Power and Propulsion

Oil, Oil, Everywhere

Grade Level(s): 3rd-5th grade

Academic Content Area(s): Science and Math

Topic(s): Earth and Space; Life Science; Science and Technology; Scientific Inquiry; Science as Ways of Knowing; Numbers, Numbers Sense and Operations Data Analysis; and Mathematical Processes

Recommended area of co-teaching for an AFRL Engineer or Scientist

Main Problem/Essential Question

How can we stop the oil leak?

Summary

Students inquire how to stop an oil leak in a model of the BP oil leak in the Gulf by simulating the situation in a 10 gallon aquarium. Students generate potential solutions, which are then tested and redesigned. Students learn about natural factors involved in this real life situation and scenario including ocean depth, properties of natural materials, earth's geological makeup at the site of the leak, and environmental issues through their scientific inquiry. Students explore a real life engineering challenge, its effects on society, and the struggles engineers face when solving a time-sensitive problem through use of the engineering design process.

Big Idea(s) / Focus

Our society relies heavily on petroleum, a non-renewable resource. Petroleum, also known as crude oil, is not only hazardous to extract but also pollutes as it is used. Manufacturing and research teams such as the Power and Propulsion directorate at the Air Force Research Lab must figure out how to safely maintain and store their fuel reserves. Materials, mechanical, and chemical engineers and scientists are tasked to help our society safely extract and store fuel.

Disasters still occur and are sometimes man-made such as the 2010 Gulf Oil Spill. Nearly 100 million gallons of crude oil have been spilled into the Gulf of Mexico. This non-renewable resource is polluting the ocean – endangering marine animals, plant species, and beach communities. Scientists, engineers, and volunteers from around the world have assisted in brainstorming potential solutions to stop this oil leak. Although, technology has enabled our ability to extract oil, build pipelines, float ocean rigs, refine oil, and use oil as a fuel in cars and rockets it has also led to the current man-made disaster. We must be mindful of the implications of our technology. This thought process has led scientists to look at renewable resources such as bio-fuel, wind, and solar power to create energy that doesn't cost so much environmentally.

Through exploring the Gulf Oil spill students will understand the magnitude of this disaster and the effects of technology, as well as the different roles people have played in this situation and the implications this disaster holds for our society and environment.

Prerequisite Knowledge

What the students need to know prior to starting this activity/unit.

Students need to know what oil is and what it is used for.

Student need to know about the EDP.

Students need a basic understanding of how all the earth systems interact with each other and that this disaster will have an impact on them.

Standards Connections

Content Area: Science

Earth and Space: Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences.

Grade 5 – Benchmark C: Describe Earth's resources including rocks, soil, water, air, animals and plants and the ways in which they can be conserved.	5. Explain how the supply of many non-renewable resources is limited and can be extended through reducing, reusing and recycling but cannot be extended indefinitely.

Life Science: Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

Grade 3- Benchmark C: Compare changes in an organism's ecosystem/habitat that affect its survival.	6. Describe how changes in an organism's habitat are sometimes beneficial and sometimes harmful.
Grade 5- Benchmark C: Compare changes in an organism's ecosystem/habitat that	6. Analyze how all organisms, including humans, cause changes in their ecosystems and how these

affect its survival.	changes can be beneficial, neutral or detrimental (e.g., beaver ponds, earthworm burrows, grasshoppers eating plants, people planting and cutting trees and people introducing a new species).

Science and Technology: Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Grade 3- Benchmark A: Describe how technology affects human life.	2. Describe ways that using technology can have helpful and/or harmful results. 3. Investigate ways that the results of technology may affect the individual, family and community.
Grade 5- Benchmark A: Describe how technology affects human life.	1. Investigate positive and negative impacts of human activity and technology on the environment.
Grade 3 – Benchmark B: Describe and illustrate the design process.	4. Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions and design a solution). 5. Describe possible solutions to a design problem (e.g., how to hold down paper in the wind).
Grade 4 – Benchmark B: Describe and illustrate the design process.	3. Describe, illustrate and evaluate the design process used to solve a problem.

