

# **Maintaining an Oil Spill Disaster: Free Volume, Solubility and Crosslinking Explained**

## Student Handout

The scientific method will be employed to discover the best way to clean up an oil spill. All the objectives and keywords should be discussed in the final presentation.

Take-Home Message:

Main Goal:

What are the steps of the scientific method? Write out each step on a separate piece of paper.

### Objectives

1. Identify and understand hydrophilic versus hydrophobic molecules.
2. Describe what oil is made of.
3. Explain the two tenants of the absorption process
  - a. Chemical: like dissolves like
  - b. Physical: Free volume aids in absorption
4. Understand how cross-linked polymers can be used to absorb large amounts of substances.
5. Understand how a micelle can be used to disperse (evenly mix) oil and water.

### Concepts and Keywords

- Density
- Free Volume
- Solubility
- Absorption
- Cross-linking Polymer
- Hydrophilic
- Hydrophobic
- Micelle

## Elaborate/Internet Search

Perform an Internet search to answer any of the following questions and include something interesting you learned in your final PowerPoint presentation:

1. What happens or causes an oil spill?
2. What are popular and common methods that are used to clean up an oil spill? (State two methods)
3. How are polymers involved in cleaning up oil spill?
4. What are some bad outcomes or repercussions of an oil spill on the environment or other?

Example Websites:

<http://science.howstuffworks.com/environmental/green-science/cleaning-oil-spill.htm>

[http://en.wikipedia.org/wiki/Oil\\_spill](http://en.wikipedia.org/wiki/Oil_spill)

<http://www.ceoe.udel.edu/oilspill/cleanup.html>

[http://www.cnbc.com/id/37593652/17\\_Ways\\_To\\_Clean\\_Up\\_The\\_Gulf\\_Oil\\_Spill](http://www.cnbc.com/id/37593652/17_Ways_To_Clean_Up_The_Gulf_Oil_Spill)

Internet Keywords:

- Oil spill
- Hydrophobic Polymer
- Methods of cleaning the oil spill
- Kevin Costner
- Hair
- Straw
- Burning
- Polyethylene pads
- Booms
- Other methods used to clean up the oil spill

## Procedure

### Roles:

1. Procedure reader (read the procedure out loud and direct the other students what to do)
2. Measurer (someone who weighs everything)
3. Recorder (someone who writes down the weight of everything and calculates)
4. Materials Collector (collect the material that your group needs for the experiment)

### Materials required:

- Water
- Clear plastic cup or beaker
- Oil (Vegetable Oil and Marvel Crude Oil)
- Calculator
- Wooden sticks
- Oil Cleaners:
  1. Detergent (Soap)
  2. Oil Absorb (Gas Station)
  3. Cross-linked hydrophobic polymer (Steve Spangler Science)
  4. Cotton

### Procedure:

1. Fill a clear glass beaker or plastic cup with approximately 100 mL of water.
2. Measure 20 mL of motor oil in a graduated cylinder and pour this into the beaker (or plastic cup) with the water. (Which layer is on top?)
3. Measure a small amount of each **oil cleaner** and record this as “weight of cleaner” in your table.
4. Next, place this oil cleaner onto the surface of the oil in the beaker.
5. You and your group members should decide what to do next. You can either stir the mixture or let it stand still (or something else). Once you think the powder has absorbed the oil, scoop it out of the beaker and record its weight (record this as “weight of oil+ weight of cleaner” in your table).
6. Mark down your observations. (For example, did the cleaner remove ALL of the oil or just some of it? Did the color of the water change, etc. Be creative and descriptive!)
7. Create a Table recording your results (see below).
8. Pick **the best oil absorber** and test it on Vegetable Oil using the same procedure as above. Did it work just as well as it did on the motor oil? (Hint: Compare the Absorbing Power)
9. Make a bar graph of your results using Microsoft Excel
  - a. x-axis: Cleaner name
  - b. y-axis: Absorbing power (%)

$$\text{Absorbing Power} = \frac{\text{weight of oil} + \text{weight of cleaner}}{\text{weight of cleaner}} \times 100$$

### Results Tables

Motor Oil			
	Weight of Cleaner (g)	Weight of Oil +Cleaner (g)	Absorbing Power (%)
Oil Absorb			
Cross-linked Hydrophobic Polymer			
Cotton			

Vegetable Oil			
Cleaner Name	Weight of Cleaner (g)	Weight of Oil +Cleaner (g)	Absorbing Power (%)

## Final Presentation

Summarize what you've learned! Prepare a creative presentation (PowerPoint, oral presentation, skit) of the problem and the solution. Below you will find a grading rubric with the requirements for a perfect score. You will also be grading each group as they present.

Time requirements: 10-15 minutes

Answer the following questions in your presentation:

1. Which material absorbed the most oil? (Use your results table and graph to support your answer.)
2. Which material absorbed the *least* oil? (Use your results table and graph to support your answer.)
3. What did the soap do to oil? Was it easy to remove the oil by adding soap?
4. Present something you discovered during your Internet search about the oil spill.

Address all keywords and concepts in your presentation (see page 1).

### Grading Rubric for PowerPoint

	1	2	3	4	5
	Poor	Needs Improvement	Satisfactory	Good	Excellent
Answered all the Objectives					
Used all Keywords and Concepts					
Provided Clear Results and Conclusions					
Organization					
Eye contact, good language, good enunciation					
Creativity of presentation					
Total Points					