summer especially, when the Davidson current goes north, the spill can come right into the river mouth. The California current goes south and is the strongest in the fall, winter, spring. An oil spill from Point Loma or even from the major tankers at Catalina Island during those seasons can make its way to the mouth and then estuary from this current. In addition, a gyre from Point Loma to Playas de Tijuana goes counter clockwise all year round.*

2. Do you think you could use any of the methods you tried in this activity to clean up these "non-point" sources of oil pollution? Explain.

*Answers will vary, but students should understand that large oil spills would be easier to clean up than constant, low-level pollution from non-point sources.*

3. What problems do you think oil pollution causes in the Tijuana Estuary? Be as specific as you can.

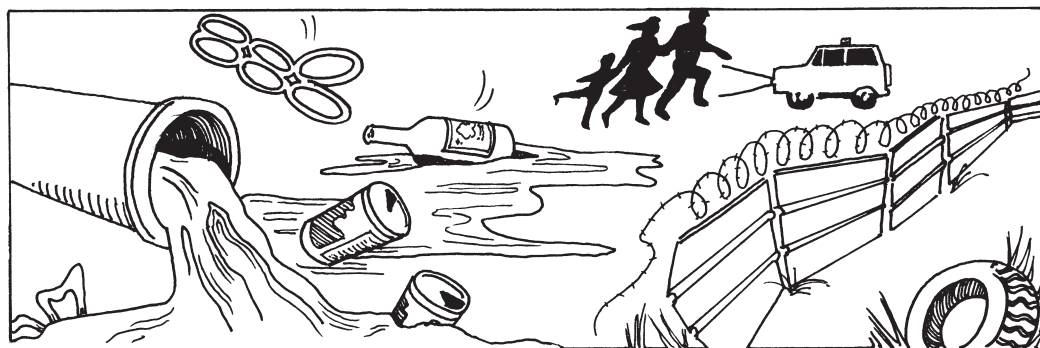
*Answers will vary. Students should concentrate on affects to organisms living in the Estuary, contamination of soil and sediments, and the affects of these on humans.*

4. Work with your group to develop a plan of action that would help keep the Tijuana Estuary oil free.

*Ask each group to present their plan to the class.*



## Human Use Chapter Student Sheet



### Activity #2: Marine Oil Spills

#### PURPOSE:

After completing this activity, you should know how oil pollution enters estuaries, and how that oil can be cleaned up.

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#### INTRODUCTION:

Water in estuaries must be free of substances that can harm or kill living organisms. Although water is considered a universal solvent, its polarity prevents oils from dissolving in water. The best way to control oil spills is to prevent them, but spills do occur. When an oil spill occurs, it may be due to a ruptured oil tanker, such as the Exxon Valdez, or it may be from many sources of oil on land. Regardless of the source of the oil, spills have a negative impact on the environment.

Cleaning up an oil spill can be a long-lasting and costly affair. Exxon has spent over two billion dollars on the Exxon Valdez spill, and there are still pockets of oil on the land. There are many methods for cleaning up oil spills, and none of them are perfect. For instance, an oil spill can be cleaned up by burning, but the smoke and ash produced during the burning can spread over large areas and cause air pollution.

The threats for oil spills at Tijuana Estuary are from three main areas- two in Baja California, Mexico and one in the U.S. At the Rosarito Power Plant, in Baja California, tankers deliver special power plant oil. In Ensenada, Baja California tankers deliver gas up from Oaxaca. At Point Loma off Shelter Island, tankers deliver diesel and bunker oil to the Navy Base. If there is a spill or accident in Baja California during the summer especially, when the Davidson current goes north, the spill can come right into the river mouth. The California current goes south and is the strongest in the fall, winter, spring. An oil spill from Point Loma or even from

the major tankers at Catalina Island during those seasons can make its way to the mouth and then estuary from this current. In addition, a gyre from Point Loma to Playas de Tijuana goes counter clockwise all year round.

Now that you have learned about the Exxon Valdez oil spill, and have read the article on Oil Pollution in Estuaries, it is your turn to determine the best method for containing an oil spill and cleaning up the oil. Your teacher has provided a number of materials for your team to use in your quest to find the most effective clean-up method. Be sure to keep good notes about the different methods your team tries, and the results.

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### **MATERIALS:**

You will need the article on oil spills and the materials to clean up the oil spill which your teacher will provide.

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### **PROCEDURE:**

1. Cover your work surface with newspapers to absorb any spills.
2. Fill a clear glass or plastic bowl about half way with water. Pour 2 tablespoons of vegetable oil into the water.
3. Using the materials provided by your teacher, try to contain the oil "spill." Your goal is to keep the oil from spreading. Once you have the oil contained, try making some "waves" with your finger to see how well the containment works in "choppy" seas. Again, be sure to write down in your notebook each method you try and the results of each experiment.
4. Next, begin testing various materials to see which ones disperse, absorb, or remove the oil best. Test each method in both "calm" and "choppy" water.
5. Rate the effectiveness of each method you try. (Hint: you might find that a combination of methods works best). Be prepared to share your findings with the rest of the class

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### **QUESTIONS:**

1. List three or four of the sources of oil pollution that your class discussed at the beginning of this activity.



# Oil Pollution in Estuaries

by Kenn Oberrecht

Oil is an imprecise term applied to various petroleum products, consisting of hydrocarbon compounds and differing widely from one another. Petroleum pumped from the ground is commonly called crude oil, which is distilled and refined into a number of other products, such as diesel fuel, kerosene, gasoline, benzene, naphtha, machine oils, and lubricating oils of various weights.

Oil is transported in its many forms by rail, truck, ship, airplane, and pipeline. It is also spilled and leaked onto land and into water throughout the world.

Tankers and supertankers haul vast amounts of crude and refined oil by sea. Smaller tankers also enter estuaries and travel up navigable rivers. Additionally, thousands of naval vessels, merchant ships, and cruise ships carry large quantities of bunker oil as fuel for their engines.

Shipwrecks, groundings, blowouts at offshore oil rigs, and other accidents on water account for the worst oil-related environmental disasters, mainly because oil is difficult or impossible to contain in water. According to the National Academy of Sciences, oil pollutes the global marine environment at a rate of about six million metric tons a year.

Oil pollutes estuaries in a number of ways, including major spills from freighters, tankers, barges, and other vessels going aground or colliding with other ships or structures, and minor spills from small recreational and commercial craft. Emptying of oil-contaminated ballast and bilge water into an estuary is another way of polluting it.

The normal operation of coastal refineries, factories, and mills adjacent to estuaries often leads to oil leakage or seepage into the water.

Runoff from rainfall and snowmelt carries oil from highways, city streets, parking lots, industrial areas, and heavy-equipment yards into the estuary, either directly or through municipal storm-sewer systems. Thoughtless vehicle owners who discard used crankcase oil in storm sewers only compound the problem.

Open seas have a much greater capacity to assimilate spilled oil and reduce its harmful effects. As many learned when the supertanker Exxon Valdez went aground in Alaska's Prince William Sound, however, near-shore spills can be disastrous, especially when they occur within partly enclosed bodies of water, such as a sound, bay, or estuary.

Riverine and estuarine currents make spills and slicks particularly difficult to contain. They quickly carry the oil to shorelines, marshes, and flats where they do their worst damage.

An oil slick is a threat to most creatures in its path, especially sea birds, waterfowl, and fur-bearing mammals. It can blanket and smother whole communities of shoreline and intertidal organisms, kill the eggs and larvae of fish and shellfish, and taint entire colonies of adult shellfish.