Designing Possible Solutions: Oil Spill Clean-up

Lesson Duration: 2 50-Minute Class Periods

Lesson Overview:
In session one, students are introduced to the negative effects of oil spills on the land, water, and other living things. In groups, students identify and discuss ways to prevent or minimize the negative impact of oil on the natural environment. In preparation for the next session, they explore different ways to remove oil from water.

In session two, students conduct an investigation to determine the most effective way (dunking, skimming or soaking) to remove oil from water. Students use evidence to show which removal process is the most effective.

Academic Standards
Disciplinary Core Ideas
ESS3.C Human Impacts on Earth’s Systems
- Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air and other living things.

ETS1.B Developing Possible Solutions
- Designs can be conveyed through sketches, drawings or physical models. These representations are useful in communicating possible solutions to a problem to other people.

ETS1.C Optimizing the Design Solution
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Science and Engineering Practices
Analyzing and Interpreting Data
- Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests or an object or tool to determine if it works as intended.

Constructing Explanations and Designing Solutions
- Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
Developing and Using Models
- Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e. diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Use a model to represent relationships in the natural world.

Engaging in Argument from Evidence
- Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).
- Construct an argument with evidence to support a claim.

Obtaining, Evaluating and Communicating Information
- Obtaining, evaluating and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information.
- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.
- Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.

Planning and Carrying Out Investigations
- Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations and design solutions.
- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.
- Make observations (firsthand or from media) to collect data that can be used to make comparisons.

Crosscutting Concepts: Cause and Effect
- Events have causes that generate observable patterns.

Common Core State Standards Connections:
ELA/Literacy
- R.1.2.1 Ask and answer questions such as who, what, where, when, and how to demonstrate understanding of key details in a text.
- S.L.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail.
- W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Mathematics
- K.MD.A.1 Describe measurable attributes of objects such as length or weight. Describe several measurable attributes of an object.
- K.MD.A.2 Directly compare two objects with a measurable attribute in
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common, to see which object has “more of”/”less of” the attribute and describe the difference.
• MP.2 Reason abstractly and quantitatively.
• MP.5 Use appropriate tools strategically.

Background Information for the Teacher:
Oil spills cause harm to the natural environment. Even small spills can be detrimental. Marine mammals, birds, and other wildlife can suffer or die from the effects of an oil spill. Not all oil spills are the same. There are many different types of oil. Each oil spill will have a different impact on the natural environment based on the type and amount of oil spilled, location of spill, current weather conditions and the breeding cycle/migration patterns of local wildlife. Many oils become stickier over time. The stickier oil adheres to wildlife more easily. When oil sticks to a bird's feathers or the fur of a marine mammal it can cause many problems including hypothermia, decreased mobility that prevents escape from predators, dehydration, infection, internal body damage (e.g. ulcers), and the disguise of scent, resulting in the abandonment of young. Oil does not have to be sticky to harm wildlife. Non-sticky oils such as refined petroleum products do not last a long in the marine environment but tend to be more poisonous than crude oil or bunker fuel. Some of the harmful effects of refined petroleum products on marine wildlife include poisoning (through eating animals that have absorbed oil into their tissues or drinking a mother’s milk), interference with breeding, and damage to body parts. It is important to prevent and efficiently clean up oil spills to minimize harm to living things and the natural environment.

Materials:
For the class:
• 1 copy Oil Spill by Melvin Berger
• 1 set of oil spill scenario cards

For each group:
• 6 tanks/baby food jars
• Corn oil
• Water
• 15 oil control film strips (in personal care/facial care aisle, as oil absorption strips (strips of absorbent paper towel may be substituted for oil control film strips)
• 1 centimeter ruler
• 1 roll of paper towels for clean-up

Teacher Prep Oil Spill Investigation: Gather materials, fill tanks/baby food jars with equal amounts of water and oil, practice qualitatively and quantitatively measuring the oil remaining after three trials of each clean-up method.
Station Set Up for Oil Spill Exploration Session One:
- 1 tank/baby food jar with oil and water
- 1 empty tank/jar
- 6 oil control film absorption strips or six strips of absorbent paper towel
- Stack of paper towels for clean-up

Station Set Up for Oil Spill Clean-up Investigation Session Two:
- 3 tanks/baby food jars with equal amounts of oil and water
- 1 empty tank/jar
- 9 oil control film absorption strips or nine strips of absorbent paper towel
- 1 centimeter ruler
- Stack of paper towels for clean-up

For each student:
- “Which One is the Best?” student resource (define best = removes the most oil)
- “Prepare to Persuade” student resource
- 1 pair safety goggles

Classroom Activities:
Session 1:
1. Set up oil spill exploration stations.

