**Oil Pollution Solutions**

Nearly 29 million gallons of oil pollution enter North American oceans each year as a result of human activity. Oil spills have devastating effects on marine wildlife and resources. In this lab you will test the ability of different materials or “sorbents” to remove oil from water. Then you will evaluate the cost efficiency of two common oil spill clean-up methods. Lastly, you will design your own clean-up method for removing oil from rocks.

**Part I: Testing the effectiveness of different sorbents**

In this part of the lab you will watch a video where the absorptivity of three different sorbents (cotton balls, polypropylene pads, and hair) is tested. **Take notes** on the materials and procedure used in the experiment and answer the following questions:

**Question 1**: Which sorbent material do you think will remove the most oil from water?

**Hypothesis**:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Graph your predicted results**:

Oil absorbed

(%)

\_\_\_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_

Sorbent

 **Materials used**:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Procedure**:

1. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
3. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Continue with as many steps as needed………..**

**Data collection**:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Cotton balls** | **Polypropylene pads** | **Hair** |
| Water | Oil | Water | Oil | Water | Oil |
| Starting amount | 750 mL | 250 mL | 750 mL | 250 mL | 750 mL | 250 mL |
| Amount after 2 minutes |  | \_\_\_ - \_\_\_\_ =\_\_\_\_\_\_\_ |  | \_\_\_ - \_\_\_\_ =\_\_\_\_\_\_\_ |  | \_\_\_ - \_\_\_\_ =\_\_\_\_\_\_\_ |
| Amount absorbed |  |  |  |  |  |  |

**Graph results**:

**Conclusion Questions**:

1. Which sorbent material did you find to be the most effective at absorbing oil from water?
2. Which sorbent material did you find to be least effective at absorbing oil from water? What characteristics about this material do you think made it not effective?
3. What are some sources of error in this experiment?

**Part II: Evaluating Oil Spill Clean-Up methods**

Cleaning up an oil spill is costly. When choosing a clean-up method, oil spill response managers have to consider not only the amount of oil that can be removed but also the cost of materials and equipment, the disposal of hazardous waste, and the amount of time and labor that are needed for the clean-up effort.

In this part of the lab, your group with will test the efficiency of two different oil spill clean-up methods. For one method you will use a small pipet, which will act like a skimmer (boats used to skim oil off the surface of the ocean), to clean oil off the surface of the water. For the second method, you will use a sorbent of your choice to remove oil from the water surface. For each method you will be charged for materials and equipment, the disposal of waste, and the number of people used.

**Materials**: Each group will need:

* Sorbent material of choice (cotton balls, polypropylene, hair)
* 1 mL disposable plastic pipets (“skimmer”)
* Two shallow pans
* 100 mL graduated cylinder
* Water
* Vegetable oil
* Funnel
* 1000 mL beaker
* 1000 mL graduated cylinder
* 3-4 Plastic baggies
* 2-3 waste water containers
* Timer

**Step 1: Design clean-up method plan**

1. Divide your group into two teams. One team will test the skimmer clean-up method and one team will test the sorbent clean-up method.
2. As a group, choose one of the three sorbent materials available to test against the skimmer clean-up method.
3. Discuss with your group your strategy and write a detailed plan for your clean-up method. Remember you want your clean-up to be as cost efficient as possible. You will be charged for each person and piece of equipment you use. You will also be charged for all waste produced by the clean-up.

**Clean-up plan:**

Method used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# of people:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Equipment:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Strategy:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Step 2: Test your clean-up method**

1. Have each team fill a shallow pan with 3 cups of water
2. Prepare your team’s oil waste disposal containers (the skimmer team will need small 10 mL containers for waste water; the sorbent team will need baggies for waste material)
3. Have each team measure out 50 mL of vegetable oil in a graduated cylinder
4. Pour the vegetable oil **slowly** into the center of your water pan.
5. Once the vegetable oil is added **start your timer and clean your ocean**!
6. Remove as much vegetable from the water as possible. Your group has a total of 5 minutes but you do not need to use the whole time if you can clean faster. Dispose of your waste material in the appropriate container so you can count it later. When your group has finished stop your timer.
7. Calculate the amount of oil removed by your clean-up:

**Sorbent method**: Using the funnel, pour the contents of your waste containers (after you have counted them) into the 100 mL graduated cylinder. Allow any water to separate from the oil. Calculate the amount of oil removed by subtracting the volume of water from the total volume in the graduated cylinder.

**Skimmer method**: Carefully pour the contents of your pan into a 1000 mL graduated cylinder (you may want to first pour the contents of your pan into a 1000 mL beaker to do this). Wait for the oil and water to separate. Measure the width of the band of vegetable oil by subtracting the volume of water from the total volume in the graduated cylinder. This will give you the volume of oil remaining in the pan after your clean-up. Subtract this from the total oil spilled to calculate how much was removed.

**Data Collection**: Fill in the data tables below

|  |  |  |  |
| --- | --- | --- | --- |
| SKIMMER METHOD | Amount | Time used | Cost (use the cost chart to calculate) |
| Equipment | # of pipet “skimmers”\_\_\_\_\_\_\_\_\_ |  | $ |
| Waste disposal | # of waste water containers\_\_\_\_\_\_\_\_\_\_\_ | NA | $ |
| Labor | # of people \_\_\_\_\_\_\_\_\_\_\_\_\_ |  | $ |
|  |  |  | **TOTAL: $** |

|  |  |  |  |
| --- | --- | --- | --- |
| SORBENT METHOD | Amount | Time used | Cost |
| Equipment | # of sorbent pieces used\_\_\_\_\_\_\_\_\_ | NA | $ |
| Waste disposal | # of waste pieces/baggies\_\_\_\_\_\_\_\_\_\_\_\_\_ | NA | $ |
| Labor | # of people \_\_\_\_\_\_\_\_\_\_\_\_\_ |  | $ |
|  |  |  | **TOTAL: $** |

|  |  |  |  |
| --- | --- | --- | --- |
| Clean-up method | Oil spilled | Amount of oil remaining  | **Amount of oil removed** |
| Skimmer | 50 mL | NA |  |
| Sorbent | 50 mL |  |  |

**Conclusion Questions**:

1. How did your team use the equipment/material during the oil clean-up? Were there any techniques that you used that you think made your method more efficient?
2. Was one method able to remove more oil than the other from the water? If yes, which method removed more oil?
3. Calculate how much it costs to cleanup 1 mL of oil for each method:

Skimmer method: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$/mL oil

Sorbent method: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$/mL oil

1. Which method would you choose to use and why?

**Part III : Challenge question: How would you clean a rocky shore?**

Oil spills can be especially challenging to clean-up once they have reached the shoreline. What method would you use for cleaning oil off of a rocky shoreline? Be creative!

Describe the method you would use: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is your reasoning behind choosing this method?: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What are the pros and cons of your method? Think about the cost, the amount of labor it would require, the effect on plants and animals on the shoreline:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_