
Water, Water Everywhere: Designing Water Filters

Water 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: 10-15 minutes Lesson: 30-40 minutes	<ul style="list-style-type: none"> ◆ examine everyday examples of technology. ◆ discuss how these objects were designed to solve problems. ◆ discuss the materials that objects are made of.
1 <i>Saving Salila's Turtle</i>	Preparation: 10-15 minutes Lesson: 90-120 minutes (2-3 sessions)	<ul style="list-style-type: none"> ◆ read the story <i>Saving Salila's Turtle</i>. ◆ be introduced to environmental engineering and the idea that engineers design solutions to problems. ◆ identify some sources of pollution and possible solutions. ◆ trace Salila's use of the Engineering Design Process.
2 Who are Environmental Engineers?	Preparation: 5-10 minutes Lesson: 40-50 minutes	<ul style="list-style-type: none"> ◆ identify some common uses of air, water, and soil in a mural of a community. ◆ identify sources of air, water, and soil contamination in a mural of a community and explain why the contaminants are a problem. ◆ brainstorm ways in which one environmental contamination problem might be addressed through engineering.
3 Exploring Filter Materials	Preparation: 20-30 minutes Lesson: 50-60 minutes	<ul style="list-style-type: none"> ◆ learn about and discuss the properties of different materials used for filtering water. ◆ predict which filter materials will work well or will not work well. ◆ conduct a controlled experiment to compare various filter materials' effects on different kinds of non-toxic contaminated water.
4 Designing a Water Filter	Part 1 Preparation: 10-15 minutes Lesson: 50-60 minutes Part 2 Preparation: 20-30 minutes Lesson: 50-60 minutes	<ul style="list-style-type: none"> ◆ use the steps of the Engineering Design Process to design a water filter to clean non-toxic contaminated water. ◆ "Ask" about the problem, "Imagine" different solutions, "Plan," "Create," and test their water filter designs, and "Improve" their designs based on test results.

<p align="center">Summarized Engineering Objectives: Students will be able to...</p>	<p align="center">Assessment</p>
<ul style="list-style-type: none"> ◆ 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. 	<ul style="list-style-type: none"> ◆ Observe student contributions to class discussion. ◆ Examine student work.
<ul style="list-style-type: none"> ◆ define engineer. ◆ identify possible sources of pollution. ◆ discuss some of the problems and engineering solutions associated with improving water quality. ◆ recognize the role of environmental engineers in helping to address problems of air, water, and soil contamination. ◆ identify the steps of the Engineering Design Process. 	<ul style="list-style-type: none"> ◆ Observe student contributions to class discussions. ◆ Examine student work. ◆ Use <i>Lesson 1 Rubric</i> {1-7} to evaluate student performance.
<ul style="list-style-type: none"> ◆ identify multiple human uses for air, water, and soil. ◆ identify multiple ways that air, water, and soil become contaminated. ◆ discuss some problems and engineering solutions associated with air, water, and soil contamination. ◆ recognize the role of environmental engineers in helping to address the problems of air, water, and soil contamination. 	<ul style="list-style-type: none"> ◆ Observe student contributions to class discussions. ◆ Examine student work. ◆ Use <i>Lesson 2 Rubric</i> {2-7} to evaluate student progress and performance.
<ul style="list-style-type: none"> ◆ make predictions about the efficacy of different filter materials based on their properties. ◆ conduct a controlled experiment. ◆ observe, analyze, and compare the performance of filter materials when used to filter contaminated water. ◆ decide which materials and/or combination of materials will be good choices for use in a water filter design. 	<ul style="list-style-type: none"> ◆ Observe student contributions to class discussions. ◆ Examine student work. ◆ Use <i>Lesson 3 Rubric</i> {3-8} to evaluate student progress and performance. ◆ <i>Be an Environmental Engineer!</i> {3-1} and <i>Choosing Materials for a Filter</i> {3-6} are good sources of information on student understanding.
<ul style="list-style-type: none"> ◆ identify and implement the steps of the Engineering Design Process. ◆ use prior analyses of filter materials to inform their water filter designs. ◆ “Imagine” ideas for making a water filter, and choose one idea to build and test. ◆ make a detailed “Plan” of their water filter design that includes a materials list, a labeled diagram, and calculated cost. ◆ “Create” their water filters and observe the results of testing. ◆ test and analyze a water filter design for strengths and weaknesses. ◆ “Improve” their designs based on earlier analyses. 	<ul style="list-style-type: none"> ◆ Observe student contributions to both class discussions and the implementation of the Engineering Design Process in their groups. ◆ Examine students’ water filter designs. ◆ Use <i>Lesson 4 Rubric</i> {4-14} to evaluate student progress and performance.

