Title: ***Oil Dispersion: The Smaller, the Better***
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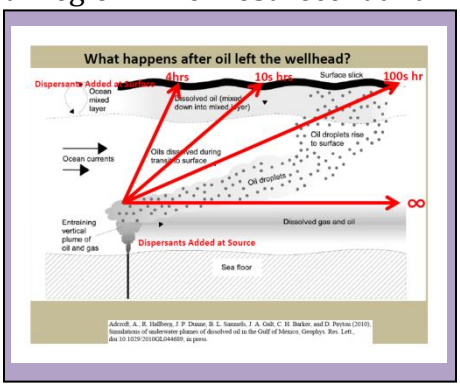
Background Information

One of the main remediation techniques for oil spills remaining on the surface is the application of chemical dispersant. Dispersants are composed of oleophilic and hydrophilic parts that separate oil and water, which causes emulsification. The surface area of the oil plumes are reduced, leaving behind smaller droplets of oil. The idea behind using dispersants was to allow biology to take its course; microbes degrade the smaller oil droplets, thus cleaning the oil contamination of a particular region. The most recent and notable offshore drilling incident was the BP Deepwater Horizon oil spill which was responsible for releasing millions of barrels of oil into the Gulf of Mexico and the surrounding coast. Chemical dispersant was used at the surface and in the deeper layers of the Gulf of Mexico.



Louisiana State Standards (Grade-Level Expectations)

SI GLE: Select and use developmentally appropriate equipment and tools and units of measurement to observe and collect data (SI-E-A4)
Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)

SI GLE: Pose questions that can be answered using students' own observations and scientific knowledge (SI-E-A1)
Generate testable questions about objects, organisms, and events that can be answered through scientific investigations (SI-M-A1).
Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)

SI GLE: Identify and use appropriate safety procedures and equipment when conducting investigations (e.g., gloves, goggles, hair ties) (SI-E-A7)
Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8)

SE GLE: Identify and explain the limitations of models used to represent the natural world (SIM-A5)

LS GLE: Describe the characteristics of *living (biotic)* and *nonliving (abiotic)* things (LS-E-A2)
Analyze the dynamics of a population with and without limiting factors (LS-H-D3)
Explain how selected organisms respond to a variety of stimuli (LS-H-F3)

ES GLE: Describe the abiotic and biotic factors that distinguish Earth's major ecological systems (SE-H-A1)

Cite and explain examples of organisms' adaptations to environmental pressures over time (SE-H-A8)
Give examples and describe the effect of pollutants on selected populations (SEH-A11)

Ocean Literacy Principles

Principle 1e: Most of Earth's water (97%) is in the ocean. Seawater has unique properties: it is saline, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. The salt in seawater comes from eroding land, volcanic emissions, reactions at the seafloor, and atmospheric deposition.

Principle 5b: Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.

Principle 6b: From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Principle 6e: Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Time Requirement

This is an activity that requires minimal setup beforehand. Place all the materials on a table and explain the procedure; this should take no longer than 5 minutes. Allow the students to perform this simple exercise for 5-10 minutes and continue with the follow-up questions afterwards.

Materials

2 Drinking or distilled water (1 gallon jug)
Vegetable oil
Liquid dishwashing soap
Food coloring
2 Graduated cylinders
Small mason jars (craft stores)

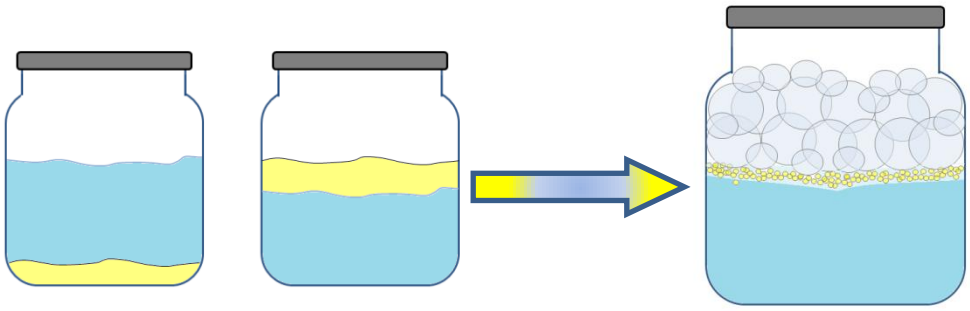
Lesson Description

Creating the Oil Dispersion: The Smaller, the Better Project

1. Add food coloring to the water jugs; this will help with visibility against the oil.
2. Add 50 mL of water, using a graduated cylinder, and pour into the first mason jar. Add 15 mL of vegetable oil, using a graduated cylinder, and pour into the second mason jar.
3. Add 15 mL of vegetable oil, using a graduated cylinder, and pour *slowly* into the first mason jar (i.e., on top of the water). Add 50 mL of water, using a graduated cylinder, and pour *slowly* into the second mason jar (i.e., on top of the oil).
4. Add 3 small drops of liquid dishwashing soap to each mason jar and shake both vigorously for 10 seconds.

Methodology

Students will simulate adding dispersants to oil spills at the surface and bottom of a water column. The objective is to examine any fundamental difference between water-on-oil samples compare to oil-on-water samples. Inform students that they should observe both mason jars for 1 minute after shaking. If the students look closely, they will begin to see a small layer of emulsified oil directly under the soap bubbles near the surface of the jar. Over time the emulsified oil layer will become more pronounced. Have the students talk about the hypothetical increase in microbial activity that will follow as a direct effect of smaller oil droplets.



Standard Evaluation (Student Deductions)

1. Before adding the dispersant (i.e., soap), was there any difference between the two jars?

2. Which liquid, water or oil, has a lower density? Would there be any change if seawater was being used instead of drinking water?
3. Chemical dispersants have been effective on surface, but why wouldn't these dispersants work as well in bottom waters?
4. Describe stratification? Where was it in this exercise?
5. What are other physical factors that help break up oil on the ocean's surface?

The evaluation can be in the form of a test, essay, questions and answers worksheet, or any other mode of measuring retainment or comprehension of material.