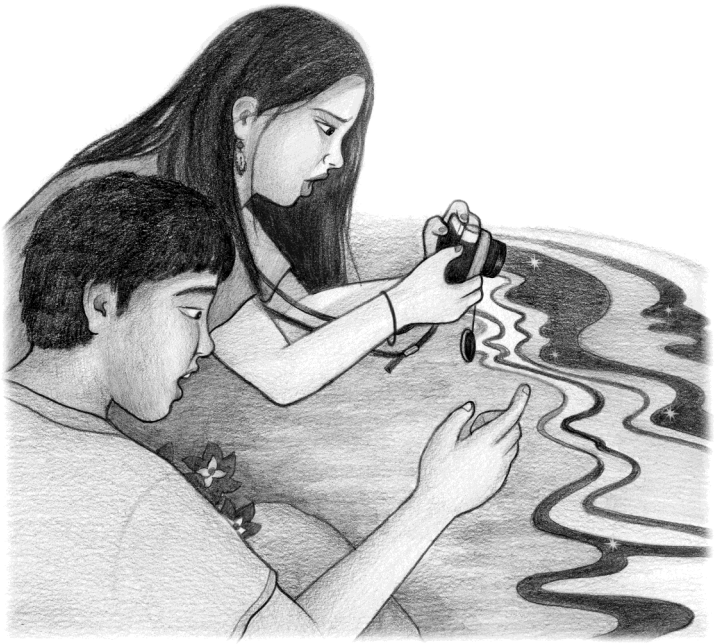
A Slick Solution: Cleaning an Oil Spill

Ecosystems and Environmental Engineering for Elementary Students



Unit Summary, Related Science, and Standards

Engineering is Elementary®

National Center for Technological Literacy®

Museum of Science, Boston

	Time to Complete	Lesson Summary: Students will…
Preparatory Lesson	**Preparation:** 5-10 minutes **Lesson:** 30-40 minutes	♦ examine everyday examples of technology. ♦ discuss how these objects were designed to solve problems. ♦ discuss the materials that objects are made of.
1 ***Tehya's Pollution Solution***	**Preparation:** 5-10 minutes **Lesson:** 90-120 minutes (2-3 sessions)	♦ read the story *Tehya's Pollution Solution.* ♦ discuss the field of environmental engineering. ♦ discuss some parts of an ecosystem. ♦ examine and discuss some connections between parts of an ecosystem. ♦ trace Tehya's use of the Engineering Design Process.
2 **An Enviro-Mystery**	**Preparation:** 45-50 minutes **Lesson:** 70-75 minutes	♦ learn about some of the problems plaguing the plants and animals of the fictional Greentown. ♦ test the pH of soil and water in certain areas of the town. ♦ compare current pH data from select sites with historical pH data to locate possible sources of pollution. ♦ view a demonstration of how water moves through soil and discuss connections between parts of the environment. ♦ present their findings concerning possible pollution sources to the mayor and citizens of Greentown.
3 **A Slick Idea**	**Part 1** **Preparation:** 20-25 minutes **Lesson:** 55-60 minutes **Part 2** **Preparation:** 35-40 minutes **Lesson:** 55-60 minutes	♦ create a model to represent the connections between the different components of a river ecosystem. ♦ brainstorm ways that the ecosystem might be affected by an oil spill and use the model they create to study how the ecosystem might be impacted. ♦ use a controlled experiment to examine different materials and methods used to clean oil spills and discuss the advantages and disadvantages of each.
4 **Cleaning an Oil Spill**	**Part 1** **Preparation:** 25-30 minutes **Lesson:** 50-55 minutes **Part 2** **Preparation:** 20-25 minutes **Lesson:** 55-60 minutes **Part 3** **Preparation:** 20-25 minutes **Lesson:** 55-60 minutes	♦ use the Engineering Design Process to design, implement, evaluate, and improve a process for cleaning an oil spill so that the oil has the least impact on the surrounding ecosystem. ♦ "Ask" questions about the problem, "Imagine" possible processes for cleaning the oil spill, "Plan," "Create," and test one oil spill cleaning process, and "Improve" their designs based on testing results.

