Making Water Safe – Student Instructions

Engineer a Water Filter

Tools of the Trade

To test whether your filter works, you will need a water sample that is not clean. For the water sample you will need:

1 quart of water	**½ cup soil or dirt**	**¼ cup sand**
2-quart pitcher	**1 long-handled spoon**	**8 cups (8 oz size)**
¼ cup measuring cup	**½ cup measuring cup**	**1 permanent marker**

Your filter will need to be housed inside a container. To test different ideas, it is recommended you get 3 of the containers you choose. You can use any container that has a neck. The following containers work well for design:

2-liter soda bottles	**20-ounce water bottles**	**½ gallon milk containers**

Since you are creating your filter using your own design, you can choose what materials you feel would be best to remove the soil/dirt and sand from your water sample. Recommended materials include:

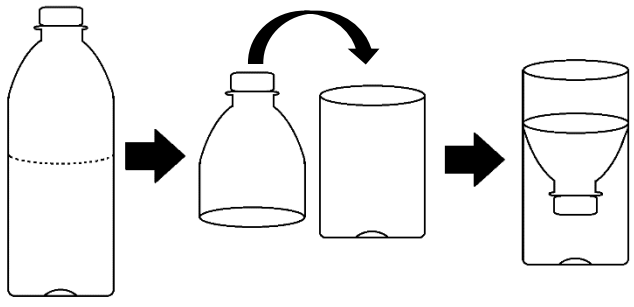
cotton balls	**tulle or netting**	**gauze or cloth bandages**
paper towels or napkins	**coffee filters**	**aquarium gravel**
tissue	**sand**	**cloth squares**

Prepare the Water Sample

1. Pour the water into the pitcher.
2. Add the soil/dirt to the pitcher and stir with the spoon.
3. Carefully fill 4 cups with the mixture. Label one of the cups "A" with the permanent marker.
4. In a fifth cup, pour ½ cup of the mixture into the cup, then fill the rest of the cup with water. Label this cup "B" with the marker.
5. In a sixth cup, pour ¼ cup of the mixture into a cup, then fill the rest of the cup with water. Label this cup "C" with the marker.
6. Fill a seventh cup with clean water. Label this cup "D." The last cup will be used later.

Prepare the Containers

7. Start with your first container. Take the cap off the container.
8. Cut the container in half, as shown in the image below. You may need an adult's help.
9. Turn the top half of the container upside down and place the top half of the container into the bottom half of the container. The top half will hold your filter, while the bottom half collects the filtered water.
10. Repeat this process with each container.
11. Write out the steps you took for your procedure on a sheet of paper. Include drawings of your containers for each step.

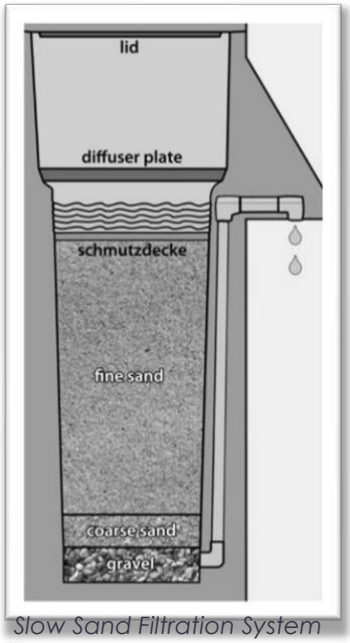


Build the Prototype

Now that you have your container built, it is time to prototype your filter. Remember, this is your design, and it may or may not work well the first time. You will measure success by how much soil/dirt and sand you can remove from your three water samples, **and** how much water you are able to gather from the filter. After all, if your filter does not let water through, it is not really a filter. Once you have decided on the materials you will use to filter your water, you need to decide the order you want them to go inside the container.

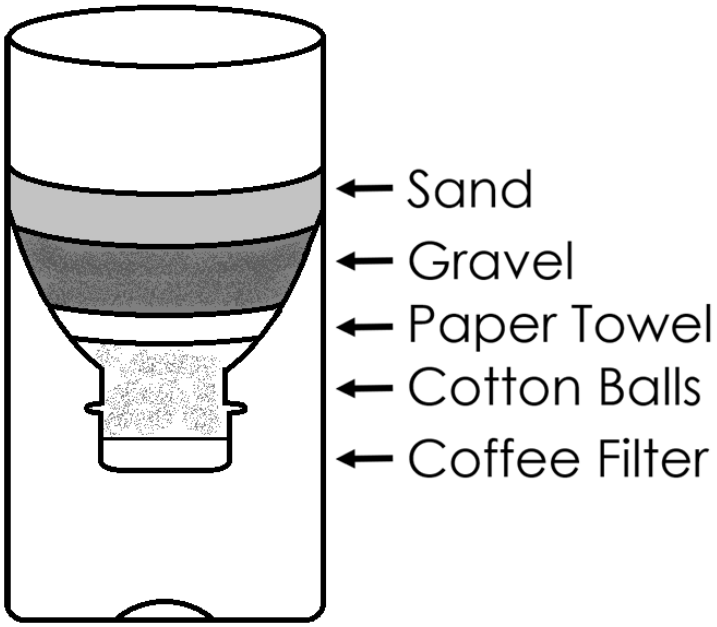
Some tips:

