

Hands-on Activity: Water Filtration

Contributed by: Center for Engineering Educational Outreach, Tufts University

Quick Look

Grade Level:	4 (3-5)
Time Required:	60 minutes
Expendable Cost/Grp :	US \$2.50 This activity also requires some non-expendable items; see the Materials List for details.
Group Size:	3
Activity Dependency :	None
Subject Areas:	Number and Operations Science and Technology



Students create water filters

Summary

Students are asked to design methods to filter water using ordinary materials, while also considering their designs' material and cost efficiencies. They learn about the importance of water and its role in our everyday lives. They come to understand what must occur each day so that they can have clean water.

This engineering curriculum meets Next Generation Science Standards (NGSS).

Engineering Connection

Clean water is not available in all parts of the world. Many people live with polluted water that is unhealthy to drink and bathe in. Civil, environmental, materials and mechanical engineers all contribute to developing technologies and systems to purify unclean water. Purifying water can be done easily if it is a small amount that is fairly clean, but larger amounts that are very polluted are much more complicated. Typical steps for full water treatment include aeration, coagulation, sedimentation, filtration and disinfection

Learning Objectives

- Understanding of how filtration works.
- Creative design methods.
- Problem solving.
- Mathematics (multiplication) reinforcement.
- Teamwork to solve a challenge.

Educational Standards

- › NGSS: Next Generation Science Standards - Science
- › Common Core State Standards - Math
- › International Technology and Engineering Educators Association - Technology
- › Massachusetts - Math
- › Massachusetts - Science

Suggest an alignment not listed above

Materials List

- 1 liter of water prepared in advance with soil and sand in it until it is thin but relatively opaque
- 3 test tubes prepared with the water standards "A," "B" and "C" (C is filtered through some grass, B is filtered through a coffee filter, and A is filtered through 2 coffee filters with a paper towel in the middle)
- cotton balls
- gauze squares
- tulle/netting
- tissue
- paper towels
- coffee filters
- gravel (aquarium gravel works great)
- sand
- 3 test tubes per student
- test tube racks
- graduated cylinders
- Design Components Worksheet

Introduction/Motivation

One of our most valuable and often overlooked resources is water. We can survive for a few weeks without food, but only a few days without water. Having clean water to drink is a luxury. The water that eventually comes out of our faucets sometimes does not start off being safe to drink. In most cases, it has gone through a water treatment plant designed by engineers prior to reaching our faucets.

Procedure

Background

This is a great activity for students to experience some "real-life" engineering.

Most any materials in a typical classroom can be adapted as filtration materials.

Water from lakes and rivers often has contaminants that make it unfit for drinking. The water may contain dirt, rocks and other objects that can be easily identified. Water may also contain bacteria and other microscopic organisms that cannot be seen easily. For these reasons, water that is delivered to our homes must go through a water treatment process. This is typically a five-part process that consists of aeration, coagulation, sedimentation, filtration and disinfection. This activity is only concerned with filtration, which removes most but not all of the impurities from the water. Make sure students know that in this activity the filtered water is still unfit to drink.

Recommended Resources:

Information on the water treatment process and drinking water standards: <http://www.epa.gov/safewater/>

Technology library with information on different types of filters and filtration processes: <http://water.me.vccs.edu/concepts/filters.html>

Before the Activity

- Gather materials and make copies of the Design Components Worksheet.
- Make the liter of dirty water and the "A," "B" and "C" tubes.

With the Students

1. *Engineering Challenge:* Tell the students they have been hired by (your last name) Water Supply Company. With the ongoing drought, not enough water is available for all the things we need to supply – people, animals and plants. Tell them that they will each be given a sample of the dirty water they have remaining, and show them the tubes "A," "B" and "C." A is nearly ready for human use, B is nearly ready for animal use, and C is nearly ready to feed the plants. Remind them that no one must taste anything in the lab. They will be paid for their supply of filtered water: A gets \$10 per ml, B gets \$5 per ml, and C gets \$1 per ml.
2. Have students complete the worksheet to make sure they understand the activity purpose, and to help them think about the components of engineering design.
3. Put trays of materials in front of the students. Let them decide in teams what materials they would like to use to filter their water. To challenge students, include one of the following constraints:
 - Limit the amount of materials allowed for the design.
 - Assign a price per unit of material and give students a budget to work within.
4. Have students draw schematics of the layers. Once completed, give each team 25 ml of the dirty water to begin to filter in their test tubes.
5. Once filtering is complete, have them bring the test tubes to you for observation. Decide if the water is A, B or C grade and help them measure their sample in a graduated cylinder. They must return to their desks and do the math to come up with their \$ value. Have students put their \$ values on the board.

Attachments

Design Components Worksheet (docx)

Design Components Worksheet (pdf)

Design Components Worksheet Answer Key (docx)

Design Components Worksheet Answer Key (pdf)

Rubric for Performance Assessment (pdf)

Rubric for Performance Assessment (doc)

Safety Issues

Make sure students know that in this activity the filtered water is still unfit to drink.

Investigating Questions

- What was the best filtering agent and why?
- What are other ways we purify our water?
- Design a package for your "clean" water.

Assessment

Activity Embedded Assessment

Have students complete the Design Components Worksheet to assess their understanding of the activity and to encourage them to consider the design components involved in design a water filtration system. Sample answers are provided on the Design Components Worksheet Answer Key.

Post-Activity Assessment

Use the attached Rubric for Performance Assessment to evaluate students' design projects using criteria for the final filtering system and teamwork effort.

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Supporting Program

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