Water Treatment	Grade 8 : Water systems

Lesson Plan

Safety Notes

Ask an adult for permission to do this experiment. Don't drink water you've added dirt to, even after it is filtered.

Description

Discover how municipalities treat their drinking water and create your own filtration system at home.

Materials

Here are the materials that you will need:

- Plastic pop bottle
- Two cups
- Scissors
- Food colouring
- Earth or dirt
- Coffee grinds or tea leaves
- Cotton balls
- Coffee filter or paper towel or napkin or old sock
- Gravel
- Sand
- Activated charcoal or carbon* (Optional, but you can get it from aquarium filters at pet stores)
- Timer (you can use one from a watch or cell phone)

* *Activated charcoal or carbon is a form of carbon (chemical) that has lots of holes within it that allows it to react or stick to other chemicals and to remove these from water. It helps to clean water by getting rid of certain chemical impurities found within it.*

Science Background

Although our planet is covered with water, most of it is saltwater or in a frozen state (ice) which is inaccessible to us. Less than 1% of the water on our planet is available for us to drink. This freshwater can be found in lakes, rivers or in the ground known as aquifers. Usually you cannot drink directly from these water sources without treating them to remove sediments, chemicals and disease-causing germs. In fact, some of the worst pandemics that have occured in history were caused by unclean drinking water. Diseases such as, cryptosporidiosis, giardiasis (beaver fever), cholera, *E. coli*, dysentery, typhoid fever, poliomyelitis and hepatitis are caused by microbes (i.e. germs) that people accidentally drink in untreated water. Diseases caused by contaminated water are known as

water borne diseases. The World Health Organization estimates that about 3.4 million people around the world die each year because of water borne diseases.

What is the cause of water borne diseases? Individuals infected with microbes will release them in the environment through their feces. These microbes end up in a drinking water source. If this water is not treated to remove the microbes, anyone drinking the water will get infected.

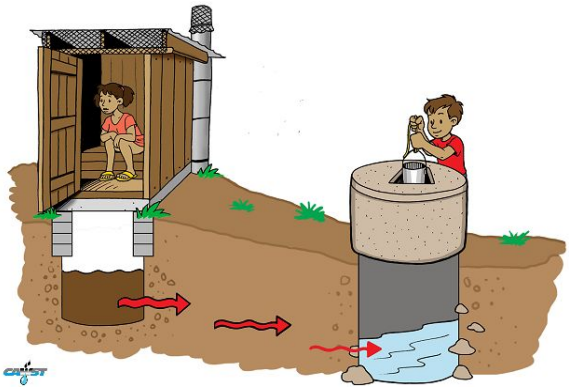


Image: CAWST (Centre for Affordable Water and Sanitation Technology)

The role of water treatment is to remove microbes and other impurities that could make us sick. Unfortunately, in many regions around the world and even in Canada, people do not have access to safe drinking water. As a result, people get sick or must bring in clean freshwater from elsewhere.

The cleaning of drinking water is done at a water treatment plant. Here water is passed through a series of steps to remove impurities and microbes, and even to improve the taste of water. Municipalities may use slightly different treatment methods but generally they follow these steps as shown in the diagram below:

1. Water is taken from a lake or river and passed through a metal screen to remove large debris.

2. Chemicals such as alum are added to the water that causes the clumping or coagulation of particles in the water.

3. The water is then placed in a basin where particles are allowed to sediment or fall to the bottom.

4. The water is then passed in a filter usually composed of gravel, sand and activated charcoal. At this step most impurities and microbes are removed.

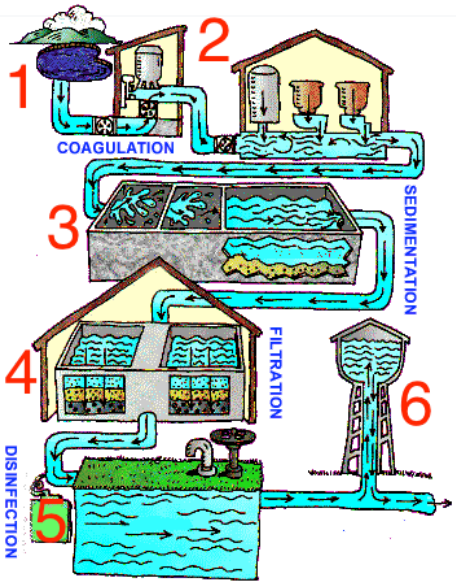


Image: Environmental Protection Agency (U.S.A.)

5. Chlorine is then added to kill any microbes that might have passed through the filter and to keep the water clean.

6. Water is pumped in a storage area awaiting to be used by people.

In addition, water is tested every week at different sites throughout a municipality to make certain that there are no microbes within it. Water treatment plants and weekly testing ensures that our water is safe to drink.

Activity Procedure

In this activity, we will be building a filter to treat water following the same principle to what is seen in water treatment plants. We will use a variety of materials to build a filter and determine which type of setup is best at removing impurities in water.