- Sand and aquarium gravel are excellent filters. In fact, one of the home **filtration systems** CDC has implemented in communities without access to adequate **filtration systems** is the slow sand **filtration system**.
- However, neither sand nor aquarium gravel can be the bottom layer of the filter because they will fall right through it.
- Tissue can be an excellent way to plug the neck so that water can come through the filter without the other filter materials falling through. However, water can weaken the tissue and cause it to break apart.
- Coffee filters are, well, filters. However, water moves very slowly through a coffee filter.
- Tulle and netting will let small debris like sand through them. However, they are both strong enough to hold all the other filter materials to keep them from falling through the filter.



Slow Sand Filtration System

Once you have determined your order, draw a diagram with each layer labeled in the container.



Test the Prototype

1. Construct your prototype based on your design. Once you have it constructed, test your filter by pouring the sample water into the prototype.
2. While your sample water works through your filter, line up cups A, B, C, and D. These will serve as comparison cups. You will compare your filtered water to the cups to test how well your filter works.
3. Once your water has finished filtering, pour the filtered water into the 8th cup. Hold your cup up to cups A-D to determine which cup matches your filtered water the best. The closer your filtered water looks to cup D, the better your water filter works.
4. Compare the amount of filtered water you recovered to the amount of water in cup D.
5. Record your results by circling them in the chart below:

Prototype 1: Data Table

Filtration: How close does your filtered water look to the clean water?	My filtered water looks like cup A. 1 point	My filtered water looks like cup B. 2 points	My filtered water looks like cup C. 3 points	My filtered water looks like cup D. 4 points
Recovery: How much water did your filter let through?	My filter let none of the water through. 1 point	My filter let less than half of the water through. 2 points	My filter let more than half of the water through. 3 points	My filter let all the water through. 4 points

6. Add up the point values for your filtered water. A good filter will earn at least 5 points. A better filter will earn at least 6 points. A great filter will earn 7 or more points.
7. If your prototype scores a 4 or less, think about improvements that could be made. Run the engineering design process again, this time changing the layers you use to filter. This could involve changing the materials themselves, the order of the materials, or both.
8. If your prototype scores well, try to replicate the results by building a second prototype of the same kind. Again, repeat the engineering design process.
9. For your third prototype, focus either on recovery or filtration. Repeat the engineering design process.
10. Record your results for your second and third prototype by circling them in the tables below:

Prototype 2: Data Table

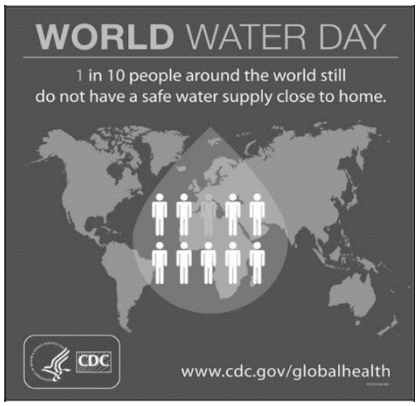
Filtration: How close does your filtered water look to the clean water?	My filtered water looks like cup A. 1 point	My filtered water looks like cup B. 2 points	My filtered water looks like cup C. 3 points	My filtered water looks like cup D. 4 points
Recovery: How much water did your filter let through?	My filter let none of the water through. 1 point	My filter let less than half of the water through. 2 points	My filter let more than half of the water through. 3 points	My filter let all the water through. 4 points

Prototype 3: Data Table

Filtration: How close does your filtered water look to the clean water?	My filtered water looks like cup A. 1 point	My filtered water looks like cup B. 2 points	My filtered water looks like cup C. 3 points	My filtered water looks like cup D. 4 points
Recovery: How much water did your filter let through?	My filter let none of the water through. 1 point	My filter let less than half of the water through. 2 points	My filter let more than half of the water through. 3 points	My filter let all the water through. 4 points

Design a Safe Water Practices Infographic

An infographic is a visual representation of information. Often, these images give people a better understanding of the information being shared. The information is organized in a way that gives visual meaning to data. CDC often uses infographics to share information with the public to make sure each person is able to understand the information being shared. Check out this infographic about World Water Day:



In this infographic, you can see that yellow is used to indicate important information. The "1" stands out for readers. Similarly, having one of the person icons colored yellow reminds the viewer of the one person in ten who doesn't have safe water. Having a water droplet and a world map helps the viewers connect the topic of water and lets them know it's a global issue.

