



GRAB-AND-GO WATER ACTIVITIES

for Orange County K-12 students



WHAT'S INCLUDED

- ✓ Activity Background
- ✓ Learning Objectives
- ✓ Activity Procedure
- ✓ List of Materials
- ✓ Engineering Design Process Worksheet
- ✓ Natural and Human Social Systems Venn Diagram
- ✓ Key Terms and Definitions

Water Filtration Challenge

Students engage in the steps of the engineering design process—Ask, Research, Imagine, Plan, Create, Test, Improve, Share—as they investigate and develop solutions to a real-world problem, and discover how everyday activities can significantly impact water supply and water quality. Working alone or together in small groups, students design, build, and measure the effectiveness of their own water filtration model using commonly available materials. Through evaluation of their model and, if working in teams, observation of the other group's models, students will modify their device and repeat the process to produce the cleanest water sample possible. Students will measure the effectiveness of their water filtration devices, and will be able to explain their process to their peers or families.

Activity Background

Water is a limited natural resource that is linked to all life on Earth. While 71% of the Earth is covered in water, less than 1% is freshwater and available for people to use and drink. Often times, water from lakes and rivers contains particles and organic matter that make it unhealthy to drink without cleaning it first. The water may contain dirt, rocks, fish, or animal waste that can be easily seen, but water may also have bacteria or other tiny, living germs that can't be seen so easily. Because of this, water has to go through a treatment process before we can use it.

The water that comes out of our faucets has passed through an intricate maze of waterways, complex systems, and vital infrastructure that were designed, developed, and implemented to deliver a clean and reliable supply of water to Orange County. Through this activity, students discover the importance and value of water, the role it plays in our everyday lives, and the challenges faced by purveyors of their drinking water to deliver it to their homes — clean, healthy, and ready to use from the tap.

Note: *This activity only deals with filtration, which removes most, but not all water impurities. Make sure students understand that the filtered water in this activity is still unsafe to drink.*



Learning Objectives

After this activity, students should be able to:

- ◆ Engage in investigation and evaluation in to solve a problem
- ◆ Understand the basic process for water filtration
- ◆ Explain the effects humans have on the quality, quantity, and availability of fresh drinking water
- ◆ Practice the steps of the engineering design process as they design, build, and test a water filtration model
- ◆ In a written summary or spoken presentation, describe the materials used and explain its effectiveness for filtering water

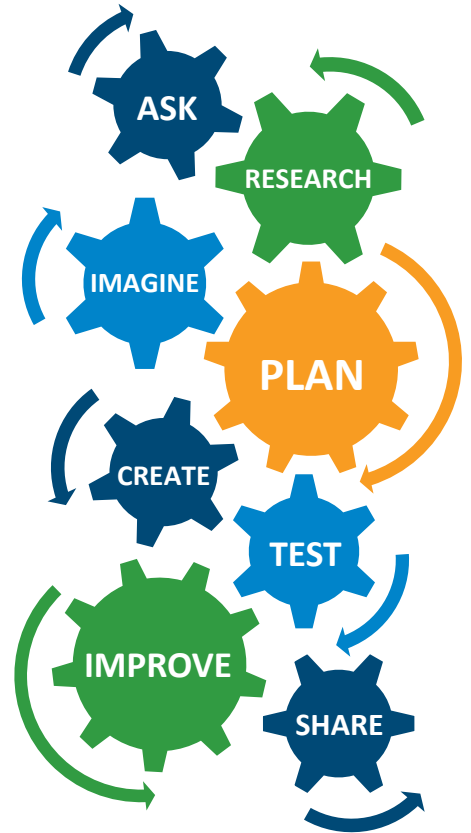
Making the Filtration Devices

Allow enough time to prepare water bottles for the filtration device. The filtration device is made from a 0.5 liter (16.9-oz) water bottle with the bottom cut off. The two bottle pieces will be stacked to allow the wastewater to filter through the materials used. The challenge is for students to use the design-test-redesign approach to determine which filter materials they should use to get the cleanest filtered water sample. Be sure to discuss each design, making observations and asking guiding questions to help students connect, reflect, and communicate their design to their peers. For ideas on how to build and test the water filtration device, watch this video of a similar activity:

www.teachengineering.org/activities/view/water_filtration

PROCEDURE:

