Operation Oil Spill Clean Up

Independent Investigation

Offshore oil drilling and the use of supertankers for transporting oil pose the risk of oil spills. Oil spills can damage commercial and recreational fishing areas, spoil beaches, kill marine birds, mammals, and other aquatic life, and destroy shellfish communities. A mere 3.8 L of oil can contaminate as many as 20 million liters of water!

Suppose you are a scientist or an engineer for Eco-Marine, Inc., an environmental remediation firm that specializes in resolving ocean pollution problems. Your supervisor has just sent the email below that describes your latest assignment.

To: All Eco-Marine Staff

From: Marina Waters, Lead Scientist Oil-Spill Cleanup Proposal

Re: Oil-Spill Cleanup Proposal

I would like to inform you that Del Mar Oil Company is accepting proposals for a cleanup plan that could be implemented in the event of an oil spill from one of the many supertankers that sail the seas. There are several top-notch companies competing for this contract, but I am confident that we at Eco-Marine, Inc. can develop the best plan for oil spill cleanups that is fast and effective yet has a minimum impact on the affected marine ecosystems.

I would like each team in my department to develop its own plan. The first part of your plan should test the various cleanup materials currently available. Phase two of your plan should involve using the materials to clean up on a small-scale oil spill along a model beachfront. Once all the plans have been tested, we will decide which to submit to Del Mar Oil Company.

Sincerely,

Marina Waters, Lead Scientist

Overall task – You and your team will go through the scientific method and create a lab experiment to determine the effectiveness of materials at cleaning up a simulated oil spill. You will have limited time for the actual experimenting – so plan accordingly! You will take notes during the investigation in your lab INB. Based on these notes, you will each write a formal lab write up on your research, the investigation, reporting the findings and sharing results, and finally include an independent conclusion based on the team’s work.

Your lab write up may be hand-written or typed (prefer typed), but must follow the formal lab write up format.
Investigation Set Up

Objectives:

- Research oil spills damages to ecosystems and clean-up methods
- Select various materials and use them to determine their effectiveness at cleaning up a model oil spill.
- Design an experiment to clean up a model oil spill.
- Test the plan and evaluate the results.
- Write a formal lab report, with the conclusion including research

Provided Materials:

- Beakers and bowls
- Water
- Gravel and/or sand
- Aluminum pan (1 per group)
- Measuring spoon

Possible Materials (students bring in from home): Use the below for inspiration

Potential debris materials: (these represent biotic and abiotic factors in the ecosystem, such as marine life and shoreline rocks) feathers, pipe cleaners, craft sticks, small stones, plastic foam, paper, felt, fabric, fake fur, pom poms, toothpicks

Oil – cooking oil only – 1 bottle per group

Potential cleanup materials: spoons, toothpicks, drinking straws, plastic wrap, aluminum foil, pieces of plastic foam, string, pieces of brown paper bag, cotton balls, pieces of nylon stocking, pieces of sponge, paper towels, coffee filters, cloth, liquid detergent, cat litter, baking soda, flour, vinegar

Procedure:

PART I—TESTING CLEANUP MATERIALS

1. Work with a team of students as assigned by your teacher. Choose items from the potential cleanup materials list (or your own ideas) which your group will bring in and use to clean up a model oil spill.
2. Use the measuring spoon to pour a spoonful of oil onto the surface of some water in one of the shallow containers or bowls. This represents an oil spill in the open ocean.
3. Pour a small amount of oil onto a test sample of the “debris materials”. Items such as rocks, sand or gravel, pipe cleaners, and feathers in another container to test cleanup of a shoreline and wildlife.
4. Test your cleanup materials to determine their effectiveness in the following categories: containing the oil spill, cleaning up the water and recovering spilled oil, and cleaning up the shore and affected wildlife. Also evaluate the potential environmental impacts of using a large quantity of each of your cleanup materials in the ocean.
5. Rate each material as poor, average, good, or excellent. Record your observations from step 4 in a table you create in your lab INB. Your table should have this title: Effectiveness of Cleanup Materials. Make your table large enough to collect the raw data. An example table is below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Containment</th>
<th>Water Cleanup</th>
<th>Oil Recovery</th>
<th>Shore Cleanup</th>
<th>Wildlife Cleanup</th>
<th>Environmental Impact</th>
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PART II—DEVISING A PLAN

6. Work with the other members of your group to devise a plan (based on your hypothesis) for cleaning up an oil spill based on the results of the materials you tested. Note that your plan must specify which materials and techniques you will use for containing the spill, cleaning up the water and recovering the oil, cleaning up the shoreline, cleaning up the affected wildlife, and minimizing the impact on ocean ecosystems. This plan information will later go into your lab report.

PART III—TESTING THE PLAN ON A MODEL BEACHFRONT

7. Build a model ocean shore in the cake pan. Create a beach using sand or gravel and a few rocks at one end of the pan and leave the other end clear. Place 2-3 “debris material” on the beach. Make sure to have representations for each category on your beach or in the ocean: containing the oil spill, cleaning up the water and recovering spilled oil, and cleaning up the shore and affected wildlife.

