I Prefer to be on Empty: Exploring the Spread of Oil Spills

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Since the Industrial Revolution, the world has become increasingly dependent on the use of fossil fuel as a source of energy. According to the U.S. Energy Information Administration (EIA) the United States consumed seven billion barrels of petroleum in the year 2011 (EIA, 2011). This accounts for 22 percent of the total world's consumption of petroleum per year. However, the United States only makes up five percent of the world's population. With such high demands for oil, the United States imports almost half of its oil from other countries around the world. With the transportation of large amounts of oil comes the risk of an oil spill. Recently, models for oil spills have been created to allow for more efficient removal and prevention of the spread of oil in the event of a spill.

For our purposes, modeling can be used to allow students to virtually explore the dispersion of oil in the ocean. By using a model, students are able to look at a situation, in our case an oil spill, through a controlled environment. This gives students the capability to test multiple variables one at a time, and make observations on the impact that each variable has on the spread of oil. Students would be provided with a complete model, consisting of an environment and agents. Using the provided model, students would have the freedom to test different scenarios by adding or removing agents from the worksheet.

This assignment consists of a cross discipline topic between Biology and Chemistry. In Biology, this model would be used during the ecology unit, or water quality unit, and would provide students with a real life example of human impact on an ecosystem. In the chemistry classroom, this model can provide students with the opportunity to apply their knowledge of the effects of polarity on solutions. This model can also be used as a real life connection to the abstract ideas of organic chemistry. Along with using AgentSheets, and completing the worksheet, students would incorporate learning through inquiry by completing a lab report on their findings. As an extra credit assignment, students would be allowed to create their own models.

Standards

Biology:
1.1-Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent one's thinking.
7.1-Describe the range of interrelationships of humans with the living and nonliving environment.
Major Understandings
7.1a The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources and deplete those resources that cannot be renewed.
7.1b Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes

may be detrimental.
7.1c Human beings are part of the Earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected.

Chemistry
Key Idea 2:
Deductive and inductive reasoning are used to reach mathematical conclusions.
M2.1 Use deductive reasoning to construct and evaluate conjectures and arguments, recognizing
that patterns and relationships in mathematics assist them in arriving at
these conjectures and arguments.
• interpret a graph constructed from experimentally obtained data
identify relationships
§ direct
§ inverse
apply data showing trends to predict information

Key Idea 1
The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.
S1.1 Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent
thinking.
• use theories and/or models to represent and explain observations
• use theories and/or principles to make predictions about natural phenomena
• develop models to explain observations
S1.2 Hone ideas through reasoning, library research, and discussion with others, including experts.
• locate data from published sources to support/defend/explain patterns
observed in natural phenomena
S1.3 Work towards reconciling competing explanations, clarifying points of agreement and disagreement.
• evaluate the merits of various scientific theories and indicate why one theory
was accepted over another
Key Idea 5:
Identifying patterns of change is necessary for making predictions about future behavior and conditions.
Examples include:
• use graphs to make predictions, e.g., half-life, solubility
• use graphs to identify patterns and interpret experimental data, e.g., heating
and cooling curves

Name:_____
Science: Modeling
Date:

Using Models to Predict the Spread of Oil in the Ocean

Background: Since the Industrial Revolution, modern society has become increasingly dependent on the use of fossil fuel as a source of energy. The United States is one of the leading consumers of oil, accounting for 22 percent of the total world's consumption. Of that oil consumed, 45 percent is imported from other countries across the world. However, one of the risks involved in transporting large quantities of oil is the potential of an oil spill.

Today, you are going to step into the shoes of a marine biologist in charge of designing a clean-up and prevention plan for a recent oil spill. Using the program Gnome, Agent Sheets, and the provided worksheet explore the different variables that will affect the spread of oil.

Virtual Quest!
Use the following link to complete the following questions:
http://www.classzone.com/books/earth_science/terc/content/investigations/es0703/es0703page01.cfm?chapter_no=investigation

1. Predict what you think happens when an oil spill like this one occurs.

2. As you explore, write down three observations about oil spills.

3. What was the average rate at which the oil spread?

4. List at least two factors that might affect the way the oil moves.

5. Predict what will happen to the oil if winds are blowing from the south at 15 knots per hour.

6. Describe how the oil moves now.

7. How does what you see compare with what you predicted would happen?

8. How does the increase in wind speed affect the way the oil moves?

Using AgentSheets complete the following questions:

1. Open the program AgentSheets and run the program without adding any agents. Describe what you observed when the oil tanker crashed on the rock.

2. Now you get the chance to explore the different variables involved in an oil spill. Using the agents provided, describe how the oil spill is affected by incorporating new agents (waves, cleanup crew, wildlife, etc.). **Hint: Make sure to only change one variable at a time.**

3. Pick what variables you want to use to collect data on, and record them in the space provided bellow. Form a hypothesis for how each variable will affect the spread of oil before running the simulation.

4. Run the simulation and collect data using the provided plot results in AgentSheets. How did your hypothesis compare to what actually occurred.

5. Analyze the data collected using an excel spread sheet. Plot the different variables and look for trends, make sure to include labels on each axis. Why do you

think the oil spread the way that it did?

6. Do you think that the model is an accurate representation of what would actually occur? If not, what would you change and why?