

Water Filtration

Grade Levels Targeted : 5-8

This activity can be extended to higher grades by having students use a Bunsen burner or other heating element to evaporate water and see what solids are left; can be used in lower grades by eliminating the choice of materials so that students only have to determine the order in which to set up the materials.

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This activity has been adapted from information on the www.riversalive.com website and Kimberly Flessner's lesson entitled, "Water Filtration," of the Nebraska Earth Science Education Network (NESEN), <http://nesen.unl.edu/lessons/water/waterfilt.asp>.

Educational Standard:

National Science Standards: Content Standard A, Science as Inquiry: all students should develop abilities necessary to do scientific inquiry and understandings about scientific inquiry.

National Science Standards: Content Standard C, Life Science: all students should develop an understanding of structure and function in living systems, reproduction and heredity, regulation and behavior, population and ecosystems and diversity and adaptations of organisms.

National Science Standards: Content Standard E, Science and Technology: all students should develop abilities of technological design and understandings about science and technology.

National Science Standards: Content Standard F, Science in Personal and Social Perspectives: all students should develop understanding of personal health, populations, resources and environments, natural hazards, risks and benefits, and science and technology in society.

National Science Standards: Content Standard G, History and Nature of Science: all students should develop an understanding of science as a human endeavor, nature of science, and history of science.

Success Indicator: Upon completion of the activity, students will have a better understanding of the factors required for water filtration and its necessity.

Setting up the Activity (for facilitator)

Facilitators will need to set up a materials station, and a water station..

The materials station is the area where the filtration materials are obtained by the groups. It would be helpful to have the items in labeled sections (Connectors, Filters, Filter Chambers, Imhoff Cones), on the table. It should be operated by an adult and stock the following materials:

Connectors: glue, rubber bands and pipe cleaners, masking tape	Filters: nylons, window screen, colanders and/or flour sifters, canvas, coffee filters, sand, clay, soil, river rocks (materials should be cut into 4 inch squares if possible).	Filter Chamber: a 20oz. plastic soda bottle with the bottom cut off and the cap off. One per group.	Imhoff Cone: A clear plastic martini glass to simulate an Imhoff cone with a stand.
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Have masking tape and markers handy for students to label their Imhoff cones with their names. Make sure they place their label on the base of the stand, not the actual cone itself. You may place these materials at the materials station, or have a facilitator walk around and place the masking tape with names on the Imhoff cones during the task.

The water station should have lake or river water, or dirty water (tap water and dirt mixed together) in a large bowl or bin. Have an 8 oz. liquid measuring cup available for each group.

Introduction (for youth): Have you ever thought about what goes into making your drinking water clean and safe to drink? How do Water Operators get muddy water from lakes and rivers and turn it into the clear, clean tap water we use for showering, cooking and drinking? Now is your chance to find out. YOU are going to work in groups to create a water filter, and then test it to see how clean your filtered water is. The winner will have the largest amount of clean water, and the smallest amount of solids.

What to do:

1. Work in groups of three. Preview the materials available prior to planning your filtration system and the Settleable Solids Test Instruction sheet. Each group is allowed the following materials: Your choice of 2 filtering materials, your choice of up to five connectors (things to attach your filter to the plastic bottle), a filtration chamber (a plastic bottle), and an "Imhoff cone."
2. Sketch your filtration system and label all parts. Once you have finished, submit it to a facilitator for approval.
3. Once your sketch has been approved, take it to the materials table and have the facilitator help you gather all of the necessary materials.
4. At your work station, assemble your filtration system.
5. Once assembled, use the Settleable Solids Test Instruction sheet and perform the test.
6. After the test is performed, present your filter and explain its design. Do not clean up until all tests and presentations have been completed. You may want to refer to the dirt and water during your presentation.

Finishing it up (for facilitator):

After testing, have each group present their filtration system. Lead a discussion evaluating the different designs presented. Which filters had the least of amount of sediment? Which ones had the most water? Which designs worked the best for both categories?

Talking It Over:

a. Share What You Did:

-Looking back, how well do you think your design worked? (The youth can rate their filters on a scale of 1-10 with 10 being the best)

-What would you do differently if given the same task next time? (Have youth examine the type of materials they used, how well they performed the settleable solids test and how well they followed instructions).