Summarized Engineering Objectives: Students will be able to...	Assessment
♦ identify everyday objects made by people as technology. ♦ identify the problem(s) that a particular object solves. ♦ identify the materials used to make an object. ♦ identify that objects are designed as a solution to a problem. ♦ identify engineers as the people who design objects.	♦ Observe student contributions to class discussion. ♦ Examine student work.
♦ discuss the work of environmental engineers and their role in cleaning up pollution. ♦ describe some parts of an ecosystem. ♦ explain how one change in an ecosystem may be related to other changes. ♦ explain how the Engineering Design Process can be used to help solve problems.	♦ Observe student contributions to class discussion. ♦ Examine student work. ♦ *Tehya and the Engineering Design Process* {1-8} is a good source of information on student understanding. ♦ Use the *Lesson 1 Rubric* {1-10} to evaluate student performance.
♦ explain how changes in soil and water pH can affect the health of an ecosystem. ♦ compare historical soil and water data to current data to build a case for the sources of pollution in Greentown. ♦ discuss connectedness within an ecosystem, particularly the connections between soil and water and the spread of pollution. ♦ act as environmental engineers to present the findings of their pollution study to the town.	♦ Observe student contributions to class discussions. ♦ Examine student work. ♦ Use the *Lesson 2 Rubric* {2-14} to evaluate student performance. ♦ *Greentown Data: pH Testing* {2-10} is a good source of information about student understanding.
♦ use a model to identify and explain how different parts of a given ecosystem might be affected by an oil spill. ♦ explain how a model of connections between living and non-living things in an ecosystem is useful, but also limited in representing the possible effects of an oil spill. ♦ conduct controlled experiments to evaluate materials, methods, and tools available for containing and cleaning an oil spill. ♦ evaluate the different materials for use in containing an oil spill based on their observations and experimental results.	♦ Observe student contributions to class discussions. ♦ Examine student work. ♦ Use the *Lesson 3 Rubric* {3-18} to evaluate students' performances. ♦ *Testing Materials and Tools: Data Sheet* {3-16} is a good source of information on student understanding.
♦ identify and implement each step of the Engineering Design Process. ♦ utilize prior knowledge of how well various materials and tools work to contain or remove oil to inform their designs. ♦ evaluate their clean-up processes using established criteria and connect results to impacts on an ecosystem. ♦ "Improve" their clean-up process designs, taking into account evaluation of their prior designs.	♦ Observe student contributions to class discussions and his/her implementation of the Engineering Design Process. ♦ Examine students' oil spill cleaning process designs. ♦ Use the *Lesson 4 Rubric* {4-13} to evaluate student progress and performances. ♦ *Engineering Design Process* pages {4-3} to {4-7} are a good source of information about student understanding.

	Tie-In Science Content: Ecosystems
1 ***Tehya's Pollution Solution***	♦ An ecosystem is a community of organisms (including animals, plants, fungi, and bacteria) and the physical environment in which they live. ♦ The organisms in an ecosystem are dependent on one another, as well as on their physical environment, for survival.
2 **An Enviro-Mystery**	♦ All areas of the environment (air, water, and soil) are connected. ♦ An environment encompasses the land, air, and water in an area. ♦ An ecosystem is a community of organisms (including animals, plants, fungi, and bacteria) and the physical environment in which they live.
3 **A Slick Idea**	♦ An ecosystem is a community of organisms (including animals, plants, fungi, and bacteria) and the physical environment in which they live. ♦ In an ecosystem, there is a food web that consists of producers, consumers, and decomposers. ♦ All organisms need food/energy, water, air (and shelter) to survive. ♦ The organisms in an ecosystem are dependent on one another, as well as on their physical environment, for survival. ♦ The Sun is the ultimate source of energy for nearly all life on Earth.
4 **Cleaning an Oil Spill**	♦ An ecosystem is a community of organisms (including animals, plants, fungi, and bacteria) and the physical environment in which they live. ♦ In an ecosystem, there is a food web that consists of producers, consumers, and decomposers. ♦ All organisms need food/energy, water, air (and shelter) to survive.

	Tie-In Science: GEMS	Tie-In Science: FOSS
1 ***Tehya's Pollution Solution***	♦ Environmental Detectives Activities: ♦ 1: Introducing the Mystery ♦ 7: Oil and "Who Done It?" ♦ 8: Solving the Problems	♦ Environments Investigation 1: Terrestrial Environments ♦ Part 1: Setting Up Terrariums ♦ Part 2: Recording Changes
2 **An Enviro-Mystery**	♦ Environmental Detectives Activities: ♦ 1: Introducing the Mystery ♦ 2: Chlorine Tests ♦ 3: Acid Rain ♦ 7: Oil and "Who Done It?" ♦ 8: Solving the Problems	♦ Environments Investigation 3: Water Tolerance ♦ Part 2: Observing Plants at 5 and 8 Days ♦ Part 3: Observing Plants at 11 or More Days Investigation 4: Aquatic Environments ♦ Part 2: Acid in Water
3 **A Slick Idea**	♦ Terrarium Habitats Activities: ♦ 2: Building a Terrarium Habitat ♦ 3: Adding Earthworms to the Terrarium ♦ 5: Adding More to the Terrarium ♦ Environmental Detectives Activities: ♦ 7: Oil and "Who Done It?" ♦ 8: Solving the Problems	♦ Environments Investigation 1: Terrestrial Environments ♦ Part 1: Setting Up Terrariums ♦ Part 2: Recording Changes
4 **Cleaning an Oil Spill**	♦ Environmental Detectives Activities: ♦ 7: Oil and "Who Done It?" ♦ 8: Solving the Problems	♦ Environments Investigation 1: Terrestrial Environments ♦ Part 1: Setting Up Terrariums ♦ Part 2: Recording Changes