8. Slowly add water to your model.
9. Use the small beaker to pour 50 mL of cooking oil into your model ocean. Gently blow the oil toward the shore.
10. Work together with the others in your team to implement your cleanup plan. Your goal should be to work as quickly and effectively as possible. For each cleanup task (oil containment, oil recovery, shore cleanup, and wildlife cleanup), have one member of your group record below the time it takes to complete the task and how well the task was completed. Pictures taken of each step can be added to the final lab write up as well.

Analysis Questions:

Use these questions to help guide you in writing your conclusion.

- Which containment method worked best? Which was least effective?
- Which of the major cleanup tasks was the most difficult to carry out? Explain.
- How much of the original spill was your group able to recover?
- What happened when the oil reached your model beach?
- How effective was the cleanup of the sand or gravel and the objects representing wildlife?

Research and Conclusion:

Your report should have the following aspects:

1. Include a summary paragraph on your research on oil spills causes and clean-up actions currently taken by scientists in the “Defining the problem or question” section of the report.

2. Restate the overall purpose of the experiment (include Independent Variable and Dependent Variable in this section.) Then include the plan (Part III) for the simulated oil spill clean up.

3. What were the major findings? (Summarize your collected data and observations – give specific examples of the data and explain what the data shows). This is a good place to answer some of the above questions!!

4. How was the hypothesis supported by the data? State the hypothesis and include data to demonstrate how you know that the hypothesis was supported or not.

5. Don’t give the procedure again, but do point out possible sources of error that may have occurred in the collection of data and suggest improvements. What were the lessons learned? Again, answer some of the above questions in this section.
### Operation Oil Spill Clean Up - Independent Investigation Rubric

**Criterion B: Inquiring & Designing**

- i. describe a problem or question to be tested by a scientific investigation
- ii. outline a testable hypothesis and explain it using scientific reasoning
- iii. describe how to manipulate the variables, and describe how data will be collected
- iv. design scientific investigations

<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor - The student is able to:</th>
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</thead>
</table>
| 1-2   | i. state a problem or question to be tested by a scientific investigation, with limited success  
      ii. state a testable hypothesis  
      iii. state the variables  
      iv. design a method, with limited success |
| 3-4   | i. state a problem or question to be tested by a scientific investigation  
      ii. outline a testable hypothesis using scientific reasoning  
      iii. outline how to manipulate the variables, and state how relevant data will be collected  
      iv. design a safe method in which he or she selects materials and equipment |
| 5-6   | i. state a problem or question to be tested by a scientific investigation  
      ii. outline and explain a testable hypothesis using scientific reasoning  
      iii. outline how to manipulate the variables, and outline how sufficient, relevant data will be collected  
      iv. design a complete and safe method in which he or she selects appropriate materials and equipment |
| 7-8   | i. describe a problem or question to be tested by a scientific investigation  
      ii. outline and explain a testable hypothesis using correct scientific reasoning  
      iii. describe how to manipulate the variables, and describe how sufficient, relevant data will be collected  
      iv. design a logical, complete and safe method in which he or she selects appropriate materials and equipment. |

**Criterion C: Processing & Evaluating**

- i. present collected and transformed data
- ii. interpret data and describe results using scientific reasoning
- iii. discuss the validity of a hypothesis based on the outcome of the scientific investigation
- iv. discuss the validity of the method
- v. describe improvements or extensions to the method

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<tr>
<th>Level</th>
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</table>
| 1-2   | i. collect and present data in numerical and/or visual forms  
      ii. accurately interpret data  
      iii. state the validity of a hypothesis with limited reference to a scientific investigation  
      iv. state the validity of the method with limited reference to a scientific investigation  
      v. state limited improvements to the method |
| 3-4   | i. correctly collect and present data in numerical and/or visual forms  
      ii. accurately interpret data and describe results  
      iii. state the validity of a hypothesis based on the outcome of a scientific investigation  
      iv. state the validity of the method based on the outcome of a scientific investigation  
      v. state improvements to the method that would benefit the scientific investigation |
| 5-6   | i. correctly collect, organize and present data in numerical and/or visual forms  
      ii. accurately interpret data and describe results using scientific reasoning  
      iii. outline the validity of a hypothesis based on the outcome of a scientific investigation  
      iv. outline the validity of the method based on the outcome of a scientific investigation  
      v. outline improvements to the method that would benefit the scientific investigation |
| 7-8   | i. correctly collect, organize, transform and present data in numerical and/or visual forms  
      ii. accurately interpret data and describe results using correct scientific reasoning  
      iii. discuss the validity of a hypothesis based on the outcome of a scientific investigation  
      iv. discuss the validity of the method based on the outcome of a scientific investigation  
      v. describe improvements to the method that would benefit the scientific investigation. |