-What went differently than you predicted? (Answers will vary. A typical answer is that they learned that even after water is filtered, it may not be perfectly clean. There may still be some sediment that gets through.)

b. Process What's Important:

-What types of filters worked best? What do they have in common? What's different? (Have youth describe characteristics of the filters that worked. For example, youth will find that filter materials with smaller holes filter more sediment than filter materials with larger holes.

-How does the permeability of the filter material relate to water purity? (The less permeable the filter is, the purer the water is) How does it relate to the amount of water yielded? (The less permeable the filter is the more water is retained in the material)

-What filtration materials do you think would last the longest over time? (Answers will vary. Have youth

think about how easy or difficult it would be to tear some of the materials they used as filters, and how that might relate to how long a filter would last. For example, civil engineers probably wouldn't use nylons as a filter because a twig carried in water could easily tear the nylons.)

c. Generalize To Your Life:

- Why is water filtration important?(So our bodies absorb the water without having to fight harmful, sometimes even fatal bacteria and viruses carried by debris. An example of what happens without water filtration is the spread of dysentery)*

- What might happen to humans as a species if we were no longer able to filter our water? (Many people could get sick and spread diseases causing death, chronic illnesses, a higher mortality rate for babies and the elderly. Eventually, the strongest would survive and our bodies would adapt to the type of water in our habitat.)*

- What might it mean if too much sediment was detected in river water over time? (It could signal accelerated erosion in certain areas of the river because the higher level of sediment could be coming from a river bank destroyed for construction, for example. It could also signal gradual ecological changes in the type of sediment in the river. For example, the river bed may eventually wear down to a softer layer of soil, which would break up and be carried more easily down the river)*

d. Apply What You Learned:

- How might you be able to use what you learned today? Think of a situation in which you might need to filter your own water. (For example, backpackers have to filter their own water when they go camping because water is too heavy to carry a lot of.)*

- What types of materials do you think are needed for a permanent filtration system? How do you think durability, permeability and filtration ability factor into what materials are used? (Many filtration systems use sand. Sand is very durable, is permeable with very small spaces between grains of sand.)*

More Challenges

To help youth learn more about why settleable solids tests are done, have them research settleable solids tests on the web or in the library and create a picture of what would happen if we didn't do these tests. For example, a student might do a picture of someone being sick or erosion along a river. Another extension activity could be to have youth write interview questions for a water operator, and then call their local water department. There are also several activities at www.epa.gov. Click on "For Kids," then click on "water."

Background Information (for facilitator):

Surface water (water in lakes, rivers, ponds, etc.) often contains bacteria and microbiological organisms that can cause disease. This is why water must go through the filtration process of four steps:

- 1. Aeration-water is exposed to air, gases in water escape and oxygen is added to the water.*
- 2. Coagulation-the chemically stimulated clumping of dirt and other solid particles for easier removal from water.*
- 3. Sedimentation-when the clumps of solid particles settle at the bottom of a filtration tank due to gravity.*
- 4. Filtration-removal of the remaining impurities through pebble and sand filters.*
- 5. Disinfectants-purify the water and kill any harmful organisms.*

This activity focuses only on the filtration step using a settleable solids test. A settleable solids test is the volume of solids in a one liter sample of water that will settle to the bottom of an Imhoff cone during a specific time period. An Imhoff cone is a graduated cone rather than the usual cylindrical shape. The cone is usually suspended point down in a test tube stand. The conical shape allows for all of the solids to slide down the sides into the bottom.

Acknowledgements:

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Resources:

www.epa.gov

www.riversalive.com

www.ne-wea.org/LabManual/settleable_solids.htm

<http://nesen.unl.edu/lessons/water/waterfilt.asp>

Settleable Solids Test Instructions Sheet

1. After you have assembled your filter onto the neck of the plastic bottle, have one person get 4oz. of dirty water from the water station. Carefully walk back to your work station without spilling any water.
2. Have one person hold the Imhoff cone steady. Have another person hold the filter (neck of the plastic bottle should be pointing down), directly over the Imhoff cone.
3. The person with the water should slowly pour the dirty water through the filtration chamber until all of the water has passed into the Imhoff cone. Remember the person with the *most* water that is clean will win, so wait for as many drops as possible.
4. When you feel that you have filtered as much water as possible, carefully remove the filter chamber and set aside. Do not clean out the filter chamber!
5. Wait ten minutes. When time is up, the facilitator will mark a sediment line and a water line with permanent marker on your Imhoff cone.
6. The Imhoff cone with the least amount of sediment *and* the most water will be declared the winner!