

Lesson Plan

Description
 During this lesson, students will learn about oil spills that occur in various bodies of water and the environmental and social implications they have on surrounding areas, including Indigenous communities. Students will use hands-on activities to explore the different technology that is used for cleanup and remediation efforts.

- Learning Outcomes**
- Oil spills can be caused by barges, tankers, pipelines, refineries, drilling rigs, and storage facilities
 - Oil spills have lasting and damaging effects on marine wildlife, surrounding local areas as well as Indigenous communities
 - Equipment and materials such as booms, dispersants, skimmers, and absorbers are used to help clean up oil spills
 - Choosing environmentally friendly alternatives to transportation may reduce the amount of oil consumption thus reducing the likelihood of oil spills

- Specific Expectations**
- A3.2** investigate how science and technology can be used with other subject areas to address real-world problems
- C1.2** assess the environmental and social impacts of fluid spills, including impacts on First Nations, Métis, and Inuit communities, and including the cost and technical challenges related to cleanup and remediation efforts
- C2.3** explain the difference between solids, liquids, and gases in terms of their density, using the particle theory of matter

Introduction

Oil spills occur in different bodies of water such as rivers, bays, and oceans and are mostly caused by oil related equipment such as drilling rigs, tankers, barges, pipelines, refineries, and storage facilities. These spills can be caused by some of this equipment breaking down, people making mistakes or being careless, natural disasters such as hurricanes or even deliberate acts such as illegal dumpers.

The science behind oil spills is related to the particle theory of matter as well as the classification of pure substances and mixtures. When comparing oil and water, oil is lighter than water. If vegetable oil were to be poured into a glass of water, it would remain separate and stay afloat at the top of the glass. This occurs because oil is less dense than water. The particles that make up oil are larger than the ones that make up water which causes them to not be packed as tightly together as water particles can.

Regarding the classification of pure substances and mixtures, a **homogenous mixture** has the same appearance and chemical composition throughout. A **heterogenous mixture** consists of different substances and both substances are distinguishable from each other. Oil and water are a heterogenous mixture.

Due to these conditions, when there is an oil spill, oil will float on saltwater (oceans) and usually on freshwater (rivers and lakes). The oil will spread out across the water to form a thin layer that is called an **oil slick**. The oil will quickly continue to spread and will become a thinner and thinner layer that has a rainbow-like appearance.

On July 22nd, 2016, a *Husky Energy* pipeline suffered a leak and spilled approximately 225,000 litres of oil into the North Saskatchewan River which greatly impacted the cities of North Battleford, Prince Albert, and Melfort. The spill has caused major disruptions, stress, and cost for residents of these cities. Water intake was shut off for two months and businesses such as laundromats and car washes were forced to close. Additionally, the communities of James Smith Cree Nation, Little Pine First Nation, and Cumberland House Cree Nation were severely impacted by the crisis. Chief Wayne Semaganis of Little Pine First Nation stated that the spill directly affected the wildlife and fish surrounding his community. Furthermore, all three communities lost traditional use of their land and are unable to fish in the river as well as farm or trap on or near reserve lands, causing the members of these communities to feel fearful, anxious, and stressed.

Oil spills are immensely harmful to wildlife because oil is composed of poisonous components. They affect wildlife not only internally through ingestion and inhalation, but also externally through their skin and eyes. For example, oil can coat feathers and fur which is essential for helping birds and mammals' ability to regulate their body temperature.

When it comes to cleaning up oil spills, the process consists of many different types of equipment and materials that are used by government and volunteer organizations to help correct the disaster. Here is a list of the different types of equipment, materials, and techniques which may be used:

Booms: Floating barriers to contain oil in smaller area

Skimmers: Boats that scoop the spilled oil from the water's surface

Sorbents: Large sponges used to absorb the oil

Chemical dispersants: Sprayed on water's surface to break down the oil

In situ burning: A controlled burning of the newly spilled oil while it is still floating on the water's surface

Vacuum trucks: Vacuum the spilled oil off the beaches or water's surface

***Images of the different types of equipment can be found on the accompanying slideshow from slides 9 to 14.**

The methods and tools that are chosen for the spill are dependent on the current conditions such as the weather, the area where the spill has occurred, the type and amount of oil spilled as well as the wildlife in the surrounding area. For example, road equipment such as a vacuum truck may work well on a sandy beach but would not be efficient in an area with big boulders or swampy grounds.