Steps to Design

1. When you are making your design, you can use the following links for information:

   Handwashing - https://www.cdc.gov/clean-hands/about/index.html

   Sanitation - https://www.cdc.gov/global-water-sanitation-hygiene/about/about-global-sanitation.html?CDC_AAref_Val=https://www.cdc.gov/healthywater/global/sanitation/index.html

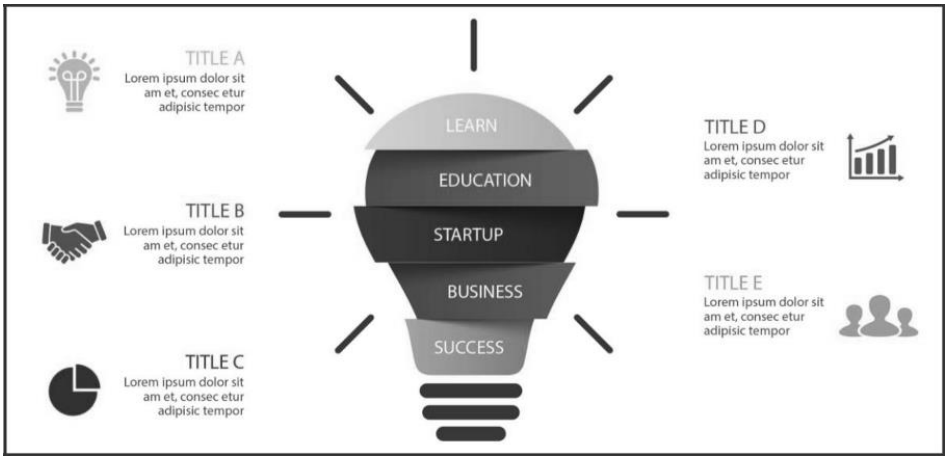
   Safe Water Handling - https://www.cdc.gov/healthywater/emergency/making-water-safe.html

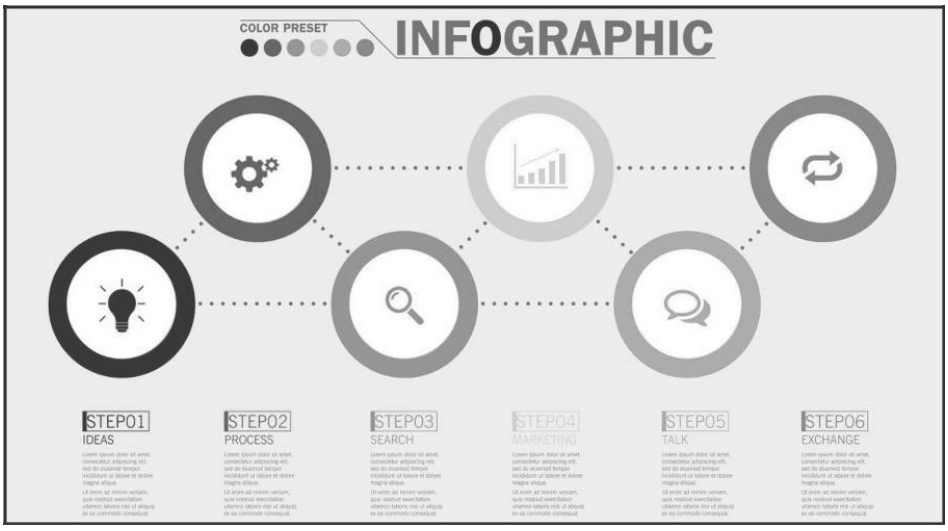
   Choose an image to go with each practice. Make sure the images help to explain each action a person should take.

2. Organize your design. Page 6 gives you examples of how you can organize your images.

3. Share your infographic with CDC on Facebook, Twitter and Instagram using @CDCgov!

Infographic Layout Examples





Share Your Designs

CDC uses a variety of social networks to raise awareness about the diseases/ conditions with which they are working and their efforts to make the world a healthier place for all people. Water safety may not be at the forefront of the minds of communities within the United States, but it does play a big role in the world at large. You can aid CDC with these efforts by sharing your infographic and pictures/videos of your most successful prototype.

- Instagram: Share with David J. Sencer CDC Museum **@CDCmuseum**.
- Twitter: Share with CDC **@CDC.**
- Facebook: Share with CDC **@CDCgov**.