Scientific Inquiry: Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Grade 3- Benchmark B: Organize and evaluate observations, measurements and other data to formulate inferences and conclusions. .	2. Discuss observations and measurements made by other people. 3. Read and interpret simple tables and graphs produced by self/others. 5. Record and organize observations (e.g., journals, charts and tables).

Grade 5- Benchmark B: Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.	2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies. 3. Use evidence and observations to explain and communicate the results of investigations.
Grade 3- Benchmark C: Develop, design and safely conduct scientific investigations and communicate the results.	6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and observations).

Scientific Ways of Knowing: Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows \ and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Grade 3- Benchmark C: Explain the importance of keeping records of observations and investigations that are accurate and understandable.	2. Keep records of investigations and observations and do not change the records that are different from someone else's work.
Grade 4- Benchmark C: Explain the importance of keeping records of observations and investigations that are accurate and understandable.	2. Record the results and data from an investigation and make a reasonable explanation.
Grade 5- Benchmark C: Explain the importance of keeping records of observations and investigations that are accurate and understandable.	5. Keep records of investigations and observations that are understandable weeks or months later.
Grade 3 – Benchmark D: Explain that men and women of diverse countries and cultures participate in careers in all fields of science.	3. Explore through stories how men and women have contributed to the development of science. 4. Identify various careers in science.
Grade 5 – Benchmark D: Explain that men and women of diverse countries and cultures participate in careers in all fields of science.	6. Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform.

Content Area: Math

Numbers, Numbers Sense and Operations: Students demonstrate number sense, including an understanding of number systems and operations and how they relate

to one another. Students compute fluently and make reasonable estimates using paper and pencil, technology-supported and mental methods.

Grade 3 – Benchmark I: Demonstrate fluency in multiplication facts with factors through 10 and corresponding divisions. Grade 3 Benchmark K: Analyze and solve multistep problems involving addition, subtraction, multiplication and division of whole numbers.	8. Model, represent and explain multiplication; e.g., repeated addition, skip counting, rectangular arrays and area model. For example: a. Use conventional mathematical symbols to write equations for word problems involving multiplication. 13. Demonstrate fluency in multiplication facts through 10 and corresponding division facts.
Grade 4 – Benchmark I: Demonstrate fluency in multiplication facts with factors through 10 and corresponding divisions. Grade 4 Benchmark K: Analyze and solve multistep problems involving addition, subtraction, multiplication and division of whole numbers.	12. Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem. 14. Demonstrate fluency in adding and subtracting whole numbers and in multiplying and dividing whole numbers by 1- and 2-digit numbers and multiples of ten.

Data Analysis:
Students pose questions and collect, organize, represent, interpret and analyze data to answer those questions. Students develop and evaluate inferences, predictions and arguments that are based on data.

Grade 3- Benchmark A: Gather and organize data from surveys and classroom experiments, including data collected over a period of time. Grade 3- Benchmark C: Construct charts, tables and graphs to represent data, including picture graphs, bar graphs, line graphs, line plots and Venn diagrams.	1. Collect and organize data from an experiment, such as recording and classifying observations or measurements, in response to a question posed. 4. Support a conclusion or prediction orally and in writing, using information in a table or graph.
Grade 4- Benchmark A: Gather and organize data from surveys and classroom experiments, including data collected over a period of time. Grade 4- Benchmark C: Construct charts, tables and graphs to represent data, including picture graphs, bar graphs, line graphs, line plots and Venn diagrams.	1. Create a plan for collecting data for a specific purpose. 2. Represent and interpret data using tables, bar graphs, line plots and line graphs. 4. Compare different representations of the same data to evaluate how well each representation shows important aspects of the data, and identify

	appropriate ways to display the data.
Grade 5- Benchmark E: Collect, organize, display and interpret data for a specific purpose or need.	2. Select and use a graph that is appropriate for the type of data to be displayed; e.g., numerical vs. categorical data, discrete vs. continuous data. 4. Determine appropriate data to be collected to answer questions posed by students or teacher, collect and display data, and clearly communicate findings.