	Tie-In Science Content: Water
<p>1 <i>Saving Salila's Turtle</i></p>	<ul style="list-style-type: none"> ◆ During the water cycle, water moves through air and land. ◆ Water can exist in solid, liquid, and vapor forms. ◆ Water can freeze, melt, evaporate, and condense. ◆ Water can be found in many different places.
<p>2 Who are Environmental Engineers?</p>	<ul style="list-style-type: none"> ◆ Contaminants are present in the environment. ◆ Some contaminants are natural and others are artificial (human-introduced). ◆ Water can contain various contaminants that affect its quality. ◆ Water from different places can contain different contaminants. ◆ Contaminants can affect the way that water looks, smells, and tastes.
<p>3 Exploring Filter Materials</p>	<ul style="list-style-type: none"> ◆ Water flows more quickly and readily through some materials than it does through others. ◆ The scientific method often includes observing, predicting, and testing.
<p>4 Designing a Water Filter</p>	<ul style="list-style-type: none"> ◆ Water flows more quickly and readily through some materials than it does through others.

Tie-In Science: GEMS	Tie-In Science: FOSS
<ul style="list-style-type: none"> ◆ Liquid Explorations Activities: <ul style="list-style-type: none"> ◆ 1: Liquid Classification ◆ 2: Swirling Colors ◆ 3: Raindrops and Oil Drops ◆ Acid Rain Sessions: <ul style="list-style-type: none"> ◆ 1: Pick Your Brain about Acid Rain ◆ River Cutters Sessions: ◆ 1: Exploring a Model River 	<ul style="list-style-type: none"> ◆ Water Investigation 1: Water Observations <ul style="list-style-type: none"> ◆ Part 1: Looking at Water ◆ Part 2: Water on a Slope Investigation 3: Water Vapor <ul style="list-style-type: none"> ◆ Part 1: Evaporation ◆ Part 4: Condensation
<ul style="list-style-type: none"> ◆ Involving Dissolving Activities: <ul style="list-style-type: none"> ◆ 3: Starry Night ◆ 4: Disappearing Eggshells ◆ Acid Rain Sessions <ul style="list-style-type: none"> ◆ 2: Introduction to Acidity and pH ◆ 3: Startling Statements about Acid Rain ◆ 4: Fake Lakes ◆ 5: Welcome to Laketown! ◆ 6: The Salamanders Have Their Say ◆ 7: Town Meeting ◆ 8: “Everything You’ve Always Wanted to Know About Acid Rain” ◆ River Cutters Sessions: <ul style="list-style-type: none"> ◆ 4: Dams and Toxic Waste 	<ul style="list-style-type: none"> ◆ Water Investigation 4: Waterworks <ul style="list-style-type: none"> ◆ Part 3: Water from Home
	<ul style="list-style-type: none"> ◆ Water Investigation 4: Waterworks <ul style="list-style-type: none"> ◆ Part 1: Water in Earth Materials

