Unit IV. Problems and Solutions

Lesson III. Oil

Lesson Objectives

- Students will be able to explain the composition of oil and how it is formed.
- Students will be aware of the dangers of oil spills and will be able to explain why oil spills have such a devastating effect on the environment.
- Students will be able to list ways in which they can help to prevent oil pollution.

keywords: booms, fossil fuels, geologists, petroleum, and sediments

What is Oil and Where Does it Come From?

The energy we use to heat, light and cool our homes and to run our car comes from **fossil fuels**. Fossil fuels are products of decayed plants and animals that have been preserved in the earth's crust. The remains of these organisms were chemically changed over millions of years.

Fossil fuels contain carbon and hydrogen compounds called **hydrocarbons**. When hydrocarbons burn they give off heat and light.

Liquid fossil fuel is called **petroleum** or **oil**.

Oil is found in areas that **geologists** believe were once covered by oceans. They think that oil was formed from partly decayed marine plants and animals. **Sediments** that built up on the ocean floor covered these organisms. As sediments have piled up over time, they have turned into rock. Pressure, **bacteria** and heat changed the plant and animal remains into oil.

How Does Oil Harm the Environment?

Oil spills are a major source of chemical pollution. For example, one of the largest spills occurred in 1989 when the Exxon Valdez oil tanker accidentally released millions of liters of oil into the ocean near Alaska. Oil spills as large as this one have devastating effects. The spill area is polluted for years despite clean-up efforts.

Even more oil pollution comes from waste oil spilled on land or into storm drains that empty into lakes and rivers.
Oil consists of at least 300 different chemicals, most of them negatively

affecting the health or living organisms. Some of the chemicals – called **petrochemicals** – can cause cancer, respiratory diseases, skin problems or various blood diseases in humans. Humans are able to take precautions against the oil, animals are not.

Oil spills threaten water quality, destroy habitats, and kill wildlife.

What Happens in an Oil Spill?

When an oil spill occurs, often due to a damaged oil tanker or leaking oil rig, people are amazed at the huge amount of environmental damage caused. Although most oil spills are the result of human error, some are naturally occurring from seepages from oil deposits beneath the ocean floor.

The first visible impacts of an oil spill are a film of oil spreading across the surface of the water. Oil stained beaches and shorelines are quickly seen. Perhaps seeing dying birds and other familiar sea animals covered with oil is the most upsetting to people.

These are the most obvious impacts because we see them in the media, but oil spills also have long term environmental impacts. It can enter the food chain and continue to cause damage to the environment long after the initial spill.

What Types of Marine Organisms are Impacted?

All organisms that come in to contact with marine organisms are impacted. Harm from oil is not limited to the birds, sea otters, and plants that live in the ocean. Ultimately, humans are also harmed.

It doesn't take much for oil to harm living organisms. Even a small amount of motor oil spilled on the ground can kill earthworms and other animals living in the soil below.

Oil spills affect the wildlife in the area they occur in a variety of different ways. It can kill by suffocating through ingestion, coating fur and feathers, contact poisoning or by exposure to toxic compounds.

Birds seem to suffer the most even in small spills – the oil soaks into their feathers allowing water to penetrate – they become cold and exhausted and eventually the extra added weight causes them to sink.

Did You Know?

Have you ever looked down at the pavement and seen what looked like a rainbow, perhaps on a driveway after it has rained? It is actually a very thin oil slick. Oil spreads out to form such a thin layer that it reflects light like a rainbow, making it look purple, green, yellow and red.

What You Can do to Help

- Although you can't prevent oil tankers from running aground or prevent a storm from rupturing an oil tank, you can take action on a personal level:
- Keep any oil or oil-product that you or your family use out of the environment.
- If you have a tank that holds home heating oil, make sure it doesn't have any leaks.
- If your family changes motor oil, take the old oil to a service station for recycling. NEVER throw the old oil down the drain – it would probably end up in freshwater supplies!
- Don't use any petroleum-based household chemicals (e.g. Furniture cleaners and polishes).
- Protest actions you think are wrong and plead for actions you think are helpful.
- Educate others.

If you find any interesting facts, or have any questions that you would like to share with the staff at Project Oceanography, please feel free to call us live during the show at 1-888-51-OCEAN. Or, e-mail us at pjocean@marine.usf.edu Your questions will be answered either via e-mail, or on the air during a broadcast. Visit our website at http://www.marine.usf.edu/pjocean

Activity I. How Can it be Cleaned Up?

Objective: To illustrate the many ways oil can be biologically, physically and chemically removed after a spill.

Background: Cleaning up oil spills is an enormous task! Exxon has spent over 2 million dollars on the Valdez cleanup operations! There are many different methods that can be used to clean up oil spills.

Activity: Discuss with students the many ways that oil spills are cleaned up. Stress the manpower that is necessary in doing so, and that ALL of the oil is never removed. Students should be able to relate to the biological, physical and engineering methods that are used.

Methods:

Cold water washing - the pumping of seawater through a hose to remove the oil that is then flushed down to the waterline, trapped by **booms**, and recovered by **skimmers**.

Warm water washing - the application of heated seawater at moderate pressure to move oil.