Material

- Aluminum pan (1/group)
- Small, graduated cylinder (1/group)
- Water (6 cups/group)
- Vegetable oil (6 tbsp/group)
- Duct tape
- Pipe cleaners or bendable straws (4-6/group)
- Paper towels (2 sheets/group)
- Popsicle sticks (1/group)
- Cardboard (1 – 4” x 4” piece/group)
- Cotton balls (4-6/group)
- Spoon (1/group)
- Food colouring (Red or green recommended, 3 drops/group)
- Dish soap (*Dawn* brand highly recommended)

Action

As a class, students will begin by viewing the accompanying slideshow to learn about the different types of equipment that can cause an oil spill as well as the equipment and techniques that are used to clean up a spill. After examining the slideshow, students will be encouraged to discuss their thoughts and ideas regarding oil spills before being put into groups.

Slide 16 of the slideshow introduces the oil spill that took place in 2016 on the North Saskatchewan River as a case study. The information presented to the students gives them a real-world problem that they must try and resolve through a hands-on activity. This activity allows the students to test out the different types of equipment and techniques that are used to clean up an oil spill on a classroom-friendly scale.

Part 1

- Each group of students will require the material designated above and the associated handout to accomplish the task. Students will begin by mixing the oil and food colouring together to demonstrate the chemicals that are found in crude oil.
- Once they have mixed the oil and food colouring, they will first add the 6 cups of water to the aluminum pan followed by the oil mixture to simulate an oil spill. A popsicle stick can be added to the pool of oil to represent an oil barge or tanker that has caused the spill.
- Using the handout, students will identify the role of each different type of cleanup material (i.e., spoon, cotton ball, cardboard, etc.) before determining their effectiveness on a scale from 1-10. Students are encouraged to use the duct tape and straws/pipe cleaners to create their own makeshift boom.

- After trying each type of material, students are to remove the oil they have collected and add it to the graduated cylinder to measure the quantity of oil that was cleaned up. Students should keep in mind that they should work as a team to clean up the oil before it makes its way to the edges of the water. This will enforce the idea that oil spills can be further destructive to the environment and wildlife if they were to reach land.

Part 2

- Add 2-3 drops of dish soap to each group’s “oil spill” which will act as a dispersant. Ask students to make predictions on what they think will occur now that the dispersant has been added. They will require the second handout to record their observations just as they did in Part 1.
- Once they have cleaned up as much of the oil spill as possible, have students set aside their material in order to have a class discussion. Ask them whether they believe one method was completely able to remove the oil as well as the chemicals. The food colouring will most likely have seeped throughout the water in the pan and symbolized the lasting impact that oil has on the water (and the land) it is spilled on.

Consolidation/Extension

Not only do oil spills cause irreparable and devastating damage to the environment and wildlife, but it also causes high levels of distress to humans. Not to mention, it can also cost billions of dollars to clean up. These disasters are frequently caused by man-made errors and are usually preventable. In order to decrease the amount of oil spills, we can turn to alternative energy to power many areas of our daily lives such as household appliances, electricity, and transportation. We can make choices such as walking and biking to diminish the consumption of oil, and therefore reduce the amount of oil that needs to be shipped internationally.

The questions on the handout out are a great way of consolidating and further discussing the lesson’s content.

Accommodations/Modifications

- Can be done outside
- Font on handout and PowerPoint can be modified to be larger or a different colour according to visual needs

Assessment

As students work as a group to test out the different materials, you can observe students and ask them the following questions to assess their understanding of the lesson’s content.

The handout can be collected and utilized as an Assessment **for** Learning to evaluate how well they have understood the lesson’s content and if they require

any more clarification. Furthermore, it can be used as an Assessment of Learning if you wish to evaluate your students in a summative manner.

References

Garcia, S. (2021, July 5). *Where Did the Oil From the Deepwater Horizon Spill Go?* JSTOR Daily. <https://daily.jstor.org/where-did-the-oil-from-the-deepwater-horizon-spill-go/>

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Office of Response and Restoration. (2021, May 4). *How Oil Harms Animals and Plants in Marine Environments.* <https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-harms-animals-and-plants-marine-environments.html>

Office of Response and Restoration. (2019, February 5). *How Do Spills Happen?* <https://response.restoration.noaa.gov/training-and-education/education-students-and-teachers/how-do-spills-happen.html>