Mathematical Processes:
Students use mathematical processes and knowledge to solve problems. Students apply problem-solving and decision-making techniques, and communicate mathematical ideas.

Grade 3-4- Benchmark B: Use an organized approach and appropriate strategies to solve multi-step problems.	
Grade 3-4- Benchmark K: Use mathematical language to explain and justify mathematical ideas, strategies and solutions.	

Preparation for activity

Gather materials.

If you are uncertain how this lab will work in your class, you may consider setting up the scenario in advance.

Critical Vocabulary

Engineering Design Process- Steps an engineer or person can follow to solve a problem. Question, Think, Design, Test, and Solve.

Fossil fuel- A hydrocarbon deposit, such as petroleum, coal, or natural gas, derived from living matter of a previous geologic time and used to create energy.

Geological Engineering- an engineering field that solves problems involving earthen materials and related structures.

Natural resource- a material source that is naturally occurring. (Examples: solar energy, oil, timber, minerals, coal, etc.)

Non-renewable resource- a natural resource which cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate.

Offshore Drilling- the drilling of oil or gas wells into water-covered locations.

Offshore platform (oil platform or oil rig) - a large structure used in offshore drilling to house workers and machinery needed to drill wells in the ocean bed, extract oil, natural gas, or both, process the produced fluids, and ship or pipe them to shore.

Crude Oil- liquid petroleum, a fossil fuel.

Oil Spill-the release of crude oil into the environment.

Renewable resource- a resource that is replaced by natural processes at a rate comparable or faster than its rate of consumption.

Toxic- poisonous, capable of causing harm or death.

Timeframe

Day	*Time Allotment*	*Activities*
1	50 minutes	Pre test Oil spill discussion: facts of the Gulf Oil Spill Introduce the design challenge and materials available
2	90 minutes	Set up oil spill scenario Individual brainstorming (10 min) Share & redesign with group (15 min) Build design (10 min) Test initial designs (30 min) Cleanup (10 min)
3	60 minutes	Group brainstorming for redesign (10 min) Build Redesign (10 min) Test redesigns (30 min) Cleanup (10 min)
4	50 minutes	Cost Analysis
5	20 minutes	Post test

Materials & Equipment

Electronic white board & internet access

10 gallon glass aquarium

Vegetable oil (~ 30 ounces)

4 snack size Ziploc bags

4 drinking straws

Blue Food Coloring

Paper towels

Small rubber duck

Scissors

Duct tape

Liquid dish detergent

Clorox green works all-purpose cleaner (this cleaner is safer for students and will still cut through the oil)

Various building supplies: string, duct tape, mini pie tins, sponges, string, hair (dog fur works well), straws (various diameters), small rocks various sizes), small dishes/containers, corks, cotton balls, top portions of water bottles, etc.

Safety & Disposal

The oil makes everything slippery and can stain clothing. Urge students to wear old clothes or lab aprons on the testing and redesign phases. Students need to be careful not to make a mess. Provide students with a good grease cutting detergent to wash themselves and their supplies.

Use the Clorox green works all-purpose cleaner and paper towels to maintain a clean testing center.

Pre-Activity Discussion

Students should be familiar with oil as a form of energy that we consume to power our vehicles, manufacture goods, provide electricity, etc. Students should understand that crude oil has to be refined in various ways to meet our energy needs, for example, to refine oil into gasoline for our cars. Students should be familiar with other forms of energy including examples of renewable and nonrenewable energy.

Students should be familiar with the term technology and examples of technology.

An engineer or scientist from AFRL, Power and propulsion directorate can speak with students on alternative energy sources, including useage and benefits.