Storm-berm relocation - the mechanical exposure and relocation of oiled storm berms (material deposited above the high tide line during storms) into the tidal zone to allow natural flushing and to enhance biodegradation.

Bioremediation - the deliberate encouragement of bacteria to consume the oil resulting from an oil spill eventually breaking it down. Oil-eating bacteria are found naturally in seawater, so all oil gets broken down eventually if left alone. In some oil spills, bacteria have been deliberately poured into the ocean. They break down the oil into compounds that can be eaten by marine life.

Manual removal and **natural processes**. Natural processes will eventually clean up oil spills but this would take a very long time.

Chemical Cleanup

- **Dispersants** are chemicals that can be used to cleanup oil spills such as that are used to break oil slicks up into many tiny droplets that don't stick together.
- **Emulsifiers** are another type of chemical used in breaking up an oil spill. They get between oil molecules and prevent them from sticking together. The oil doesn't disappear but it can then be carried with the currents and not washed up on shore in a huge wave of thick oil.
- **Surfactants** (surface-active agents) are chemicals that are compatible with both oil and water so that they collect at the boundary between oil and water and break down the barrier between them. Surfactants make surfaces slippery preventing oil from sticking to them.

Activity II. Oily Feathers

Objective: To show the devastating effect that oil pollution and the detergents used during clean-up operations can have on birds.

Materials:

- Large glass bowl
- 1 spoon of oil
- Powdered washing detergent

Procedure:

1. Fill the bowl about two thirds full of water.
2. Add a spoonful of oil
3. Observe the water surface
4. Record observations
5. Sprinkle 2 spoons of powdered detergent over the liquid surface.
6. Carefully stir the mixture being careful not to produce bubbles.
7. Again observe the surface of the water.
8. Record observations

Results: The oil will spread out in large circles on the surface of the water in the bowl. Once the detergent is added some oil will sink, while the rest breaks up into small bubbles which cover the water's surface.

Explanation: Since water is heavier than oil, the oil will float on the surface of the water. When the detergent is added, the detergent molecules stick to the water on one side and oil on the other. The large circles of oil initially observed no longer exist as the molecules of detergent allow the oil and water to mix.

Effect on Birds: Birds stay afloat in the water because of the oil on their feathers, which also makes the feathers waterproof. Detergents in the water can soak into birds' feathers breaking up the oil into tiny molecules (as you observed happening in the above lab) and allowing water to penetrate. The bird will eventually drown due to the extra weight of the water saturating its feathers.

Activity III. Pollution Spreads

Objective: To illustrate the far-reaching impact a small amount of pollution can have on a stream and it's associated wildlife.

Materials:

A 4 liter plastic jug
Red food coloring
Measuring cup (250 ml)

Procedure:

1. Pour one-half cup of water into the jug.
2. Add two drops of food coloring.
3. Add one cup of water at a time to the jug until the red color disappears.

Results: It should take approximately 7 measuring cups of water to make the food coloring disappear.

Explanation: At first the red color is visible because the food coloring molecules are close enough together to be seen. As clean water is added, the food coloring molecules continue to spread evenly throughout the water. They are finally are far enough away from each other so as to be invisible because of their small size. This is what happens to some water pollutants. The pollutant is visible where it is initially dumped, but as it flows downstream and becomes mixed with more water it can no longer be seen with the naked eye. Just because the pollutant cannot be seen doesn't mean that it is gone – just like the red food coloring, it is still present in the water and you would be ingesting it if you drank the water. In the same way, pollutants many miles from the source affect animal life in the stream.

Student Information Sheet III

If we have a car, heat and cool our home, we use energy. This energy comes from fossil fuels. Fossil fuels are carbon compounds called hydrocarbons. When hydrocarbons burn they give off heat and light.

Liquid fossil fuel is called petroleum or oil. The United States relies on oil for automobiles, industry, heating, and many more things.

Oil is found in areas that geologists believe were once covered by oceans. Oil is formed from partly decayed marine plants and animals that have sunk to the sediment and been there for a very long time. Over time, the sediments have built up over these materials have pushed the decaying plants and animals to great depths. Pressure, bacteria and heat have changed the plant and animal remains into oil.

How Does Oil Harm the Environment?

When an oil spill occurs, often due to a damaged oil tanker or leaking oilrig, people are amazed at the huge amount of environmental damage caused. Although most oil spills are the result of human error, some are naturally occurring such as seepages from oil deposits beneath the ocean floor.

Oil spills are a major source of chemical pollution. There are biological, physical and chemical ways to clean up oil spills, but the area affected by a spill is polluted for many years afterward. The wildlife that live in an area where oil is spilled suffer for many years. Even more oil pollution comes from humans not properly disposing of their waste oil. Oil that is spilled on land or emptied into storm drains will eventually reach lakes and rivers.

Oil spills, and improper disposal of it threatens water quality, destroy habitats, and kill wildlife.

Did you know?

Did you know that when you look down at the pavement and see rainbow colors, or you look at the surface of water and see a sheen of metallic rainbow colors that you are looking at a very thin oil slick? Oil spreads out of a wide area in into such a thin layer that it reflects light like a rainbow, making it look purple, green, yellow and red.

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