

Homemade Water Purifier

PURPOSE: To introduce students to the concept of water filtration and water borne diseases and help them become aware of drinking water safety.

SUMMARY: By building their own water filters, students will learn what water filtration is, how it works and what it can and cannot affectively remove.

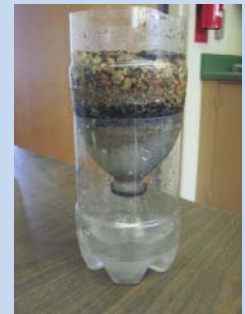
BACKGROUND: Water we use comes from lakes, rivers, and groundwater. Before we can use this water domestically, it must be cleaned. This process generally has 4 main steps, coagulation, sedimentation, filtration and disinfection.

1. **Coagulation:** removes dirt, metals and other particles suspended in water. Chemicals like Alum are added to the water that form sticky particles called “floc” which attract the dirt particles.
2. **Sedimentation:** the combined weight of the sediment and chemicals stuck together become heavy and sink to the bottom.
3. **Filtration:** smaller particles are removed as water passes through a series of filters (sand, gravel, charcoal)
4. **Disinfection:** to kill bacteria or microorganisms found in the water, a small amount of chlorine is added.

Suggested grade level: K-6

Duration: 30 minutes

Setting: Classroom
Outdoors



This lesson focuses on the filtration and disinfection steps. This experiment shows that even a simple purifying system can help clean dirty water through understanding the physical process of removing solid impurities of varying sizes and the chemical process of removing dissolved solids.

MATERIALS:

- 1-liter soda bottles cut in half
- Napkins or paper towels
- *Gravel
- *Sand
- *Potable Aqua Chlorine Dioxide, water purification drops or tablets
- Cups or scoops (for gravel and sand)
- Activated Filter Carbon (available at pet stores)
- Large water container for dirty water (pitchers or gallon jugs)
- Dirty water (made by adding dirt, twigs, leaves, etc., to water)
- Large waste container (plastic container or thick garbage bag for used filtering materials)
- 2 clean pitchers for filtered water
- Pathogen pictures (at the end of this lesson)



Picture 1: Filtering materials

*Available at hardware stores

LESSON PREPERATION:

1. Precut enough 1-liter soda bottles for each student or for each group of students
2. Create dirty water
3. Set up spots for scooping in the filter materials (charcoal, sand, gravel, etc.)
4. Have copies of the water-borne disease pathogens to show students

PROCEDURE:

1. Ask students: What is clean water? What makes water dirty? (*Discuss how “clean water” is defined by how it is used. For example, what we consider clean water for drinking may not be considered clean water for fish and vice versa.*)

2. Show students the dirty water and explain the general process of water treatment to make water safe to drink (see the background section at the beginning of this lesson for information on water treatment).



Picture 2: Dirty water

3. Guide students through building their own filter.
 - a. Have students put the top half of the soda bottle-upside down (like a funnel) inside the bottom half. The top half will be where they build their filter; the bottom half will hold their filtered water.
 - b. Show the students the filter materials they will be using (gravel, sand, and carbon). Ask the students: What will each of these layers remove? (*Gravel and sand remove large and small particles, carbon removes pesticides, chlorine and other chemicals and improves the taste of water.*)



Picture 3: Filter

- c. Let each student or group decide on an order of the filtration materials for their own filter with the exception that the napkin or paper towel should go first at the bottom (into the neck of the bottle).
4. Once students have made their filters, put the filter on a stable surface and pour in the dirty water.

5. As their filters drip water, ask students: What does the filtered water look like? (*Help the students to think about how the filter is working, what is being filtered out and what might not be filtered out, even if the water looks clean.*) Students may need to run the water through the filter a few times in order to purify the water. Excess dust from the activated filter carbon may turn the water slightly gray. In order to save time you may want to rinse off the carbon beforehand.



Picture 4: Filter with water

6. Compare the water from each filter and discuss what order of

materials cleans the water best. (*The recommended order from bottom to top in the bottle is napkin → sand → charcoal → gravel.*)

7. Discuss how even if the water looks clear that does not necessarily mean it is clean and safe for us to drink. Ask the students: Is the water clean enough for us to drink? What else might be in the water that we can't see? (*There could still be harmful bacteria and microorganisms in the water.*)
8. Have students empty the bottom of their filters into the pitchers and add chlorine-dioxide drops or tablets according to label instructions in order to remove harmful bacteria and microorganisms.
9. Discuss with the students the terms **parasites** and **microorganisms**. Show pictures of each water-borne disease pathogen, explaining that these are commonly found in lakes, streams, etc. Discuss how they get into our water, their life cycles inside us, and how they make us sick. See the "Further Discussion" section at the end of this lesson for more information.
10. Explain that filtering water is important, but cleaning it chemically is also important to kill pathogens before we drink it. Show the dirty and clean water and ask the students: Which would you rather drink? Why? Compare the dirty and clean water and ask any other follow-up questions.

