



How Do We Get Clean Water? With Philadelphia Water Department

Objectives

- Understand the importance of clean water for human health
- Understand the basic principles of water filtration
- Learn about different types of water filters and their uses
- Build and test a DIY water filter using everyday materials

Next Generation Science Standards (NGSS) addressed

- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- 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.



Materials

- Two-liter plastic bottles
- Fine gravel or small stones
- Coarse and/or fine sand
- Cotton balls
- Napkins
- Activated charcoal (optional, available at pet stores)
- Coffee filter or cloth
- “Contaminated” water source [tap water mixed with dirt or other small particles, such as: litter (bits of plastic, small objects like paperclips, etc.); food scraps (orange peels, eggshells, lettuce, etc.); bits of leaves or grass; or food coloring. Use any of the above, or any other similar materials you may have.]

Preparation

- Before the lesson, the two-liter bottles should be pre-cut for class or small groups of students.
- Cut circumferentially around the bottle about halfway or a third of the way down.
- Keep both pieces together and set aside for the activity.



Introduction (5 minutes)

Explain to students the importance of clean water for human health and how access to clean water is a basic human right.

According to the U.N., “The right to water entitles everyone to have access to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use.

The right to sanitation entitles everyone to have physical and affordable access to sanitation, in all spheres of life, that is safe, hygienic, secure and socially and culturally acceptable and that provides privacy and ensures dignity.

Physical presence is not the same as access. A water or sanitation service does not serve the whole community if it is too expensive, unreliable, unhygienic, unsafely located, unadapted for less able groups or children, or non-gender segregated, in the case of toilets and washing facilities.

All people are entitled to water and sanitation without discrimination. Marginalized groups – women, children, refugees, indigenous peoples, disabled people and many others – are often overlooked by, and sometimes face active discrimination from, those planning and governing water and sanitation improvements and services, and other service users.”

Introduce the concept of water filtration and explain that it is the process of removing impurities from water in order to make it safe for drinking and other uses. Ask students if they have ever heard of water filters and if they know how they work.



Main Activity (20 minutes)

Water Filtration Principles:

Explain the basic principles of water filtration to students. Discuss how water filters work by removing impurities, such as dirt, sand and bacteria, through different layers of materials that trap or absorb these impurities. According to the CDC, “Public drinking water systems use different water treatment methods to provide safe drinking water for their communities. Public water systems often use a series of water treatment steps that include coagulation, flocculation, sedimentation, filtration and disinfection.” See attached infographic for details.

Building a DIY Water Filter

As a large group, build a DIY water filter. If materials allow, divide students into small groups and instruct students to follow these steps to build their filter.

1. Place the top half of the two-liter bottle upside down (like a funnel) inside the bottom half. Make sure the cap is slightly twisted open. The top half will be the filter and the bottom half will hold the filtered water.
2. Layer the filter (top half or funnel) with fine gravel or small stones, followed by coarse sand, fine sand, napkins, cotton balls and activated charcoal (if using). Each layer should be about 2 inches thick, with the activated charcoal on top.
3. Place the coffee filter or cloth on top of the activated charcoal layer.
4. Carefully pour contaminated water into the filter and observe the process of filtration.
5. Observe the filtered water in a clean container and write down notes. How does it look? Does it smell? Can you still see any impurities? Describe what you see in your notes or out loud as a group.



Conclusion (5 minutes)

Have students reflect on what they learned about water filtration and the importance of clean water. Ask them to share their observations and experiences building and testing their DIY water filters. Ask them what additional steps the Philadelphia Water Department might take. Summarize the key points of the lesson and encourage students to continue learning about water filtration and conservation.

Questions to ask during activity

- What pollutants need to be filtered out?
- Are there any pollutants that were not able to be filtered out with handmade filters?
- Is it possible that the water is still undrinkable, even if it looks clean?
- How might they remove contaminants from the water that cannot be filtered out?
- Would they get sick if using and drinking water filtered by a homemade filter? What safe uses could this water have?

Level Up: Higher level thinking prompts and questions

- Students can plan a public service announcement video or poster to educate others about storm drainage and preventing stormwater pollution.
- Have students write up hypotheses.
- Ask students about microscopic organisms and pollutants that cannot be seen but could impact people's health. Can they point out examples that they have seen in the news or historical events?
- Get students to wonder: Where does water pollution originate? Who is the most affected by it? What national and local organizations review water pollution and quality?
- Have students design a water filter they would use if they had to, including drawings. How much would a filter like this cost? Would it be hard or easy to make? Do they have access to all these materials?