2. Read Oil Spill by Melvin Berger or a similar book. Prompt students to answer questions to demonstrate their understanding of key details in the text, including the importance of preventing oil spills and the importance of minimizing the impact of oil spills. As a class, discuss how preventing and efficiently responding to oil spills can help reduce the impact of oil on the natural environment.

3. Grade 2: Create groups of four.
   K-1: Gather class around oil spill scenario card set

4. Grade 2: Read scenarios aloud one at a time. After reading a scenario, pause and have students explain if prevention or clean-up efforts are needed. Allow students to share and justify their thinking. Distribute a scenario to each group. Have student groups discuss how they would minimize the impact of oil on the natural environment for their assigned scenario. Circulate and ask questions to help students reflect on their thinking. Sample questions:
   - In your scenario, will you be preventing oil from entering the natural environment or removing oil from the natural environment?
   - In Oil Spill on page seventeen, what method was used to prevent the oil from spreading? (method: boom around the spill)
K-1: Read scenarios aloud. Work together to categorize the scenarios as prevention or clean-up. As students categorize the scenarios have them explain what humans might do to prevent or minimize the impact of oil in each scenario. Create student groups of three or four.

5. Model the methods of dunking, skimming and soaking to remove oil from water.

6. Provide each group with a tank containing a mixture of water and oil and six oil absorption strips or six strips of absorbent paper towel. Allow students to practice/explore the three removal methods (dunking, skimming and soaking). Using two strips per method.

7. Explain to students that they are now ready to test the removal methods in the next session to determine which one works the best (removes the most oil).

Session 2
1. Set up oil spill clean-up investigation stations.

2. Put students in their groups.

3. Present the problem:
   Your job is to determine the best way to remove oil from water. (Best=Removes the most oil from the water)

4. Have students conduct the investigation to test the different clean-up methods (dipping, skimming, soaking) so they can use data to determine which one is the best at removing oil from the water.

Teacher Directions for Oil Spill Clean-up Investigation:
Explain to students that it is important for them to keep the method consistent for all three timed trials to get accurate results. Direct students to put on their safety goggles. Tell students that they will test each clean-up method using a separate tank. Tell students they will first test the method of dunking in the first tank. Have students point to the first tank. Direct students to use an absorption strip, to test the dunking method, for fifteen seconds. Stop students after fifteen seconds. Have students discard used strip in the empty tank. Instruct students to record and share some of their observations. Repeat two more times. Move on to the second tank and repeat the process testing the skimming method. Then move onto the third tank to repeat the process to test the soaking method. Ask students questions to prompt them to compare effectiveness of methods such as, “Do you notice that one method is working better than another? How do you know?” or “Was more oil removed with the skimming or soaking method?” or “Are the strips absorbing oil? Explain your reasoning.”
5. Post the class’ oil removal data (none, some, most/metric measurements).

6. Grade 2: Have student groups use class data to prepare oral presentations on which removal method is best/most effective. Prompt students to cite evidence and add drawings or other visual displays to provide additional details. Help students recall or gather information from the provided sources (text, investigation data) to support their recommendation. Have students deliver their oral presentations.
   K-1: Discuss class data as a whole group to identify which removal method worked the best overall.