Teacher Instructions

Day 1:

Objective: Students will be able to describe the history of the situation in the gulf and the challenges that engineers and scientists face in solving it.

1. Administer written assessment, appendix A.
2. Lead a discussion on Oil and the Gulf Oil spill.

   Explore: http://www.eia.doe.gov/kids/energy.cfm?page=oil_home-basics with your students.

   Establish:

   - Oil is a nonrenewable resource.
   - We rely on oil for energy to fuel our cars, trucks, and planes as well as heat our homes and manufacture products such as plastics.

3. Explore the accompanying Power point presentation with your students.

   Establish:

   - The Gulf oil spill is polluting the Gulf ocean habitat and shorelines.
   - This emergency leak is not an easy problem to solve due to water depth and pressure of the gushing oil.
   - Engineers and Scientists have tried a variety of potential solutions that have all failed.

Teachers Note: An alternative is to have students conduct their own internet research with a partner and then share the collected information as a class. If you choose this option allow an extra class period for data sharing. Guide your students research by having them answer who, what, when, where, how much, what has been tried and why didn't it work, as well as how has technology helped and how has it hindered us?

4. Introduce the design challenge and materials available.

   Design Challenge: *Your team will design and test a device built to stop or contain the leaking oil. You will test your model design in an aquarium.*

   Constraint: You may not put your hands in the water. Remember, This oil leak is over 5,000 feet beneath the ocean surface.

Day 2: Setup aquarium in advance of lesson.

 A mechanical engineer from Wright Patterson AFRL can assist students in designing and testing their solution. The engineer can help implement the Engineering Design Process and or explore materials and design issues that arise.

Objective: Students will use their knowledge of the situation, oil, and materials to stop a simulated oil leak.

Scenario Setup:

**Do not fill the oil bag in advance of lab setup as it will start to permeate the plastic bag.*

Fill snack size Ziploc bag 80% full of the cooking oil, keeping the zipper portion oil free. Seal bag and use 6 inch strips of duct tape to secure the bag to the inside bottom of the aquarium. Optional: add tennis ball size rocks around the taped down Ziploc bag.

Carefully fill the aquarium with 6-8 gallons of room temperature water. Add blue food coloring to make the oil leak more visible.

To "drill" into the oil bag, load a standard drinking straw with a thin wooden skewer. Insert both into the water on top of the bag. Push gently, using the skewer to puncture the bag and insert the straw into the oil bag.

To simulate the underwater pipeline explosion, sever the straw an inch or two above the bag using scissors. You can have the students simulate the sound effects (explosion noises).

1. Post the Engineering Design Process (slide 13 of the power point)
2. Post the design challenge and display available materials.
3. Drill into the oil deposit. To "drill" into the oil bag, load a standard drinking straw with a thin wooden skewer. Insert both into the water on top of the bag. Push gently, using the skewer to puncture the bag and insert the straw into the oil bag.
4. Simulate oil explosion by cutting the straw an inch above the bag.
5. Allow students 10 minutes to draw out an individual design solution.
6. Allow students 15 minutes to share their designs with their engineering team (3-5 students) and create one group design. (This design must be drawn out and all parts must be labeled. It will be helpful to have student engineering groups chosen beforehand.)
7. Allow engineering teams to build their design.
8. Have engineering teams approach the aquarium one at a time to test their design while their peers watch. Encourage the team members to explain to the other engineering teams their design and how it is working while they are testing it. Elicit what problems they are encountering.

Teachers Note: Allow each team 5 minutes for testing. Explain that the seas are rough (possibly because of incoming hurricanes) and that there is only so much time to test implementation. As students test their designs, they may inadvertently disrupt the setup in the bottom of the aquarium, forcing later groups to adjust their design at the last moment. Explain that this is something that engineers have had to deal with in the Gulf. Do not try to reset the scenario for each group if something like this occurs.

