

Water Heroes Program

Lesson 2: Engineering solutions for water filtration

Grade level	3-6
Time required	45 minutes (10-15 minutes for PowerPoint # 2 with activities interspersed throughout). Can be modified to fit a 90 minute block of time.
Subject areas	Science and Engineering
Overarching question(s)	<ol style="list-style-type: none"> 1. What causes water pollution? 2. How do scientists test water to ensure that it is safe for human use? 3. How does water filtration work in the natural environment?
Purpose	To introduce students to real-world applications for testing and filtering polluted water..
Lesson objectives	<p>After this lesson, students should be able to:</p> <p><u>Application</u></p> <ul style="list-style-type: none"> ● Identify contaminants that could pollute a water source. ● Build water filters using design constraints.
Worksheets and Attachments	<p><u>Attachments</u></p> <ul style="list-style-type: none"> ● PowerPoint #2 Script ● Activity Sheet #2
Lesson background for instructors	<p>This lesson was adapted and modified from the Straining out the dirt lesson plan: (https://www.teachengineering.org/activities/view/cub_enveng_lesson_06_activity1)</p> <p>“Environmental and civil engineers design systems to process communities' water supplies to make them clean enough for people to drink. Depending on the starting water quality, most municipal water treatment systems involve many steps to eliminate the contaminants that could make people sick. Often, the treatment process includes the use of filters of sand and activated carbon to remove particulate matter and certain bacteria just before the water is disinfected with chlorine.”</p> <p>Guiding questions:</p> <ul style="list-style-type: none"> ● Are there any concerns with drinking unclean water? ● Can you conduct your normal activities with unclean water?
Vocabulary	<p>PowerPoint: Presentation</p> <p><i>Pollution:</i> The presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects.</p> <p><i>Sediment:</i> Matter that settles to the bottom of a liquid; dirt.</p> <p><i>Water quality:</i> Describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect</p>

	to its suitability for a particular purpose such as drinking or swimming.
Materials and supplies	<p>The following supplies will be needed to complete Lesson 2 and are found in Kit #2:</p> <ul style="list-style-type: none"> ● Plastic cups ● Toothpicks ● Plastic measuring spoons ● Aquarium sand ● Gravel ● Filter paper ● Cheese cloth ● Cotton balls ● Coffee filter ● Dirt (Inside Ziplock bag) ● Wooden balls (Inside Ziplock bag)
Lesson activities	<p>Activity time: 10-15 minutes (PowerPoint #2)</p> <ul style="list-style-type: none"> ● PowerPoint Presentation #2 - Use script associated with PowerPoint #2 to guide the presentation <p>Water filtration: 25-35 minutes</p> <p><i>Pre-activity Preparation: 5-10 minutes</i></p> <p>Take the contents from Kit #2 and set those aside on a separate station which can be identified as the shop. The filter components which include the aquarium sand, gravel, filter paper, cheese cloth, cotton balls, and coffee filters should be separate. One plastic cup (one without the pre-drilled holes) will also be needed and this will be where students will deposit their currency to pay for items. You can also assemble the basic filter units and set these aside at the “shop”. To assemble the units, place four toothpicks, one into each of the pre-drilled holes in the plastic cups; this will help to keep the cup suspended above a second cup (without holes) which will act as the catchment.</p> <p>For this activity, students will use Activity Sheet #2 to document their findings. Students will need to be broken into groups. Inside Kit #2, you should find plastic cups with four pre-drilled holes where toothpicks can be inserted into. These toothpicks will help to keep the cup hoisted above a second cup; this is the basic set-up for the water filtration unit that each student group will receive one of. Divide the wooden balls evenly amongst the groups; these represent a form of currency that students will use later on to purchase the components to complete their filters. Collectively, students should decide which filter components they would like to purchase; there are six (6) components</p>

	<p>but the price for each should be set so that students cannot purchase all components (i.e. depending on how many groups there are, set the price for each component at \$2 and each ball represents \$1). Once students have identified which components they want to use, they can approach your table set-up and buy their supplies, placing their money in a plastic cup. You can use the plastic spoons to measure out the sand and gravel that each group receives. Students will return to their groups and assemble their water filters using their purchased components by layering their supplies. Once their filters are built, you can pour some of the dirty water mix into their filters (don't add too much water to inundate the filter; add water gradually). Students should be completing Activity Sheet #2 while they are conducting this activity. If time permits, students can be given back their currency, and purchase a new set of supplies to alter their design of the filter to see if different components are able to filter the dirt out of the water better.</p>
<p>Post-activity assessment</p>	<p>If time permits, students can engage in a short discussion to recap any of the activities that were facilitated. The following are a series of questions that can be posed to students to gauge their retention of knowledge from the PowerPoint as well as to steer a discussion.</p> <ol style="list-style-type: none"> 1. Which components filtered the dirt out of the water better? 2. Is this water safe to drink? Why not? (<i>Could still have bacteria and other pollutants present</i>)
<p>Online resources</p>	<ul style="list-style-type: none"> ● NASA - Show me the water https://www.youtube.com/watch?v=4HSFKwho7MQ ● The Nature Conservancy - How nature filters water https://www.youtube.com/watch?v=7fqEuKXanBg ● Water education resources: https://www.usgs.gov/mission-areas/water-resources/education
<p>References</p>	<p>Lessons for the Water Heroes Program were modified and adapted from www.teachengineering.org. Specific lessons that were utilized include: You are what you drink: https://www.teachengineering.org/lessons/view/cub_enveng_lesson06 How clean is that water: https://www.teachengineering.org/lessons/view/cub_enveng_lesson02</p>