7. Assess individual understanding using their completed “Prepare to Persuade” resource.
Additional Resources:

- Oil Spill Recovery Institute
  [www.pws-osri.org](http://www.pws-osri.org)
- NOAA National Ocean Service Office of Response and Restoration
- California Coastal Commission Oil Spill Education
  [http://www.coastal.ca.gov/publiced/oilspills.html](http://www.coastal.ca.gov/publiced/oilspills.html)
- Gulf of Maine Research Institute – Save the Bay
- National Environmental Education Week – Oil Spill Resources
- eGFI -Oil Spill Solutions
- Minnesota Science Teachers Education Project – Exploring Effects of Oil Spills on Birds
  [http://serc.carleton.edu/sp/mnstep/activities/26016.html](http://serc.carleton.edu/sp/mnstep/activities/26016.html)
- AAAS: Science NetLinks – 2010 Gulf of Mexico Oil Spill
- NOAA Education Resources- Gulf Oil Spill
  [http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html](http://www.education.noaa.gov/Ocean_and_Coasts/Oil_Spill.html)
- 3M Sorbents Materials
  [http://solutions.3m.com/wps/portal/3M/en_EU/OccSafety/Home/Products_for/Sorbents/](http://solutions.3m.com/wps/portal/3M/en_EU/OccSafety/Home/Products_for/Sorbents/)
Dear Parent or Guardian,

Your child has been learning about the impacts of oil spills on the natural environment. During this lesson students learned about the importance of preventing and efficiently cleaning up oil spills to help protect living organisms and their habitats. They also explored different processes for removing oil from water.

Complete the following tasks together with your child to help reinforce and apply his/her understanding of the science concepts addressed in this lesson:

- Ask your child to explain why it is so important to focus on the prevention of oil spills. *Hint: Even with efficient clean-up methods it is impossible to remove all of the spilled oil.*
- Discuss how your family can decrease oil usage to help reduce the risk of oil spills.
  - Use less electricity (often generated by oil)
  - Use less gasoline (made from oil)
- Read about and discuss a specific oil spill.
Oil Spill Scenario Card Set:

1. Oil slick needs to be absorbed.

2. A homeowner is preparing to oil a hinge on the storm door.

3. While doing an oil change, a car owner wants to protect the garage floor and natural environment.

4. A docked boat is leaking oil. A boundary needs to be established to contain the oil.
5. An oil tanker truck crashes. Oil spreads down the street towards the storm drain.

6. Clean-up crews have discovered oil in the crevices between rocks on the shoreline.

7. Oil is leaking into the ocean.

Prevention or Clean-up?
1. Clean-up
2. Prevention
3. Prevention
4. Clean-up
5. Clean-up
6. Clean-up
7. Clean-up
Name:
Which Clean-up Method Works the Best?
Data Collection Sheet

Think back to when you explored the dunking, skimming and soaking clean-up methods. Predict which one you think will remove the most oil. Use pictures or words to record your prediction in the space below.

Dunking:

<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 seconds each</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate of how much oil</td>
<td>Most</td>
<td>Most</td>
<td>Most</td>
</tr>
<tr>
<td>remains in the water</td>
<td>Some</td>
<td>Some</td>
<td>Some</td>
</tr>
<tr>
<td>after trial, circle one</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Depth/width of oil layer/slick on surface in cm.</td>
<td></td>
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<td></td>
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</tbody>
</table>

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### Skimming:

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<th></th>
<th>Trial 1</th>
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<th>Trial 3</th>
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</thead>
<tbody>
<tr>
<td>15 seconds each</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate of how much oil remains in the water after trial, circle one</td>
<td>Most</td>
<td>Most</td>
<td>Most</td>
</tr>
<tr>
<td></td>
<td>Some</td>
<td>Some</td>
<td>Some</td>
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<tr>
<td></td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Depth/width of oil layer/slick on surface in cm.</td>
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</tbody>
</table>

### Soaking:

<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 seconds each</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Estimate of how much oil remains in the water after trial, circle one</td>
<td>Most</td>
<td>Most</td>
<td>Most</td>
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<td>Depth/width of oil layer/slick on surface in cm.</td>
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</tbody>
</table>

Based on your data, which method removed the most oil? Circle one.

Dunking  Skimming  Soaking
Prepare to Persuade

Class Discussion Questions:

- How do oil spills impact the natural environment?
- Why is it important to try to prevent oil spills?
- Why is it important to efficiently clean up oil spills?

Review the class data set. Use the data to identify which cleanup method worked the best.

Dunking  Skimming  Soaking

Which cleanup method do you recommend as the best?

Dunking  Skimming  Soaking

Use pictures or words to record information that supports your choice.