

Water Filtration Challenge

Deep Science

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Nearly a mile below the earth's surface, in a former gold mine, researchers at the Sanford Underground Research Facility (SURF) are conducting world-leading research in physics, biology, geology, and engineering.

To keep naturally infiltrating water from accumulating underground, approximately 700 gallons of water per minute are pumped from underground to a surface reservoir where it awaits the treatment process.

Since 2008, more than 10 billion gallons of water have been treated at the Waste Water Treatment Plant (WWTP).



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Waste Water Treatment Plant

As part of normal operations at Sanford Underground Research Facility, water is pumped from deep underground and treated before it is released back into the environment. The water that comes from underground isn't toxic, but it does contain dirt and suspended solids, like iron, which gives the water a rusty color.

The treatment cycle combines mechanical procedures (screening and filtration), chemical procedures (coagulation, flocculation), and biological procedures (Rotating Biological Contactors-RBC's).



Focus on Filtration

Water filtration is the process of removing, or reducing, the concentration of particulate matter including suspended particles, macroinvertebrates, algae, and other impurities from water.

The three main types of filtration are mechanical, biological, and chemical filtration. **This challenge focuses on a mechanical filtration, which physically traps impurities.*

The most basic form of mechanical filtration uses gravity to filter a mixture. The mixture is poured from above onto filter material and gravity pulls the liquid down. The solids are left in the filter, while the liquid flows below it.

Water Filtration Challenge

During this challenge, you will work as a team to design and construct a basic water filter using everyday materials. You will then test the effectiveness of the filter and consider the feasibility of using this design with larger quantities of water. Your goal is to design a filtration system to eliminate as many impurities as possible from your water sample.

Engineering Design Process

Identify/Imagine/Design

Brainstorm and collect a variety of materials that could be used in a filtration system. Look closely at each of the materials available to determine which you think will work best to clean up the “dirty” water. Then, as a team, decide which of the materials you will be using, how much of each, and in what order. Make sure to sketch your design idea and clearly label each component.



Create

Begin constructing the prototype according to your plan. If the material planned for the first layer is at risk of falling through the mouth of the bottle, you may need to place something across the opening to help keep it in place. Make sure it will allow the filtered water to pass through. Once the filter is complete pour some clean water through to rinse and wet the filter materials. (Do not save this water)

Test/Improve

Test your filter. Does the water collected after filtration appear to be more clean than the water entering the filter? What did each material filter from the water? What worked well? What could work better? If something isn't working as well as you imagined, this is the time to make improvements.

Share

What aspect of your design do you think worked best?
Why?

What challenges did you have? How did you resolve them?
Now that you have some experience, what might you change in the filter design or materials?



If you were to select certain aspects from multiple designs and combine them to create a super filter, which would you choose? How do you think the filter and materials would perform if they needed to filter hundreds or thousands of gallons of water each day? Why?