

Spill the Tea: Fluid Spills in the Environment	Grade 8 Matter and Energy
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Lesson Plan

Big Ideas

How oil spills affect environments and communities, and how the clean-up and remediation will cost money, take time, and affect the environment/ community surrounding the spill.

Specific Expectations

C1.2: Assess the environmental and social impacts of fluid spills, including impacts on First Nations, Inuit, and Métis communities, and including the cost and technical challenges related to clean up and remediation efforts.
 Extension: **C1.1:** assess the environmental, social, and economic impacts of various innovations and technologies that are based on the properties of fluids

Description

Students will work together to build a habitat, create an oil spill, and then attempt to clean up the oil spill from the environment, exploring the costs, methods, and impacts of the clean-up.

Materials

Natural materials:

Rocks
 Sand
 Grass with roots/soil attached (if possible)
 Dirt
 Sticks
 Any other relevant natural materials

Other materials:

Tin pie plate
 Feathers (animal feathers, not plastic)
 Paper towel (white absorbent kind if possible)
 Sponge
 Plastic spoons
 Beakers
 Graduated cylinder
 Sawdust
 Dawn dish soap (or any other grease-fighting soap)
 Water
 Vegetable oil
 Red or blue food colouring

Introduction

What is an oil spill?

An oil spill is the release of a liquid petroleum product into the environment. Often but not always, this is a marine environment, and it is typically the result of human activity.

Spills are categorized into five types:

- Group 1: Gasoline Products.
 - These are highly flammable and very toxic.

- Group 2: Diesel-Like Products/Light Crude Oils.
 - These spread quickly into thin slicks.
 - They are most commonly jet fuel, kerosene, or diesel fuel for vehicles.
- Group 3: Medium Crude Oils/Intermediate Products.
 - Up to 1/3 will evaporate from this type.
 - The remains tend to smother animals.
- Group 4: Heavy Crude Oils/Residual Products
 - Very sticky, very little evaporation.
- Group 5: Non-floating Oils
 - Difficult to clean up, as it tends to sink after a short time.

What causes an oil spill?

Accidents at any oil facility or transport method, such as tankers, pipelines, refineries, rigs, and storage facilities tend to be the cause of the biggest oil spills, but smaller oil spills regularly happen from recreational and industrial vehicles, such as recreational and fishing boats, cars, and trucks.

Who is impacted by oil spills?

Oil spills have an impact on the people nearby. Often, pipelines are built in or near Indigenous communities, and Indigenous people experience a disproportionate impact from oil pollution. People exposed to oil spills can experience bad health effects, such as damaged immune, cardiac, and respiratory function. Indigenous people who have had pipelines built around their communities and experience small, frequent leaks are at much greater risk of health complications.

The long-lasting damage to the environment also has a big impact on Indigenous communities, as it impacts game and fishing, often for many years.

What are some major spills in Canadian history?

- In 1970, the tanker SS Arrow crashed near Nova Scotia and released 10 million litres of fuel.
- In 2011, 4.5 million litres of crude oil leaked from a pipeline near an Indigenous community in Alberta.
- In 2015, 5 million litres of sand-water-bitumen emulsion spilled from a pipeline in Alberta.
- In 2016, the Nathen E Stewart tugboat crashed in BC and released 110,000 litres of fuel.

Our most recent leak at the time of writing was in 2023, when 60-100 litres of oil were spilled off the coast of BC by the container vessel MV Europe.

How can a spill be cleaned up?

There are 14 main ways oil spills can be cleaned up. The best method will depend on the type of spill, the location of the spill, and the availability of materials. Different methods may be used in combination.

1. Oil-absorbent pads
 - A polypropylene pad floats on the water over the spill. Polypropylene absorbs oil and repels water.
2. Sawdust
 - Sawdust is a nontoxic method best for small spills on land. Pour sawdust over the spill, stir until the oil is absorbed, and sweep it up.
3. Hay
 - Hay works the same way sawdust does, but it can be used on water and on land. It must be left 6-8 hours to soak, and on water, it must be carefully contained so that it does not spread and become a pollutant.
4. Oil Spill Dispersant
 - A mix of emulsifiers and solvents are sprayed on a spill to break it into smaller droplets. This makes it harder to skim up, and more likely to impact deep-sea life, but less likely to make it to shore and effect wildlife there. It also makes it easier to break down over time.
5. Skimmer
 - Skimmers are a mechanical solution which can be attached to a boat. They skim the surface of the water, scooping up the oil but not the water. This works best on calm water.
6. Oil boom
 - Oil booms are floating devices which contain a spill and keep it from spreading.
7. Oil-absorbent powder and granules
 - These can be deployed where a spill needs to be cleaned up more quickly. The granules absorb oil and repel water and can be used on land or on water.
8. Bioremediation
 - Microbial organisms can be deployed where a dispersant has been used to quickly consume the oil. These may be aerobic or anaerobic microorganisms or fungi.
9. Vacuum pumps
 - A vacuum may be used in conjunction with a skimmer, sucking up with more precision leftover oil on the water's surface, or for smaller land spills.
10. Manual removal
 - Manual removal is the use of rakes and buckets to manually remove oil from a shoreline which cannot be reached or cleaned with heavy machinery.