First thing you will need to do is to make some dirty water. Take a cup and fill three quarters of it with water. Now you can add "impurities" to it. You can choose what you want to add. You can add "dirt" (sand or earth), coffee grinds, and/or tea leaves to your water. Mix everything together in your cup of water.

To build your filter, take a pop bottle and cut it in half. Place the half with the cap opening upside down into the bottom half of the bottle (see picture). You will be placing the filtration materials in the inverted portion and collecting the filtered water into the bottom portion.

Now it is time to experiment what materials you want to use as a filter. One trick is to use coarser (gravel) on top followed by finer materials at the bottom (sand, activated carbon). The coarser material will remove the larger impurities and the fine materials will remove the smaller impurities. I would suggest placing a sock or coffee filter or cotton balls at the bottom to ensure that your fine materials do not fall/slide through the cap opening. Using the activity sheet, label and draw the layering scheme of your filter.

Get your timer ready and hold your cup of dirty in your hand. Start the timer the moment you pour the dirty water into the filter. Look at the bottom of the filter for signs of water. The moment you see water dripping from the bottom of the filter, stop the timer. Record your result on the activity sheet. Allow the water to go through the filter; this might take a few

minutes. Once the water has been filtered, pour the water into a clean glass or cup. Make observations on the filtered water that you see. Is it clean? Do you see little particles? What colour is it? Write your observations on your activity sheet.

Repeat the experiment again, using different materials or materials in different layered combinations. Do you see differences in results? Don't forget to write your results on the activity sheet.

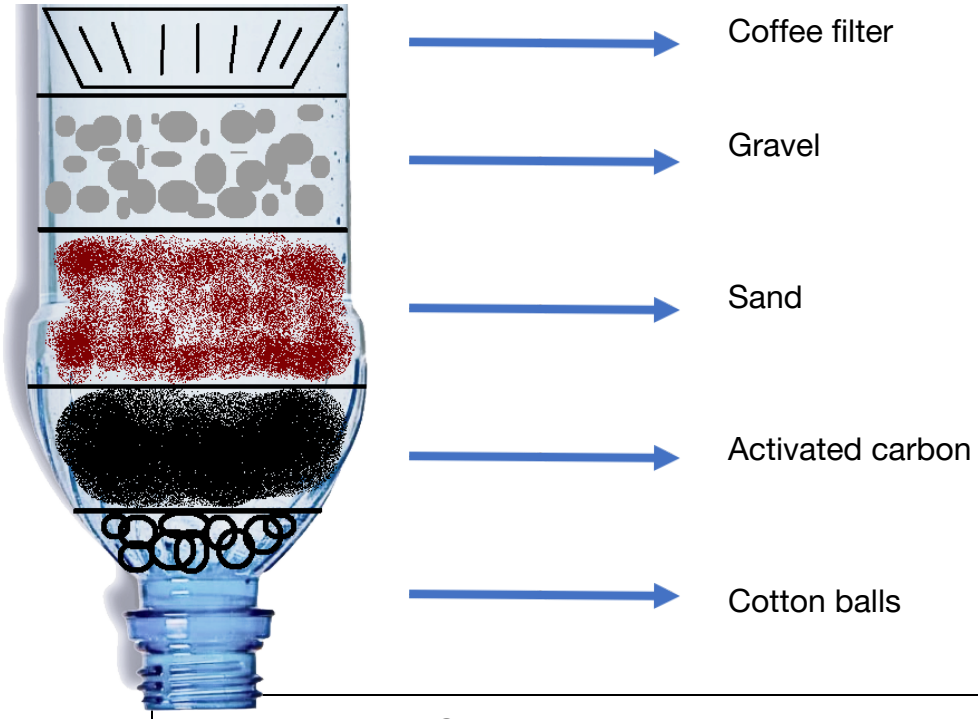
Generally, you want the water going through your filter to flow slowly. The slower the better. This means that your filter is doing a better job removing impurities in the water. Was this the case with your experiment? You will also notice that if you use the activated charcoal or carbon, your water will be colourless. The activated charcoal or carbon is good at removing chemicals found in the water such as the food colouring.

Debrief

The treatment of our drinking water is essential to protect us from water borne diseases. Water treatment plants use chemicals and filters to remove impurities from water to make it safe for us to drink. You experimented making filters and you saw that certain combinations of materials work better at removing impurities.

