

Water Heroes Program

Lesson 1: Water as an important natural resource

Grade level	3-6
Time required	45 minutes (35-40 minutes for PowerPoint # 1 with activities interspersed throughout). Can be modified to fit a 90 minute block of time.
Subject areas	Science and Math
Overarching question(s)	<ol style="list-style-type: none"> 1. Where does most of our water come from? 2. Why do we need reliable, safe water? 3. How do we ensure that water is safe for drinking?
Purpose	To provide students with a better understanding of where their drinking water comes from and issues concerning water sustainability.
Lesson objectives	<p>After this lesson, students should be able to:</p> <p><u>Conceptualize</u></p> <ul style="list-style-type: none"> ● Identify common uses of water in their daily lives. ● Quantify their daily usage of water. ● Identify where water is most abundant on Earth. ● Identify common parameters tested for with drinking water.
Worksheets and Attachments	<p><u>Pre-lesson Preparation</u></p> <ul style="list-style-type: none"> ● Students should be provided with a centrifuge tube before the start of the lesson and instructed to fill it with water from their sink at home. These water samples will be tested during the classroom presentation. <p><u>Attachments</u></p> <ul style="list-style-type: none"> ● PowerPoint #1 Script ● Activity Sheet #1
Lesson background for instructors	<p>There are two main sources of water on planet Earth that this lesson will focus on and these include surface water (water currently on land in the form of rivers, lakes, and streams) and groundwater (water that is present beneath Earth's surface). Both sources of water can be utilized by humans to meet our everyday needs; however, groundwater is often cheaper, more convenient and less vulnerable to pollution than surface water. In the U.S. Virgin Islands, households are supplied with water either through the Virgin Islands Water and Power Authority (WAPA), tap into a well (groundwater) or through collected and stored rainwater held in cisterns.</p> <p>The U.S. Geological Survey (USGS) estimates that the average person in the United States uses about 80 to 100 gallons of water per day, most of that comes from flushing the toilet. Locations that have a large population size have a huge demand for safe water for everyday usage. The Virgin Islands has a population size of a little over 100,000;</p>

however, we do experience seasonal droughts as well as have negative impacts from groundwater pollution which does present some issues with safe, potable water. Groundwater pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems. In the Virgin Islands, there are numerous watersheds, especially where land-based development has occurred that can contribute to contamination of ground water sources. As cisterns collect rain water from gutter systems on residential roofs, contamination can come from foliage, sediment, fecal contamination from animals, etc.

Water is tested for a variety of different parameters and in most scenarios, the source and final use of the water dictate what parameters are tested. For drinking water purposes, here are some of the parameters that are tested for:

Heavy metals

- Copper: Plumbing systems (pipes) long ago were made from copper.
- Lead: Plumbing systems (pipes) long ago were made from lead; however, due to regulations, lead is no longer used for plumbing. Some lead pipes for plumbing still do remain in the United States.

Other elements

- Nitrates: Nitrates can be derived from fertilizers, agricultural practices (farming and livestock). Although nitrogen is important in protein formation; however, nitrates are transformed into nitrites in the digestive system and can negatively interfere with oxygen-carrying hemoglobin in the body.
- Fluorides: Fluorides are naturally found in the Earth's crust in very minute quantities but are also added to city water supplies to prevent tooth decay. Exposure to large quantities of fluorides like most other elements can be detrimental to human health.
- Chlorine: Chlorine is often added to water to disinfect it, essentially to inactivate bacteria and viruses that cause diarrheal disease. Chlorine in large amounts can be lethal.

Other parameters

	<ul style="list-style-type: none"> ● pH: This is a measure of how acidic or basic the water is. The range goes from 0-14 with a value of 7 being neutral, pHs less than 7 indicate acidity, and pHs greater than 7 indicates a base. The pH of water is a very important measure concerning water quality. ● Bacteria: Bacteria such as E. coli can cause illnesses if ingested. These bacteria are normally found in the guts of humans and animals and can be found in fecal samples.
Vocabulary	<p>PowerPoint: Presentation (* From Videos)</p> <p><i>*Groundwater:</i> Water held underground in the soil or in pores and crevices in rock.</p> <p><i>Natural resource:</i> A material or substance such as minerals, forests, water, and fertile land that occur in nature and can be used by humans.</p> <p><i>pH:</i> A measure of how basic or or acidic a liquid or substance is.</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>*Rain garden:</i> A garden of native shrubs, perennials, and flowers planted in a small depression, which is generally formed on a natural slope. It is designed to temporarily hold and soak in rain water runoff that flows from roofs, driveways, patios or lawns.</p> <p><i>Water quality:</i> Describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose such as drinking or swimming.</p> <p><i>*Watershed:</i> An area of land that feeds all the water running under it and draining off of it into a body of water.</p>
Materials and supplies	<p>The following supplies will be needed to complete Lesson 1: <u><i>Pre-activity (These items should be given to students at least 1 day before the lesson)</i></u></p> <ul style="list-style-type: none"> ● Centrifuge tube (1 for each student) <p><u><i>Activities built in to PowerPoint presentation #1 (Supplies in Kit #1).</i></u> <u><i>Items marked with * are not in the kit.</i></u></p> <ul style="list-style-type: none"> ● *Gallon water jug (Slide # 6) ● *Calculator ● Milk of magnesia ● White vinegar ● Water ● Plastic cups ● pH testing strips ● Centrifuge tubes
Lesson activities	<p>Activity time: 25-30 minutes (PowerPoint #1)</p> <ul style="list-style-type: none"> ● PowerPoint Presentation #1 - Use script associated with PowerPoint #1 to guide the presentation

	<p>Water usage survey: 10-15 minutes</p> <p>For this activity, students will use Activity Sheet #1 to calculate how much water they use at home and at school. Instructions are provided on the sheet and guidance may be needed to assist students with calculations.</p> <p>Demonstration: 10-15 minutes</p> <p>For this demonstration, the instructor will test the pH of the following liquids/solutions:</p> <ul style="list-style-type: none"> ● Water (Neutral pH of 7, Green color) ● Vinegar (Acidic, pH of 3-4 Red color) ● Milk of Magnesia (Basic, pH of 10-12, Blue color) <p>To do this, take three of the pH testing strips and insert one strip into each of the centrifuge tubes containing each liquid. Present your findings to the class. Each student will take their water sample from home and test the pH using the litmus paper. Students should record their findings on the Activity Sheet #1. After all students have tested their water samples from home, engage students by asking for a few students to share with the class what their values were and whether their water was neutral, acidic, or basic.</p> <p>For practice, you can also have students test the pH of water from the school.</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. What are the two main sources of water that are found on planet Earth? 2. What are some sources that could contaminate water? 3. What are some of the parameters that are tested for in drinking water?
<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>Lesson extensions</p>	<p>You can use these following activities to further engage your students with this topic:</p> <ul style="list-style-type: none"> ● Building your own watershed: https://www.youtube.com/watch?v=6fIvUaiyk0w

References	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
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