- Make sure each student has the attached engineering design worksheet to complete the assignment.
- Prepare a 1-liter bottle of dirty water with soil and sand. Mix until it is thin, but relatively opaque. Gather the remaining materials needed to build a water filtration device.
- Cut the empty bottles 4 inches below the mouth and place the top upside down in the bottom section of the bottle like a funnel. *CAUTION: Adult supervision is required when handling sharp objects.*
- If working in teams, divide the class into small groups (3-4). Ask the students to design a filtering system to turn the wastewater into the clearest sample using the materials provided.
- Have students use the bottle funnel as their basic structure, and fill it with 4-5 items from the materials list to create a filtering device. There are many ways to build a filter, so encourage students to be creative!
- Once students have completed their filtering system, have them describe their process to their peers or family members, remove the screw caps, and watch as they test how effective their system is for clarifying water.
- Repeat: Have students build another filtration system with one less material. Did the filter work as well this time? What elements are needed to get the clearest sample of water?



LIST OF MATERIALS

- ✓ 1-liter bottle of wastewater
- ✓ Empty 0.5 liter plastic bottles
- ✓ Rubber bands
- ✓ Cotton balls or gauze squares
- ✓ Sponges
- ✓ Paper towels or paper
- ✓ Coffee filters
- ✓ Sand, gravel, or rocks
- ✓ Cereal
- ✓ Grass or leaves
- ✓ T-shirt fabric
- ✓ Food coloring

Note: Filtration materials can be anything readily available to you. There's no right or wrong answer! Just remember to use the design-test-redesign approach.



WATER FILTRATION CHALLENGE

Engineering Design Process Worksheet

NAME: _____

DATE: _____

ASK

What is the problem? What are your constraints?
What do you hope to accomplish?

RESEARCH

Use books, technology, or human resources to research what process or solutions already exist.

IMAGINE

What are the possible solutions? Brainstorm ideas.
Then, choose your best idea.

PLAN AND CREATE

Draw your design, gather your materials, and build your first model.

TEST

Test your model. Make notes on what materials you used, what worked and what didn't, and why.

IMPROVE

What could work better? How can you improve your model? Redesign your model, and test it again.



WATER FILTRATION CHALLENGE

Natural Systems and Human Social Systems

NAME: _____

DATE: _____

System: When different parts or components connect to form a whole. Example: Pedals, handle bars, and wheels are different parts or components that connect to form a bicycle.

Natural Systems: Systems that occur in nature without any human influence like weather, rivers, or trees.

Human Social Systems: Systems that are created by humans like schools, freeways, parks, and government.