FURTHER DISCUSSION:

1. What are pathogens and which pathogens should we be concerned about in our water?

Pathogens are disease-causing organisms which may include types of bacteria, viruses, protozoan parasites, and other organisms. United State Environmental Protection Agency (USEPA) regulates the following pathogens in drinking water:

- *Cryptosporidium: This is a single-celled protozoa parasite found in lakes and rivers, especially in waters with sewage or animal waste pollution. This protozoan parasite can cause gastrointestinal illness like diarrhea, vomiting and stomach cramps.*
- *Giardia lamblia: This is a single-celled protozoan parasite that can be found in the intestines of infected humans and animals, in soil, food, or water contaminated by feces from infected humans and animals. This pathogen can cause nausea, stomach cramps, diarrhea, and associated headaches.*
- *Legionella: This is a type of bacteria that is naturally found in the environment, usually in water. It grows best in warm water (hot tubs, cooling towers, hot water tanks, large plumbing systems or air-conditioning systems of large buildings are ideal places for this bacteria). Legionella bacteria in water can become a health risk if the bacteria are aerosolized (e.g., in an air conditioning system or a shower) and then breathed in. Inhaling Legionella bacteria can cause a type of pneumonia known as Legionnaires disease.*

2. What are other methods of cleaning or filtering water?

- *Boiling water: Boiling water can kill harmful bacteria and microorganisms. Do not boil water in order to remove nitrate, lead or some other substances. Boiling water will actually increase the concentrations of these substances, not remove them.*
- *Filters: Most water filters available at stores remove 99.99% of waterborne viruses, bacteria and protozoan parasites and have carbon which will improve the taste of the water. This is the recommended way to completely clean water for drinking purposes.*
- *UV water purifiers: UV light can kill bacteria and microorganisms in water because the energy emitted by the light is absorbed by the cells of microbes which prevents the cell enzymes from “reading” DNA. Without intact DNA microbes cannot reproduce.*

REFERENCES/ADDITIONAL SOURCES:

Water Filtration IV

<http://www.scienceinschool.org/2008/issue10/nextgeneration>

FUN SCIENCE: Filter Magic

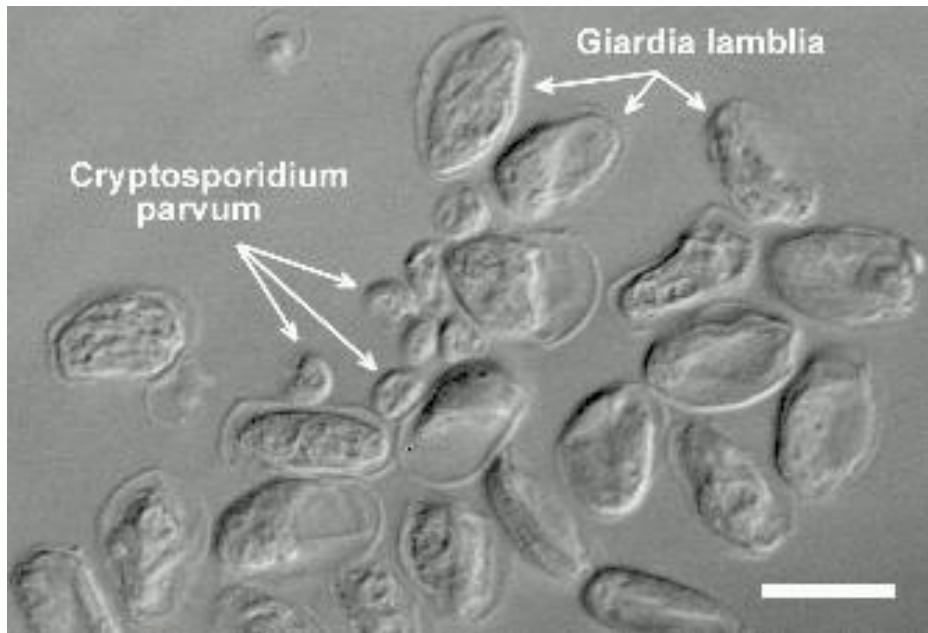
<http://www.thefreelibrary.com/Fun+science%3A+filter+magic.-a0119071356>

Zoom Water Filter

<http://pbskids.org/zoom/activities/sci/waterfilter.html>

Basic Information about Pathogens and Indicators in Drinking Water

<http://water.epa.gov/drink/contaminants/index.cfm#Microorganisms>



Cryptosporidium and Giardia Lamblia
Photo Credit: <http://www.epa.gov/>



Legionella
Photo Credit: <http://www.epa.gov/>