

## OIL SPILL IN THE OCEAN LAB

Name \_\_\_\_\_

### OIL SPILL IN THE OCEAN LAB

Coastal waters of the United States are heavily traveled. Major oil refineries are situated along the shorelines. Oil tanker traffic is common. In spite of great efforts made to prevent oil spills, oil spills do occasionally occur. Oil spills have demonstrated the disastrous effects of oil on wildlife and aquatic plant life. The surface of the ocean is a highly productive "nursery" habitat. An oil spill which floats on the surface has a great effect on this habitat. Since the oil from spills usually washes ashore, shore birds and other shore animals and plants are especially likely to suffer. In fact, the spill off the Shetland islands, Jan. 1993, actually sprayed oil inland from the wind and surf and was effecting animals in fields along the coast. The impact of the spill will depend upon many factors:

----size of the spill

----wind and tides during the spill

----concentrations of organisms in the area affected.

How can we deal with these oil spills? In the following activities, you will have a chance to investigate some of the ways oil spills are removed before the oil reaches to shoreline and after the oil reaches the shoreline.

1. How might oil be removed from the surface of the ocean?

a.

b.

c.

## I REMOVAL OF OIL FROM WATER

## OIL SPILL IN THE OCEAN LAB

**MATERIALS:** non-flammable container (aluminum pans), oil (crankcase in dropper bottles), bunsen burner or matches, wood splints, water, goggles, watch with second hand, sand, straw, detergent- concentrated liquid, 2 test tubes (50ml or larger), test tube rack, grease pencil, graduated cylinder (50 ml).

**CAUTION: IF OIL IS SPILLED, CLEAN IT UP IMMEDIATELY!**

### Part 1 - Burning

Although technological strides have been made in the area of oil spill removal and cleanup, many rather simple and non-technical methods of cleanup are still extensively used. The most obvious method of removal is by burning the oil.

#### Procedure:

1. Add water to the non-flammable container until the water level is within about an inch from the top. This is your mini-ocean.
2. Add 5-7 drops of oil to the surface of the water simulating an oil spill.
3. Ignite a wood splint.
4. Try igniting the oil slick with the burning wood splint. Did the wood burn?
5. RECORD the length of time the oil burns.

#### Burning Analysis and Interpretation:

1. If the oil burned, how long did it burn and was there oil left when the flame went out?

If the oil did not burn, explain what happened when you tried to ignite the oil.

2. What other type of pollution will probably occur if burning the oil is used as a method of oil spill removal?

3. In your estimation, is the burning of oil an effective method for the removal of oil? Explain your answer.

4. In which situations might you want to use burning as a method of oil spill removal?

### Part 2--Sinking

Another very simple method of oil removal is to make it sink to the bottom. It can be brought about by increasing the density of the oil above that of water by adding sand, soil or some other fine, granular or powdered substance to the surface of the oil.

#### Procedure:

1. Place water in the container and place a small quantity of oil on the surface.
2. Sprinkle the sand on the surface so that the oil will sink.

Sinking Analysis and Interpretation:

1. Does this method remove all of the oil from the surface?
2. When this method is utilized, what other effects will it have on the natural marine environment?
3. What other observations should be made before this method is used?
4. In your estimation, is this method a good method of cleaning up the pollution caused by oil spills? Explain.
5. Another alternative to complete sinking of the oil is to partially sink it; that is sink it to a level of 5-6 meters below the surface. What good will this do?
6. What group of animals and plants is most likely to be affected by the oil spill if the oil is sunk?

Part 3--Absorption

If you have read accounts or seen pictures of cleanup of oil spills, you may be familiar with this method of removal.

## OIL SPILL IN THE OCEAN LAB

### Procedure:

1. Set up the mini-ocean as before...use from the last part and don't worry about the sunk oil. Pour more oil on the top of the water.
2. Place a small amount of straw on top of the oil.

### Absorption Analysis and Interpretation:

1. What is happening to the oil in relation to the material added?
2. Does this clean up the oil? How would removal of the oil and straw then be accomplished?
3. Is this method a fairly reasonable method for cleaning up oil spills? Explain.
4. How would you dispose of the straw?
5. Straw has been estimated to absorb from 5-40 times its weight in oil. After a 1971 tanker crash in San Francisco Bay, 40,000 bales of straw were used. If the average 100 pound bale could absorb 25 times its weight in oil, how many pounds of oil were absorbed by the available straw?
6. If a gallon of the spilled oil weighed 8 pounds, how many gallons of spilled oil were

absorbed by the straw?

#### Part 4--Dispersion

Detergents have been used to disperse oil spills. Detergents cause the oil to become dispersed throughout the water in the form of tiny droplets. The resulting solution is called an emulsion.

#### Procedure:

1. Obtain two test tubes and a rack. Label one test tube as the control and the other as the experiment.
2. Fill each test tube with 50 ml of tap water.
3. Add one ml of oil to each of the test tubes.
4. To your experiment tube add one ml of detergent.
5. Agitate each tube and place in the test tube rack.
6. Observe each tube immediately after agitation and **RECORD** your observations of their appearance in the space below.

**CONTROL:**

EXPERIMENT:

7. Allow the tubes to stand until the end of lab or even the next week and then observe them again. RECORD your observations of their appearance in the space below.