9. As students clean up, elicit what students have learned about this challenging situation.
10. Explain that tomorrow students will have an opportunity to redesign their solution and test one last time. Note that the scenario will be set up the way it was at the beginning of the lesson rather than as it may have ended up after testing.

Day 3: Setup aquarium in advance of lesson.

A mechanical engineer from Wright Patterson AFRL can assist students in their redesign and testing. The engineer can help implement the Engineering Design Process and or explore materials and design issues that arise.

Objective: Students will use their collective knowledge gained as a class to create an improved design for stopping a simulated oil leak.

Scenario Setup:

**Do not fill the oil bag in advance of lab setup as it will start to permeate the plastic bag.*

Fill snack size Ziploc bag 80% full of the cooking oil, keeping the zipper portion oil free. Seal bag and use 6 inch strips of duct tape to secure the bag to the inside bottom of the aquarium. Optional: add tennis ball size rocks around the taped down Ziploc bag.

Carefully fill the aquarium with 6-8 gallons of room temperature water. Add blue food coloring to make the oil leak more visible.

To "drill" into the oil bag, load a standard drinking straw with a thin wooden skewer. Insert both into the water on top of the bag. Push gently, using the skewer to puncture the bag and insert the straw into the oil bag.

To simulate the underwater pipeline explosion, sever the straw an inch or two above the bag using scissors. You can have the students simulate the sound effects (explosion noises).

1. Post the Engineering Design Process (slide 13 of the power point)
2. Discuss what the engineering teams experienced yesterday.
3. Drill into the oil deposit. To "drill" into the oil bag, load a standard drinking straw with a thin wooden skewer. Insert both into the water on top of the bag. *Push gently, using the skewer to puncture the bag and insert the straw into the oil bag.*
4. Simulate oil explosion by cutting the straw an inch above the bag.
5. Have engineering teams return to their design plan and make needed changes. Allow 5-10 minutes.
6. Allow students 10-15 minutes to build their redesign.
7. Have engineering teams approach the aquarium one at a time to test their design while their peers watch. Encourage the team members to explain to the other engineering teams their design and how it is working while they are testing it. Elicit what problems they are encountering.

Teachers Note: Allow each team 5 minutes for testing. Explain that the seas are rough (possibly because of incoming hurricanes) and that there is only so much time to test implementation.

8. As students clean up themselves and supplies elicit, what students have learned about this challenging situation and how it applies to the real life scenario that has unfolded in the Gulf Ocean.

Day 4:

Objective: Students will use addition and multiplication to calculate the cost of their solution to the oil leak.

1. For 3rd Grade: provide each team member with a copy of Appendix B: How does it all add up.

   For 4th and 5th Grade: Have students use paper and their group redesign diagram to: Calculate how much money their model cost to build. Provide students with the cost of each material, using appendix B. Allow students to formulate their own plan for collecting data and displaying their used materials, costs, and total design cost. Have students staple their work to the group redesign sheet.

   Teachers Note: For 4th and 5th graders do not display appendix B, as students should create their own organization method to display data. If students are capable, provide dollar amounts with decimal places and cents to strengthen their mathematical skills.

2. Allow students time to complete calculations.
3. Discuss what each group project cost, as well as design effectiveness. Discuss how cost is important in engineering design since someone will have to pay for a design.

   Teachers Note: This discussion can include calculating costs of all of the student time spent on a project, an approximate hourly rate for a skilled engineer is $50/hour. Also, students could calculate the cost of all the materials consumed in the initial design.

4. Elicit what students have learned about oil, resources, oil spill, the engineering design process, and designing a solution to a problem. Elicit that it takes a variety of people and professions involved in engineering to find a solution (slides 3 and 12 of power point).

Day 5:

Objective: Students will demonstrate an increased awareness of the Gulf Oil spill, non-renewable resources, scientific professions, the engineering design process, effects of technology and oil.