	Tie-In Science: STC	Tie-In Science: Insights
1 ***Tehya's Pollution Solution***	♦ Ecosystems Lessons: ♦ 1: Thinking about Ecosystems ♦ 8: Upsetting the Stability ♦ 12: Observing Early Effects of Pollution ♦ 15: Examining a Real Environmental Problem	♦ Habitats Learning Experiences: ♦ 1: A Question of Needs ♦ 4: Exploring Other Habitats ♦ 6: Minibeasts in the School Yard? Where? Why? ♦ 10: New Eyes on the Old Neighborhood
2 **An Enviro-Mystery**	♦ Ecosystems Lessons: ♦ 8: Upsetting the Stability ♦ 9: Reporting on Pollutants ♦ 10: Planning Pollution Experiments ♦ 11: Setting Up Our Pollution Experiments ♦ 12: Observing Early Effects of Pollution ♦ 13: Where do Pollutants Go? ♦ 14: Drawing Conclusions about Our Experiment	
3 **A Slick Idea**	♦ Ecosystems Lessons: ♦ 1: Thinking about Ecosystems ♦ 5: Observing the Completed Aquarium ♦ 7: Joining the Terrarium and Aquarium ♦ 8: Upsetting the Stability ♦ 9: Reporting on Pollutants ♦ 10: Planning Pollution Experiments ♦ 12: Observing Early Effects of Pollution	♦ Habitats Learning Experiences: ♦ 1: A Question of Needs ♦ 4: Exploring Other Habitats ♦ 6: Minibeasts in the School Yard? Where? Why? ♦ 7: Exploring Physical Factors ♦ 10: New Eyes on the Old Neighborhood
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Tie-In Science: Science Companion

- Habitats
  Lessons:
  - 2: Who Needs An Oak Tree?
  - 9: Habitat Talk, Habitat Walk: Plants
  - 10: What is a Biome?

- Watery Earth
  Lessons:
  - 5: Learning About Groundwater

- Habitats
  Lessons:
  - 1: What's My Habitat?
  - 2: Who Needs An Oak Tree?
  - 9: Habitat Talk, Habitat Walk: Plants
  - 10: What is a Biome?
- Nature's Recyclers
  Lessons:
  - 3: Nature's Cleanup Crew
  - 6: From Decomposers to Soil
  - 10: Agents and Evidence of Decomposition
  - 13: Producers, Consumers, and Decomposers
  - 14: The Nutrient Game
  - 15: Recycling Nutrients

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	ITEEA National Standards and Benchmarks
1 ***Tehya's Pollution Solution***	♦ **1B** All people use tools and techniques (technology) to help them do things. ♦ **4A** The use of tools and machines can be helpful or harmful. ♦ **4B** When using technology, results can be good or bad. ♦ **4C** The use of technology can have unintended consequences. ♦ **8A** Everyone can design solutions to a problem (brainstorming is important; everyone's ideas should be considered). ♦ **9A** The engineering design process includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others.
2 **An Enviro-mystery**	♦ **1B** All people use tools and techniques (technology) to help them do things. ♦ **2A** Some systems are found in nature, and some are made by humans. ♦ **4A** The use of tools and machines can be helpful or harmful. ♦ **4B** When using technology, results can be good or bad. ♦ **4C** The use of technology can have unintended consequences. ♦ **5B** Waste must be appropriately recycled or disposed of to prevent unnecessary harm to the environment. ♦ **5C** The use of technology affects the environment in good and bad ways. ♦ **9B** Expressing ideas to others verbally and through sketches and models is an important part of the design process. ♦ **10A** Asking questions and making observations helps a person to figure out how things (technologies) work.
3 **A Slick Idea**	♦ **1B** All people use tools and techniques (technology) to help them do things. ♦ **1D** Tools, materials, and skills are used to make things and carry out tasks. ♦ **2C** Tools are simple objects that help humans complete tasks. ♦ **2D** Different materials are used in making things. ♦ **2J** Materials have many different properties. ♦ **3A** The study of technology uses many of the same ideas and skills as other subjects. ♦ **4A** The use of tools and machines can be helpful or harmful. ♦ **4B** When using technology, results can be good or bad. ♦ **4C** The use of technology can have unintended consequences. ♦ **5C** The use of technology affects the environment in good and bad ways. ♦ **9E** Models are used to communicate and test design ideas and processes. ♦ **10E** The process of experimentation, which is common in science, can also be used to solve technological problems.
4 **Cleaning an Oil Spill**	♦ **2C** Tools are simple objects that help humans complete tasks. ♦ **2D** Different materials are used in making things. ♦ **2E** People plan in order to get things done. ♦ **8A** Everyone can design solutions to a problem (brainstorming is important; everyone's ideas should be considered). ♦ **8C** The design process is a purposeful method of planning practical solutions to problems. ♦ **8D** Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design. ♦ **9B** Expressing ideas to others verbally and through sketches and models is an important part of the design process. ♦ **9C** The engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results. ♦ **9D** When designing an object it is important to be creative and consider all ideas. ♦ **11E** The process of designing involves presenting some possible solutions in visual form and then selecting the best solution(s) from many. ♦ **11F** Test and evaluate the solutions for the design problem. ♦ **11G** Improve the design solutions.