	Tie-In Science: STC	Tie-In Science: Insights
1 Saving Salila's Turtle	<ul style="list-style-type: none"> ◆ Land and Water Lessons: <ul style="list-style-type: none"> ◆ 1: The Water Cycle: Modeling Land & Water ◆ 6: Where Does the Water Go? Looking at Ground Water & Runoff ◆ 11: Hills & Rocks: How Nature Changes the Direction & Flow of Water 	<ul style="list-style-type: none"> ◆ Liquids Learning Experiences: <ul style="list-style-type: none"> ◆ 1: Liquids Around Us ◆ 2: Find Out What You Can ◆ 3: What Do We Know? ◆ 4: How are Liquids Different?
2 Who are Environmental Engineers?		<ul style="list-style-type: none"> ◆ There Is No Away Learning Experiences: <ul style="list-style-type: none"> ◆ 1: Setting the Stage ◆ 2: Manufactured and Natural Waste ◆ 3: Sources of Waste ◆ 5: Rain on the Landfill ◆ 6: Understanding the Land in the Landfill ◆ 7: Keeping the Water from Escaping ◆ 8: The Great Cleanup ◆ 9: What Happened? ◆ 10: Concluding the "Away" Experiments ◆ 16: Industrial Waste is Our Waste Too
3 Exploring Filter Materials	<ul style="list-style-type: none"> ◆ Land and Water Lessons: <ul style="list-style-type: none"> ◆ 5: Examining Earth Materials 	
4 Designing a Water Filter		

Tie-In Science: Science Companion

◆ Watery Earth

Lessons:

- ◆ 1: The Wonder of Water
- ◆ 3: Following a Drop of Rain
- ◆ 6: Learning About Frozen Water
- ◆ 7: Learning About Water in the Air
- ◆ 8: Modeling the Water Cycle
- ◆ SBA: Using Models in Science

◆ Watery Earth

Lessons:

- ◆ 1: The Wonder of Water
- ◆ 2: Exploring Who Uses Water
- ◆ 12: Walk the Talk—Looking for Pollution
- ◆ 14: Water Resources Case Studies
- ◆ 15: Protecting Water Resources Project

◆ Watery Earth

Lessons:

- ◆ 13: Investigating a Way to Clean Water
- ◆ 14: Water Resources Case Studies

◆ Watery Earth

Lessons:

- ◆ 13: Investigating a Way to Clean Water
- ◆ 14: Water Resources Case Studies

	ITEEA National Standards and Benchmarks
<p style="font-size: 2em; font-weight: bold;">1</p> <p style="text-align: center;">Saving Salila's Turtle</p>	<ul style="list-style-type: none"> ◆ 1D Tools, materials, and skills are used to make things and carry out tasks. ◆ 6A Products are made to meet individual needs and wants. ◆ 6C Individual, family, community, and economic concerns may expand or limit the development of technologies. ◆ 9A The engineering design process includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others.
<p style="font-size: 2em; font-weight: bold;">2</p> <p style="text-align: center;">Who are Environmental Engineers?</p>	<ul style="list-style-type: none"> ◆ 1A The natural world and human-made world are different. ◆ 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.
<p style="font-size: 2em; font-weight: bold;">3</p> <p style="text-align: center;">Exploring Filter Materials</p>	<ul style="list-style-type: none"> ◆ 2D Different materials are used in making things. ◆ 3A The study of technology uses many of the same ideas and skills as other subjects. ◆ 10A Asking questions and making observations helps a person to figure out how things work. ◆ 10E The process of experimentation, which is common in science, can also be used to solve technological problems.
<p style="font-size: 2em; font-weight: bold;">4</p> <p style="text-align: center;">Designing a Water Filter</p>	<ul style="list-style-type: none"> ◆ 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. ◆ 8B Design is a creative process. ◆ 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 and testing it, making the item, evaluating it, and presenting the results. ◆ 9D When designing an object it is important to be creative and consider all ideas. ◆ 11B Build or construct an object using the design process. ◆ 11F Test and evaluate the solutions for the design problem. ◆ 11G Improve the design solutions.