STEP 1

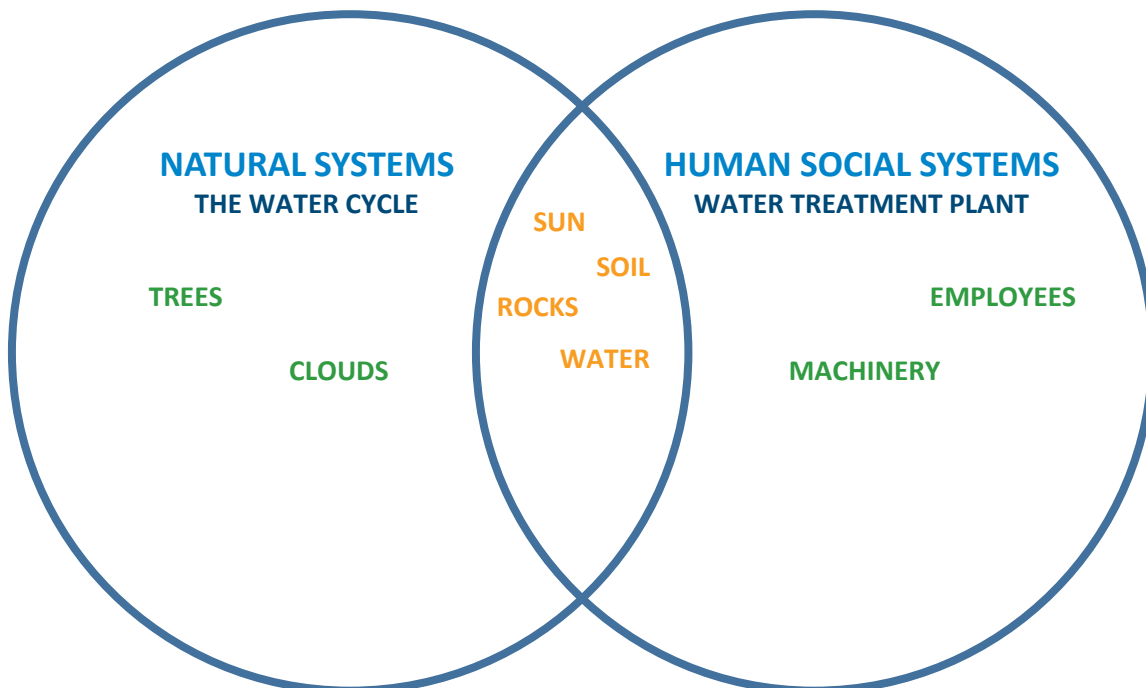
Explore your home and neighborhood. Observe examples of natural systems and human social systems. Can you find instances where water is used or needed? How does water get to this particular area? Why is water used or needed in this location?

STEP 2

The water cycle is a natural system. Several components of the water cycle help filter water naturally like soil, rocks, or plants. What other natural components do you see around your home or neighborhood that help filter water? Write your list in the natural systems circle below.

STEP 3

A water treatment plant is a human social system. It is built and operated to filter water so that it's clean and safe to drink. Components of a water treatment plant include the machinery used, the people who work there, and screens to capture trash. What other components do you think make up a water treatment plant? Write your list in the human social systems circle below.



STEP 4

In the center of the two circles, make a list of connections between the natural systems and the human social systems. Think about the materials used to construct the buildings and what natural elements are either used in the treatment process, or might affect the quality of the final product.

How have human activities caused changes to natural systems in your home or neighborhood?
Are there ways that you can help protect water quality at home or in your neighborhood?



WATER FILTRATION CHALLENGE

Key Terms and Definitions



- 01 Drinking Water:** Water that is safe to drink or use, such as tap water from your faucet.
- 02 Engineering Design Process:** A series of steps used to solve a problem. In this activity, the steps are Ask, Research, Imagine, Plan, Create, Test, Improve, and Share.
- 03 Freshwater:** Naturally occurring water such as glaciers, lakes, rivers, and streams. This does not include seawater or water from the ocean.
- 04 Infrastructure:** Facilities or systems that support the functions of a country, state, or region. Examples include: water supply, roads, housing, schools, hospitals, and airports.
- 05 Natural Resource:** Materials or substances that are found in nature and can be used by people, like air, plants, animals, soil, and water.
- 06 Purveyors:** A person that sells or supplies something. Drinking water purveyors are people from your local water district that supply clean and safe water to your home and school.
- 07 Quantity:** The number, amount, or measurement of something.
- 08 Reliability:** Someone or something to be trusted or relied upon. You can trust that Orange County's water is clean and safe, and there is plenty of it.
- 09 Water Filter:** A device or system that cleans your water by removing dirt, germs, and other materials.
- 10 Water Quality:** The measurement of how clean and healthy your water is to drink and use.
- 11 Water Treatment:** The process of removing particles and matter from water so that it is safe to drink or use.