1. Administer written assessment, appendix A.

Background Information

Petroleum or crude oil is a naturally occurring, toxic, flammable liquid consisting of a complex mixture of hydrocarbons and other organic compounds, that are found in geologic formations beneath the Earth's surface. Petroleum is recovered mostly through oil drilling. It is refined and separated, most easily by boiling point, into a large number of consumer products, from gasoline and kerosene to asphalt and chemical reagents used in plastics manufacturing.

Instructional tips

Do not fill the oil bag in advance of lab setup as it will start to permeate the plastic bag.

Be careful that students don't puncture the Ziploc bag while implementing their design solution.

Assignment of Student Roles and Responsibilities:

Students will all assume the same role: (example provided)

Role Name	*Brief Description*
Engineer	Responsible for creating an individual design, participating in the group design, build, test, and redesign and testing as well as the mathematical analysis of building costs.

Student Instructions

Use the teacher instructions to provide the appropriate amount of guidance for students.

Formative Assessments

Lab Inquiry Rubric

Category	**2**	**1**	**0**
Teamwork	Student actively interacts with group throughout the lab.	Student intermittently interacts with group throughout the lab.	Student does not interact with the group during the lab.
Communication of Scientific Inquiry	Student verbally shares personal explanations or critical thoughts during the testing and class discussion of the lab.	Student verbally participates but does not provide any original thoughts during the testing and class discussion of the lab.	Student does not verbally participate in testing and class discussion of the lab.
Building Phase	Student actively participates in the building phase. Examples include: materials collection, building, or verbal guidance during the build.	Student minimally participates (only once or twice) in the building phase. Examples include: materials collection, building, or verbal guidance during the build.	Student provides no assistance to the group in the building phase.
Testing Phase	Student actively participates in the testing phase either through physical assistance or verbal explanations to peers.	Student provides little group assistance in the testing phase either through physical assistance or verbal explanations to peers.	Student provides no group assistance in the testing phase either through physical assistance or verbal explanations to peers.
Redesign Phase	Student actively participates in the redesign phase. Examples include: drawing, materials	Student minimally participates (only once or twice) in the redesign phase. Examples include:	Student provides no assistance to the group in the redesign phase.

	collection, building, or verbal guidance during the build.	drawing, materials collection, building, or verbal guidance during the build.	
Redesign Testing Phase	Student actively participates in the testing phase either through physical assistance or verbal explanations to peers.	Student provides little group assistance in the testing phase either through physical assistance or verbal explanations to peers.	Student provides no group assistance in the testing phase either through physical assistance or verbal explanations to peers.

Post-Activity Discussion

Lead a class discussion on the topics below. If desired, save one of the topics for a journaling entry.

- Review what a renewable and non-renewable resource is.
- Elicit that oil is a non-renewable resource.
- Elicit that we use refined oil to fuel our cars and power our homes as well as make plastics.
- Elicit that our use of oil has consequences such as oil spills and pollution.
- Elicit the environmental effects of the Gulf Oil Spill as hazards to marine life and coast lines that will result in animal and plant death, as well as the economic effects on the region's tourism and fishing industries.
- Discuss how if we were less dependent on fossil fuel and relied more on "green energy sources" or renewable energy sources such as wind or solar power, it would be better for the environment because there is no hazardous material involved that could leak into the environment and there is no pollution generated.

Pre-Test / Post-Test

3rd-5th grade

Use of a student response system in conjunction with an Electronic White Board for pre and post-test assessment will allow for immediate data collection of students conceptual understanding and misconceptions.

Pre-Test / Post-Test Rubric

Question
1. What is oil? A. a natural resource B. a fuel C. a pollutant D. all of the above 2 points: Student chose answer D.

2. What does “non-renewable resource” mean? Provide an example.

3 points: Student explains that a nonrenewable resource is a natural resource which cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate.

Student provides an example such as petroleum or natural gas.

2 points: Student explains that a nonrenewable resource is a natural resource which cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate.