Handout

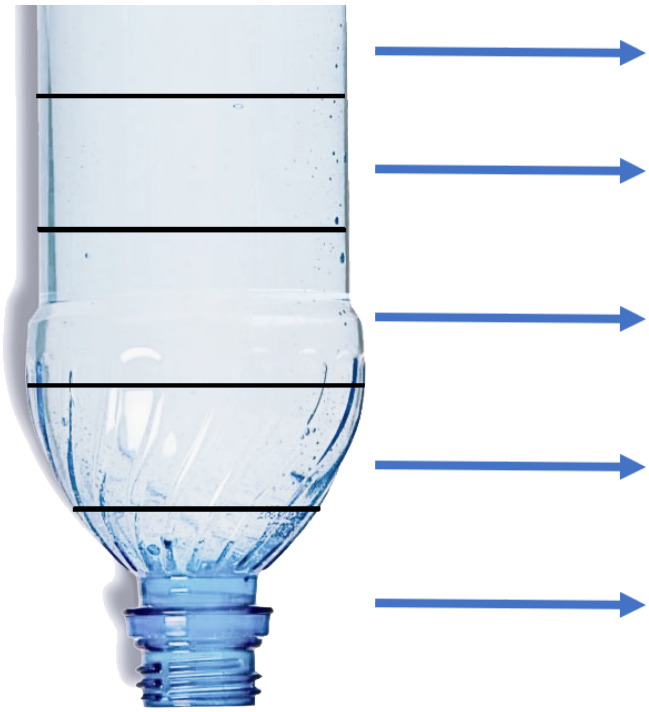
Draw and label the layers of materials you used to make your filter. Record your results so that you can compare your different filter setups. An example is shown below and three record sheets are provided in the following pages.



Observations of filtered water	
Number of seconds for first drop:	3 min 50 seconds (230 seconds)
Is it clear or murky?	Clear
Do you see particles?	No particles seen
Is it transparent or do you see colour?	Transparent
Write down any other observations	Took a long time to filter

Handout

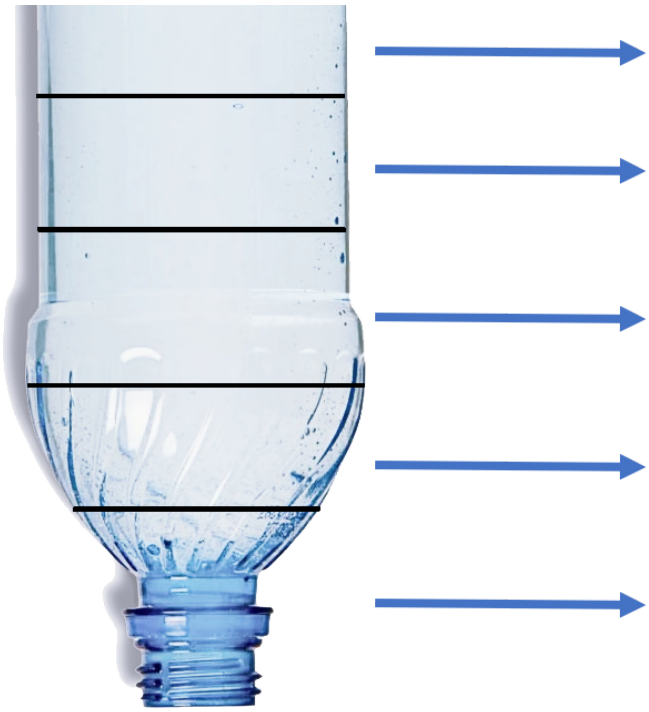
Trial #1



Observations of filtered water	
Number of seconds for first drop:	
Is it clear or murky?	
Do you see particles?	
Is it transparent or do you see colour?	
Write down any other observations	

Handout

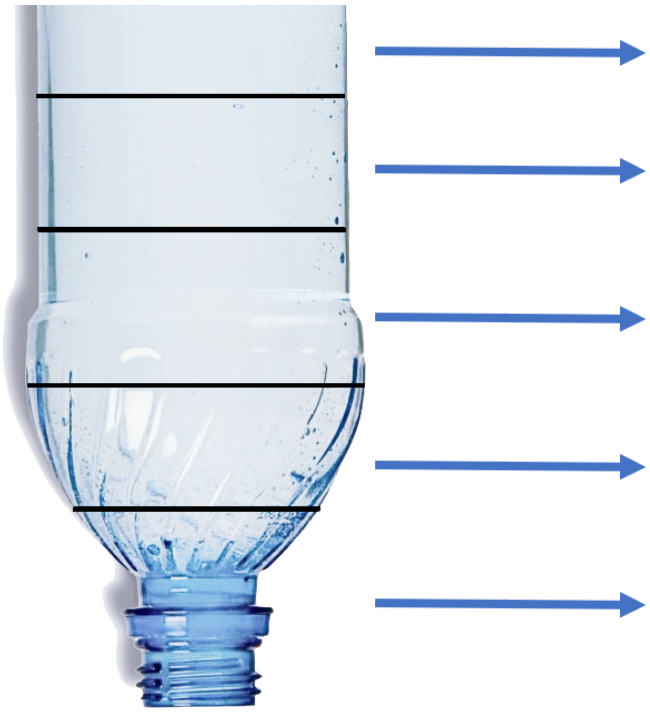
Trial #2



Observations of filtered water	
Number of seconds for first drop:	
Is it clear or murky?	
Do you see particles?	
Is it transparent or do you see colour?	
Write down any other observations	

Handout

Trial #3



Observations of filtered water	
Number of seconds for first drop:	
Is it clear or murky?	
Do you see particles?	
Is it transparent or do you see colour?	
Write down any other observations	