Title: ***Oil Transportation May Equal Direction Uncertainty***
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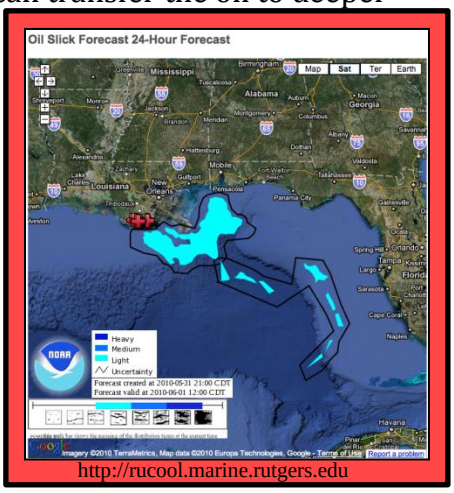
Background Information

Oil has a lighter density than saltwater, so oil will float to the surface of the water when the two are combined. Once the oil rises to the surface, it is usually subject to weathering and other environmental processes. Eventually the oil layer within the surface water can become thinner and covers more area via emulsification. As a result, oil slicks, mousse, and even tar balls may appear in regional ocean water. Remnants of oil are transported effortlessly by wind, currents, and eddies that can transfer the oil to deeper depths unseen by the human eye or even remain in the top layers of the ocean forming oil sheens. The most recent and notable oil spill was the BP Deepwater Horizon incident which was responsible for releasing millions of barrels of oil into the Gulf of Mexico. This oil may be eventually transported to the surrounding coast.



http://rucool.marine.rutgers.edu

Louisiana State Standards (Grade-Level Expectations)

SI GLE: Predict and anticipate possible outcomes (SI-E-A2).
Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2).
Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2).

SI GLE: Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4).

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: Use a variety of appropriate forms to describe procedures and express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibits, portfolios) (SI-E-A6).
Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-3).
Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls (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).
Given a description of an experiment, identify appropriate safety measures (SI-H-A7).
Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8).

ESS GLE: Compare weather patterns as they relate to seasonal changes in students' immediate environment (ESS-E-A4).

PS GLE: Identify forces acting on all objects (PS-M-B3).
Determine the magnitude and direction of unbalanced (i.e., net) forces acting on an object (PS-M-B4).
Compare the characteristics and strengths of forces in nature (e.g., gravitational, electrical, magnetic, nuclear) (PS-H-E1).

SE GLE: Analyze positive and negative effects of human actions on ecosystems (SE-H-A7).
Give examples and describe the effect of pollutants on selected populations (SE-H-A11).

SE GLE: Determine the interrelationships of clean water, land, and air to the success of organisms in a given population (SE-H-C1).
Describe how accountability towards the environment affects sustainability (SE-H-D5).

Ocean Literacy Principles

Principle 1c: Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of the Earth's rotation (Coriolis effect), the Sun, and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation.

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

The teacher can create the coastal habitats inside the cooler and also create the "oil pockets", but it is not advised because this is a relatively short project for the students.

Decorating the coastal habitats will require 10 minutes for basic research and coloring. Creating the oil pockets may be messy, but should not last over 5 minutes. Once the project is underway, have students assess the location of their oil in increments (e.g., 30 second increments, up to 3 minutes).

Materials

Styrofoam cooler
Water
Plastic wrap
Vegetable oil
Food coloring
2 Keyboard cleaners (compressed air)
Yarn or string
Assorted markers
Pipette
Small container

Lesson Description

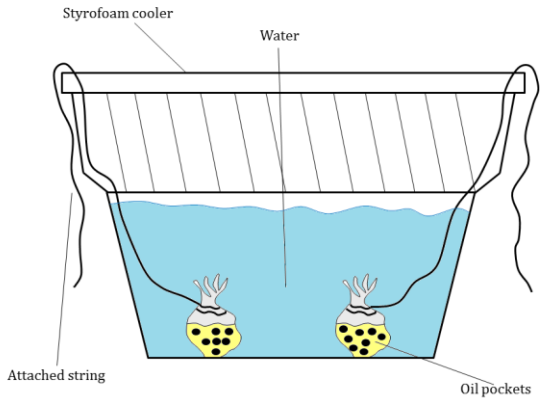
Creating the Oil Transportation Project

1. Have students color/decorate each of the four sides of the Styrofoam coolers. Each side should represent a different coastal habitat.
2. Fill the cooler to the water line denoted on the inside.
3. Add food coloring to each set of oil used by each group. Make sure the oil is a different color for both groups to ensure an easy time identifying oil movement.
4. Oil pockets are created by outlining plastic wrap inside a small empty container. Use a pipette to insert small amounts of oil into the wrap. Fill it ¼ - $^1/_3$ the size of the container.
5. Twist the bag shut and tie a yarn or string around it (e.g., shoelace knot). Make sure the yarn or string is long enough to be used outside of the water in the cooler.
6. If the students are having a difficult time untying the oil pocket once underwater, they may have to hold the base of the oil pocket (i.e., underwater) and then untie.

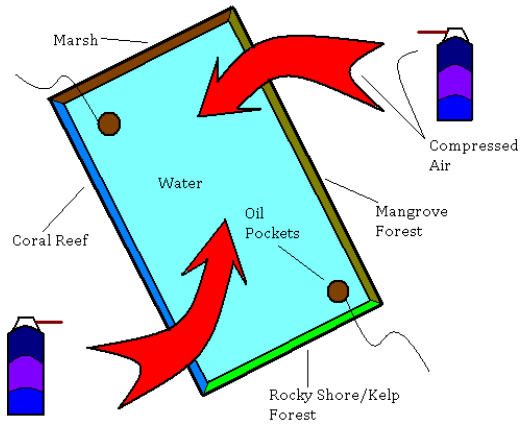
Methodology

Students should be divided into two groups and are responsible for creating an oil pocket to assess how oil is distributed once it is released. Before untying the oil pockets, have students also continuously use short bursts of the compressed air in directions simulating geostrophic winds (i.e., clockwise simulates the northern hemisphere and counterclockwise simulates the southern hemisphere). These short burst of compressed air will create wind-driven currents within the water that will transport the oil once untied. The illustration below uses the compressed air in a counterclockwise manner to simulate geostrophic winds in the southern hemisphere. Have students untie the yarn or strings to

the oil pockets and watch how/where the oil disperses at different time increments. At each increment, have students take note of what is happening.



Profile View



Aerial View

Standard Evaluation (Student Deductions)

1. Did the oil from your group transport to any coastal habitats? Why or why not?
2. Name the ecological implications of oil pollution to each coastal habitat?
3. Compare and contrast oil transport depending on the difference in wind direction for both hemispheres?
4. Did any oil remain at bottom or middle layers of the water? Why or why not?
5. If oil did remain at the middle or bottom layers, what may be the effect on those ecosystems?
6. Identify if the oil remained as an oil sheen/slick or did it turn into mousse or tarballs? Why or why not?

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.