Student does not provide an example.

1 point: Student provides an incorrect or incomplete definition but does provide a correct example. Such as petroleum or natural gas.

3. Name 3 problems created by the Gulf Oil Spill.

3 points: Student provides three acceptable examples such as:
Dirty beaches, Dead/Sick animals, Dead plants, Pollution from burning the oil off, People died in the initial explosion, We can’t consume the oil e.g. its wasted, People can’t swim in the ocean, we can’t eat any contaminated ocean life, etc.

2 points: Student provides two acceptable examples such as any of the ones listed above.

1 point: Student provides an acceptable example such as any of the ones listed above.

4. How is oil in the ocean habitat harmful?

2 points: Student answers: that plants can grow in oily water, OR that animals can’t eat things covered in oil, OR that animals can see in the oil OR breathe in the oil.

1 point: Student states that oil is bad for the animals or plants but does not explain how.

5. How has technology been harmful in the Gulf Oil Spill?

2 points: Student provides an example of how technology has harmed the environment in this situation. Such as: drilling wouldn’t have occurred without drills, oil rigs or pipelines. OR if we didn’t have electricity or cars we wouldn’t need the oil.

1 point: Students states that technology caused the oil spill.

6. How has technology been helpful in the Gulf Oil Spill?

2 points: Student explains that technology is what is helping to clean up/ stop the spill. Student provides an example such as: containment booms, detergents to clean affected animals, safety materials/clothing, Top Kill, etc.

1 point: Student explains that technology is what is helping to clean up/ stop the spill.
7. Name 3 types of professionals that have been involved in the Gulf Oil Spill. 3 points: Student provides three types of professionals involved, such as: Biologists, Marine Biologists, Chemists, Engineers, Mechanical Engineers, Geological Engineers, Materials Engineers, Conservationists, Ecologists, Environmentalists, etc. 2 points: Student provides two types of professionals such as the ones mentioned above. 1 point: Student provides one type of professional such as the ones mentioned above.

Technology Connection

Use the **ADISC** Model created by ITEL to plan the use of technology.

Integration Model	***Application Description***
Technology that supports students and teachers in **adjusting, adapting, or augmenting** teaching and learning to meet the needs of individual learners or groups of learners	Electronic White Board Student Response System Power point
Technology that supports students and teachers in **dealing effectively with data**, including data management, manipulation, and display	Electronic White Board Internet Power point
Technology that supports students and teachers in conducting **inquiry**, including the effective use of Internet research methods	Electronic White Board Internet Power point
Technology that supports students and teachers in **simulating** real world phenomena including the modeling of physical, social, economic, and mathematical relationships	Electronic White Board Internet Power point
Technology that supports students and teachers in **communicating and collaborating** including the effective use of	Electronic White Board Internet

multimedia tools and online collaboration	Power point

Interdisciplinary Connection

Students can journal about their role throughout the engineering design process.

Students can read: Prince William by Gloria Rand, Illustrated by Ted Rand or Oil Spill! By Melvin Berger, Illustrated by Paul Mirocha.

Students can study the role of oil throughout history, its role in our culture or its geographic locations.

Home Connection

Students can research how dependent they are on oil by constructing a list of all the plastic they touch in one day or by researching the fuel efficiency of the family vehicles.

Differentiated Instruction

Product:
Have students research the Gulf Oil Spill independently and write a brief summary of their findings including: Who, what, when, where, how, and why

Have students write a summary of the Gulf Oil Spill using the Engineering Design Process to describe the situation. Have students include two different tests and their outcomes.

Content:
Have the students create a more detailed diagram of their redesign. Have students include measurements of the materials.

Read the stories provided in Interdisciplinary connection section to broaden students understanding of Oil spills.

Extension

Students can continue to use the Engineering Design Process in other classroom projects.

Students can journal their energy consumption, investigate renewable energy sources, or investigate how to conserve energy.