Background info

1. Centers for Disease Control and Prevention. (2022). Water Treatment. Retrieved from https://www.cdc.gov/healthywater/drinking/public/water_treatment.html
2. National Science Foundation. (n.d.). What is water filtration? Retrieved from https://www.nsf.gov/news/special_reports/science_nation/waterfiltration.jsp
3. UNICEF. (n.d.). Water filtration: An essential component of clean water. Retrieved from <https://www.unicef.org/wash/water-filtration-essential-component-clean-water>
4. Gatlin, L. (2021, August 26). Earth Day Water Processes and filtration experiment. Delta Learning. Retrieved February 10, 2023, from <https://www.deltalearningspace.com/blog-collection/earth-day-water-processes-and-filtration-experiment>
5. Human Rights to Water and Sanitation | UN-Water (unwater.org)

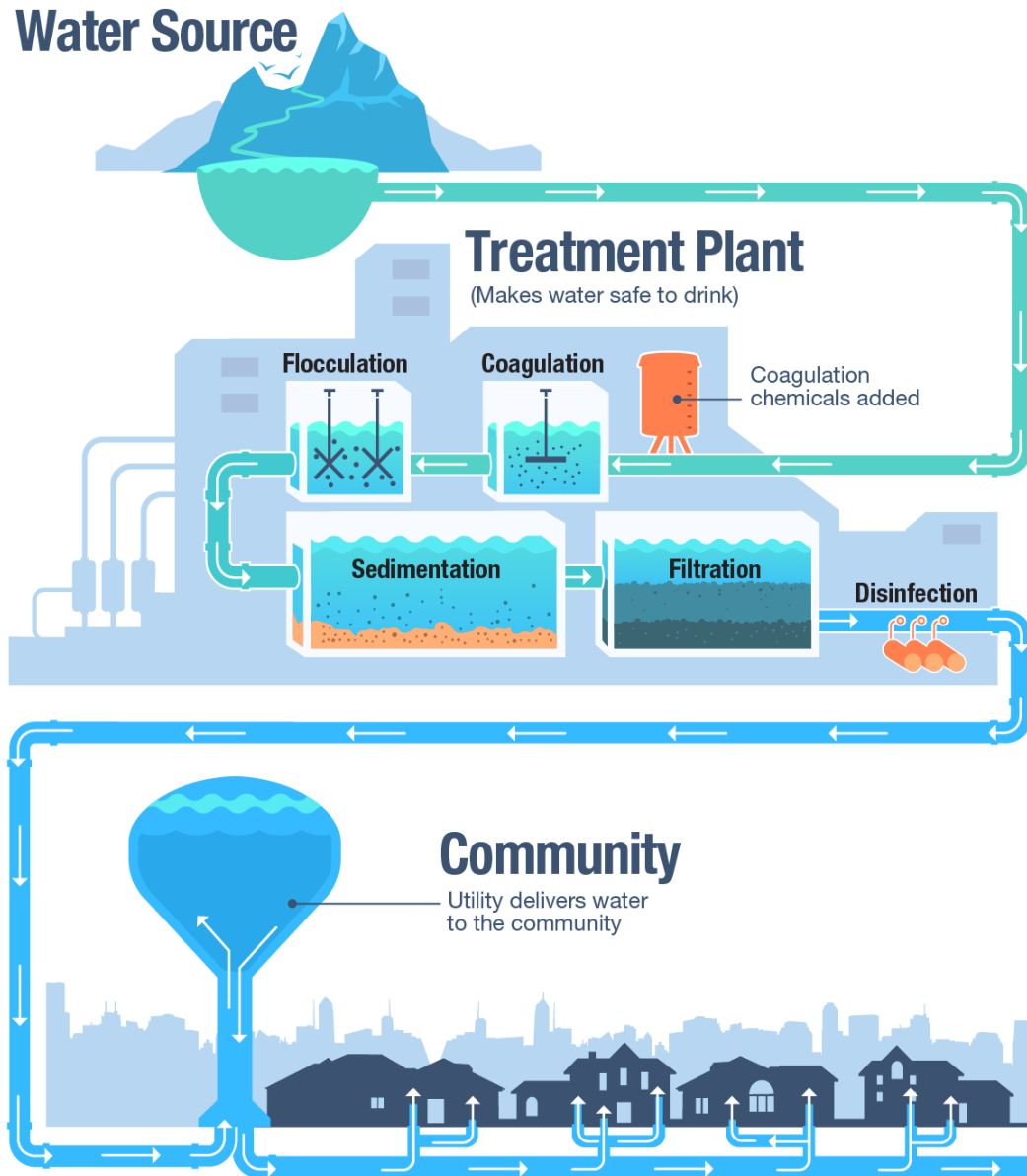


CHAMPIONS

Infographic courtesy of www.cdc.gov/healthywater/drinking/public/water_treatment

Water Treatment Steps

Water Source



cdc.gov/drinkingwater

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