11. Mechanical removal

- Mechanical removal is used in shoreline cleanups where the polluted sand and dirt can be removed with heavy machinery.

12. High-pressure hot water washing

- High-pressure hot water washing can remove traces of oil left on shorelines, but it also kills microbial life, and is less effective on gravelly or sandy shores compared to rocky ones.

13. Gelatin treatment

- A material is dropped on oil which becomes gelatinous on contact. The gelatin can be more easily skimmed, and with heat, the gelatin can be separated from the oil and reused.

14. In-situ burning

- Burning can remove almost all the oil, as long as it has been effectively contained. However, it results in significant air pollution, and residues may sink to the ocean floor. Residues are also much more difficult to remove. The conditions must also be just right – the oil must be sufficiently thick, and the weather must not put the fire out.

Action

Introduction

Go through PowerPoint slides 1-10 with your students, discussing what an oil spill is, and some Canadian examples.

Then, have a group discussion about the impact of oil spills on the environment. You can use these discussion questions as a guide.

1. What parts of the environment are impacted by an oil spill?
 - a. All; inorganic components like rock, sand, etc. are coated; animals are harmed; food sources are polluted; water and air are polluted
2. Why is containment so important?
 - a. An oil spill can spread quickly. If it is contained, it is much easier to clean up, and the impact can be limited.
3. How are people and communities impacted by oil spills?
 - a. Water and air pollution; food sources impacted when animals are hurt; loss of income for people who rely on fish or game or outdoor recreation, etc.

Continue with the remaining PowerPoint slides to discuss cleanup methods, and their pros and cons. Do students know any other methods of cleaning up oil spills?

Experiment

1. Have students pick a Canadian ecosystem. Have them use the worksheet to guide their research on that ecosystem.

2. When their research is complete, have them choose materials with which to model their ecosystem in a pie plate. Materials may include sand, rock, dirt, plant matter, mosses/lichens, sticks, feathers, fabric pieces (wool, felt), and other natural materials.
3. Once the ecosystem is complete, add water to their pie plate.
4. Measure 25mL of vegetable oil and add a few drops of food colouring to make it easier to see.
5. Pour the coloured oil into the pie plate.
6. Have students plan a clean-up method based on what they learned and the materials available to them (see material list). Then, have them attempt to clean up their oil spill.
7. When they have cleaned up as much as they can, pour the water and oil into a graduated cylinder and wait for the water and oil to separate again.
8. Once they have separated, measure how much oil remained. Subtract that amount from 25mL to learn how much they cleaned up.
9. Finish the worksheet's final questions.

Consolidation/Extension

Have a class discussion.

1. What methods worked well?
2. What methods were challenging?
3. In the ecosystem you created, what might have been impacted by an oil spill?
(Animals, plants, people)
4. Are some methods more cost-prohibitive than others?
5. How can we prevent future oil spills, rather than just reacting to them when they happen?
6. What are some alternatives to oil that are better for the environment?
7. How can we make those alternatives less cost-prohibitive?
8. What can you as young people do?

Additional Resources

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It Stops Here: Standing up for our Lands, our Water, and our People by Reuben George and Mike Simpson

A Line in the Tar Sands: Struggles for Environmental Justice by Joshua Kahn, Stephen D'Arcy, Tony Weis and Toban Black

<https://gulfwatchalaska.org/resources/educational-resources/virtual-field-trips/>

Youtube.com/watch?v=CzkhAMUifTY -> Dep Sea Learning: Oil Spills

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Youtube.com/watch?v=e-akuQkO4k8 -> Super-éponge pour les déversements de pétrole

Youtube.com/watch?v=vaC1GWtPaaU -> comment le pétrole se comporte-t-il dans l'eau?

<https://science.gc.ca/site/science/fr/ressources/pedagogiques/sciences-mer-aux-douces/larctiquecrpgee>

Bilingual

<https://letstalkscience.ca/search/site?keys=oil+spill&op=Search>

<https://parlonssciences.ca/search/site?keys=deversement+de+petrole>

<https://ontariosciencecentre.ca/teachers-plus-students/teacher-resources/curriculum-resources/ecosystems-and-oil-spills-grade-11>

<https://centredessciencesontario.ca/ecoles/ressources-en-enseignement/ressources-pour-le-curriculum/ecosystemes-et-deversements-de-petroles>