



PLTW Engineering

12/Water Filtration Challenge

May 5, 2020



12/EDD

Lesson: 5/5/2020

Objective/Learning Target: Students will apply the design process solve the challenge of creating a water filtration device.



Background

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.



Background

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.



Background

In order to design a water filtration device, we need to gain an understanding of how filtration works.

Using ordinary materials, while also considering the designs material and cost efficiencies, you will follow the design process to prototype a water filtration device.



Gather materials

You will be limited to the following or similar materials:

- 1 liter of water prepared in advance with soil and sand in it (shake it up)
- cotton balls
- gauze squares
- tulle/netting
- tissue
- paper towels
- coffee filters
- gravel (aquarium gravel works great)
- sand
- 3 clear drinking glasses or test tubes if you have them



Define the problem

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.



Define the problem

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.



Define the problem

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.

AT NO TIME DURING THIS LAB, EVEN AFTER YOU FILTER THE WATER SAMPLES - DO NOT DRINK ANY OF THE WATER.



Here is your challenge

You have been hired by ABC Water Supply Company. With the ongoing drought, not enough water is available for all the things we need to supply - people, animals and plants.

You will create filtration devices for each of 3 different levels

Sample A is nearly ready for human use, B is nearly ready for animal use, and C is nearly ready to feed the plants.

Never taste test anything during the lab.



Brainstorm

With the materials you have gathered, think about different ways you can filter the liter of dirty water.

Record any ideas you find on the internet or other ideas on paper so you can use them during the next step.

Remember that you will need to create 3 different levels of purified water, so you should go for quantity on your ideas and it would be best if they were scalable.



Brainstorm

Here are a couple of helpful links to help you gather information as you brainstorm ideas.

[EPA information on ground water and drinking water](#)

[Chemistry help with filtration processes explained](#)



Generate Ideas

Sketch out some ideas for you to prototype.

Remember that you will need to create 3 different levels of purified water, so you should have a minimum of 3 different sketches.

Make sure you label each idea and add leaders with descriptions that clearly communicate your ideas.



Build your prototypes

When building your prototypes, make sure you can test them multiple times before they are worn out.

You are limited to **ONLY** the materials listed in the earlier slide.



Test your prototypes

When testing your prototypes, make sure you use the same 1 liter of dirty water to pour into them.

Place each of the prototype filtration devices over an empty clear drinking glass or test tube.

Once filtering is complete, make and record your observation. Decide if the water is A, B or C grade.



Quiz yourself

What are the limits (constraints) that you need to consider when designing your water filter?

How can you determine how successful your design is?

What was the best filtering agent and why?

What are other ways we purify our water?