



Middle School Green Career Awareness Modules

Clean Water ▾

Segment	Impacting our Water Supply
Lesson # and Title	Lesson Ten ▾ Water Treatment
Duration	90 minutes

Lesson Overview

During the previous lesson, students learned about water pollution, water quality, and water testing. In this lesson, students will learn about how wastewater is treated, both on earth and in space, and then are challenged to design a water filtration using the engineering design process used by scientists and engineers to develop the water recovery system used on the International Space Station.

The design challenge in this lesson was adapted from NASA's Jet Propulsion Lab's "Water Filtration Challenge":
<https://www.jpl.nasa.gov/edu/teach/activity/water-filtration-challenge/>

Learning Objectives

By the end of this lesson, students will be able to:

1. Describe the purpose of treating wastewater and, generally, how a wastewater treatment plant functions.
2. Create a water filtration system using household materials.
3. Describe why it is important to conserve our freshwater supply.

Content Standard(s)

NGSS ▾ MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

NGSS ▾ MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

NGSS ▾ MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

NGSS ▾ MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

NGSS ▾ MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Equipment, Instructional Resources, and Materials

1. Water Filtration Challenge Website: <https://www.jpl.nasa.gov/edu/teach/activity/water-filtration-challenge/>
 - a. All materials for the design challenge are found on the website.
2. Directions to build a conductivity tester: <https://www.jpl.nasa.gov/edu/pdfs/conductivitytester.pdf>

Key Vocabulary and Terms

1. Wastewater
2. Water treatment
3. Conductivity

Teacher Preparation

- Begin collecting empty, matching 0.5 L bottles weeks or months in advance of this activity to save the cost of purchasing bottles.
- Build (or have students build) and validate conductivity testers (if using) prior to engaging in this activity. [Download Conductivity Tester Plan \(PDF\)](#).
- Be sure to use clean aquarium gravel and play sand (not yard gravel or beach sand, as these may add to the pollutants in the water).
- Be sure to rinse and thoroughly dry activate carbon (if using). Un-rinsed carbon will turn the water black.
- Consider assigning roles to team members, such as materials manager, science recorder, engineering recorder and engineering builder.

- Note: Water filtered in this experiment SHOULD NOT be consumed by humans.
- This Activity can be guided by competition between the student teams. Be the judge for a qualitative assessment of the filtered water: hold a piece of white paper in back of the filtered water and examine for particulate matter and color. The winning team has the clearest water bottle.

Lesson Procedure

Slide Deck:  **Clean Water Lesson 10: Water Treatment**

Segment Title	Activity/Task, Student Grouping, Special Accommodation, Related Career(s), and Assessment	Time
Wastewater Introduction	Activity/Task: 1. Ask students and discuss, “Which types of activities in your home result in water going down the drain after use?” 2. Ask students and discuss, “What do you think happens to this wastewater after it goes down the drain?” a. Remind students about the water cycle and that humans can impact and influence the water cycle at any point within the process. 3. Ask students and discuss, “How do we treat wastewater?” 4. Play video: “Wastewater treatment plant - virtual tour” (06:15) and then have students discuss what they learned 5. Play video: “Water Recycling on the International Space Station” (01:53) and then have students discuss what they learned. Student Grouping: Whole Group ▾	20 min
Water Recovery System Design Challenge	For this design challenge, students will be following the procedures found on the NASA's Jet Propulsion Lab's “Water Filtration Challenge” website: https://www.jpl.nasa.gov/edu/teach/activity/water-filtration-challenge/ *** Teachers can find all information about the design challenge materials and procedure on the website. To test the water quality, students can use the same water testing kit that they used	70 min

	during the previous lesson. They can also construct the conductivity tester, which would require an extra ½ hour - or - purchase a conductivity tester. Student Grouping: Small Group ▾ Related College Major and Career(s): Wastewater Treatment Plant Operator, Environmental Engineer, Water Quality Analyst, Industrial Waste Treatment Specialist, Environmental Health and Safety Specialist	
Home/Extension Activity	Water Audit: Conduct a simple water audit at home. Walk around your house and identify areas where water might be wasted. Make a list of potential water-saving measures you can implement in your daily routine.	15 min