Students can start a fund raiser to help a nonprofit group that aids in animal rescue or conservation such as Pennies for the Planet. http://www.togethergreen.org/p4p/

Career Connection

AFRL Power and Propulsion has biologists, chemists, and engineers researching viable biofuels. If biofuel can be efficiently created by a pond of algae, the demand for petreoleum would decrease and we would no longer have to worry about oil leaks and spills since we would no longer be extracting it from the earth.

AFRL Power and Propulsion has scientists and engineers tasked with the maintenance of 36 underground storage tanks in which hazardous materials such as fuel is stored in. These

professionals must assess and maintain the equipment to ensure the structural integrity of the equipment. Also, these professionals have in place emergency plans and protocal to deal with leaks and other potential disasters.

Mechanical and materials engineers research, design, test and oversee manufacturing of are different materials and equipment such as pipeline, oil rigs, drills, oil absorptive materials, and even protective clothing.

Additional Resources

Resource:	***Purpose and Application:***
http://www.eia.doe.gov/kids/energy.cfm?page=oil_home-basics	U.S. Energy Information Administration website on oil.
http://www.bp.com/sectiongenericarticle.do?categoryId=9033572&contentId=7061710	BP videos regarding the Gulf Oil Spill
http://www.togethergreen.org/p4p/	Pennies for the Planet: An Audubon, nationwide campaign to help critical conservation projects. It's powered by kids collecting pennies (and nickels, dimes, quarters, and dollars, too!) to help save wild places and wildlife in the United States.
http://www.pbs.org/newshour/rundown/2010/05/how-much-oil-has-spilled-in-the-gulf-of-mexico.html	An online counter provided by PBS of how much oil is suspected to have leaked into the Gulf.
http://www.washingtonpost.com/wp-dyn/content/article/2010/05/26/AR2010052602509.html	Washington Post Article on Oil spill's animal victims struggle and experts roles and concerns

Credits

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Teacher Reflections

- Were students focused and on task throughout the lesson? *Insert answer here.*

- If not, what improvements could be made the next time this lesson is used? *Insert answer here.*
- Were the students led too much in the lesson or did they need more guidance? *Insert answer here.*
- Did the students learn what they were supposed to learn? *Insert answer here.*
- How do you know? *Insert answer here.*
- How did students demonstrate that they were actively learning? *Insert answer here.*
- Did you find it necessary to make any adjustments during the lesson? *Insert answer here.*
- What were they? *Insert answer here.*
- Did the materials that the students were using affect classroom behavior or management? *Insert answer here.*
- What were some of the problems students encountered when using the …? *Insert answer here.*
- Are there better items that can be used next time? *Insert answer here.*
- Which ones worked particularly well? *Insert answer here.*

Additional Comments

Appendix A: Oil, Oil, Everywhere Assessment

NAME _____

Directions: Answer the following questions.

1. What is oil?

   A. a natural resource

   B. a fuel

   C. a pollutant

   D. all of the above

2. What does nonrenewable resource mean? Provide an example.

3. Name 3 problems created by the Gulf Oil Spill.

   -
   -
   -

4. How is oil in the ocean habitat harmful?

5. How has technology been harmful in the Gulf Oil Spill?

6. How has technology been helpful in the Gulf Oil Spill?

7. Name 3 types of professionals that have been involved in the Gulf Oil Spill.

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Appendix B: How Does it all add up?

NAME _____

Directions: Use your group redesign diagram to determine how many of each item your group used to build your redesign. Then calculate the total cost of each type of item and your total redesign cost.

Item	*Number of Items*	*Cost per Item*	*Item Total*
String: 6 inches		$200	
Duct tape: 2 inches		$110	
Small Sponge		$75	
Hair		FREE	
Large Straw		$250	
Small Straw		$125	
Pebbles		$50	
Cork		$20	
Metal dish		$180	
Cotton Ball		$5	
Water Bottle top		$160	
		PROJECT COST	