CONTROL:

EXPERIMENT:

Dispersion Analysis and Interpretation:

1. What was the immediate effect of the detergent on the oil?
2. Was it any different at the end of the period or when you checked it the next day?
3. Detergents were used to emulsify a massive oil spill near Santa Barbara, California. Researchers noted that "the milky white fluid (caused) a scene of progressive devastation and within a few days virtually nothing remained save for tufts of dead and dying algae". In your estimation does the dispersion of oil by detergents help in the removal of the oil? Does it clean up the pollution? Explain.

Part 5--Evaporation

Some oil spills are never contained, treated, or cleaned up. What happens to the oil from these spills?

Procedure:

1. Obtain a container of water and spread a small quantity of oil over the surface. Record your observations below.

Oil:

Water:

2. Let the container sit for two weeks or longer. NOTE: Water may have to be added from time to time to prevent complete drying.

3. Record your observations after the two week period.

Oil:

Water:

Evaporation Analysis and Interpretation:

1. How does the character of oil change with time?

2. This experimental setup is a model of the real world. To make the setup a more realistic model of the real world, what other factors should we add?

CONCLUSIONS

1. Which technique removed the oil spill from the water with the least damage to the aquatic environment? Explain.

2. What advantage would a type of bacteria have that can "eat" oil over the other mentioned methods.

3. How do you think the old expression "an ounce of prevention is worth a pound of cure", could be applied to oil spills?

OIL ON THE SHORE

Oil which is spilled onto the oceans and cannot be contained and removed can eventually

## OIL SPILL IN THE OCEAN LAB

become beached. Widespread oil pollution along the shore can result. The amount of beach covered depends upon many factors including the direction and speed of the wind, tides, and wave action. How does this beached oil affect the plant and animal life of the beach? How can the oil be removed? Here are some answers you can investigate.

### MATERIALS:

Ring stand, glass or plastic cylinder, , sand, clamp, glass wool, rubber stopper, glass tube, rubber tube and clamp, beaker, oil, detergent, water, graduated cylinder (10 ml), rulers (metric).

### Part 1-OIL IN/ON SAND

#### Procedure:

1. Set up the apparatus shown in the figure on the right.
2. Add 5 ml of oil to the top of the column of sand.
3. With the drain tube clamped, fill the remainder of the column with water. After one minute, release the clamp so that the water will drain off into the beaker.
4. Repeat step 3--15 times.
5. After you have answered the questions below, dismantle and clean the apparatus.

#### Analysis and Interpretation:

## OIL SPILL IN THE OCEAN LAB

1. How far down into the sand did the oil penetrate?  
\_\_\_\_\_ml
2. Do you think that increasing the number of additions of water would change the depth of penetration?
3. Test your answer to #2 by repeating step 3 five more times.
4. Do the plants and animals living beneath the surface of the sand escape the problems caused by oil spilled on the surface? Explain.
5. Wave action is like the pouring of the water you did in step 3. Why are the first few hours after an oil slick reaches the beach critical in determining how well the beach can be cleaned?
6. What are two things that can be done with the oily sand?

### Investigation II Removing Oil From the Beaches

When oil spills reach the beaches, attempts are made to clean up the oil as quickly as possible in order to minimize environmental damage. Some of the techniques used are the same as those used to remove oil from the ocean waters: others are entirely different. Oil absorbing straw is often used on the beach. Mechanical removal of the sand by scraping is also used. Millions of gallons of detergent do not, of course, destroy the oil. There is some indication that the emulsion droplets may even increase the danger to marine life. What are some of the effects of the detergents on the environment?

#### Part A - Penetration

##### Procedure:

1. Set up the apparatus as you did in investigation one.

## OIL SPILL IN THE OCEAN LAB

2. Instead of adding oil, add 7 ml of an oil-detergent emulsion to the top of the sand column. The oil-detergent emulsion is made by mixing 5 ml of oil with 2 ml of detergent in a test tube.
3. With the drain tube clamped, fill the remainder of the column with water. After one minute, release the clamp so that the water will drain off into the beaker.
4. Repeat step 3 fifteen times.
5. Save the sand column for Part B of this investigation.

### Penetration Analysis and Interpretation:

1. How far into the sand did the oil emulsion penetrate? \_\_\_\_\_mm
2. How did the detergent effect the depth of penetration of the oil?
3. If you were planning to remove oil on a beach by scraping, would you first want to treat the oil with detergents to emulsify the oil? Explain.
4. If the oil kills all of the animals in the sand with which it comes into contact, more/less animals would be killed if detergents were used to emulsify the oil.

### Part B Sandcastles

#### Procedure:

1. Use the sand column from Part A to make a sand pillar by removing the rubber stopper and gently tapping the column until the sand comes out. Leave the pillar undisturbed while you proceed with step 2.

2. Obtain a quantity of clean sand equal to that from step 1. Replace the rubber stopper in the apparatus and place the sand in the column.

3. Thoroughly wet the sand and remove it as before, forming another sand pillar.

Sandcastles Analysis and Interpretation:

1. Observe the two pillars. Does there appear to be any differences in how long they stay together? IF SO, which pillar stays together longer?

2. Which of these sands would more likely be washed away (eroded) by natural wave and tidal motion along the shore?

3. How would wave erosion affect the plants and animals that live on the beach?

4. Do detergents seem like a good solution for oil spills?

Overview

1. Which technique seems best for removing oil from beach sands? Explain your choice.

2. Is the best technique for removing oil from sands also the best technique for removing oil from water?

3. Before we use any new product to combat oil spills, what are two of the many questions we need to ask (and have answered)?

materials for labs.

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### OIL ON THE SHORE

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