National Aeronautics and Space Administration

Educational Product	
Educators	Grades K–4

Educational Topic

Clean Water . . . Where Does It Come From?
Water Purification for the International Space Station

Objective
Students will construct a filter to demonstrate and simulate the water purification system on the International Space Station.

Science Standards
Science as Inquiry
Life Science
- The characteristics of organisms
- Organisms and their environment

Science and Technology
- Understanding about science and technology

Science in Personal and Social Perspectives
- Personal health

Math Standards
Estimation
Measurement

Materials Needed
(per group, class, or student)
Clear plastic soda bottle (2-liter)
Gravel (aquarium)
Sand
Aquarium charcoal (activated)
Cheesecloth (a nylon stocking can be used instead)
Muddy water
Rubber bands
Food coloring (optional)
pH water testing kit (optional)
Vinegar (optional)

Background Information
The International Space Station inhabitants will join the world in the effort of recycling. The recycling that will be done is different than that which may take place in your home or school. The astronauts will be recycling their water. This includes respiration, perspiration, shower and shaving water, and even urine. These waste waters will be purified and then used as drinking water.

Biological treatments are used to purify water on Earth. The microorganisms used in this process destroy contaminants in the water. The International Space Station will use physical and chemical processes to remove contaminants. The Urine Processor will remove volatile components in the urine using distillation (heat disinfection used to prevent microbial growth). Less desirable and volatile components will remain as a liquid brine, which will be returned to Earth and disposed.

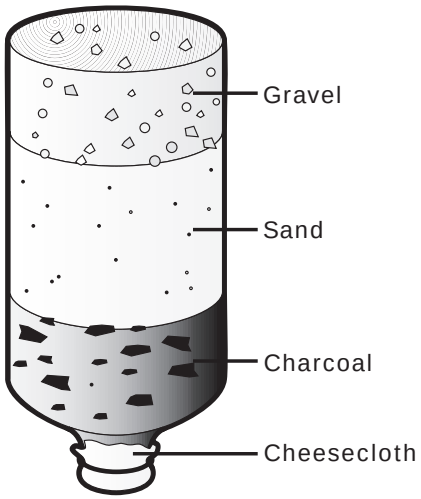
The International Space Station will also use filtration and temperature sterilization to ensure the water is safe to drink. Water will be checked often to ensure it meets the water quality requirements and monitored closely for bacteria, pollutants, and proper pH (a measure of the acidity or alkalinity in the solution). The pH scale ranges from 0 to 14. Substances with a pH value of 7 are neither acidic nor basic. Pure water has a pH value of 7. The lower pH value indicates higher

acidic levels; the higher the pH value the more alkaline the substance is. Public water systems have to meet a pH level of 6.5 to 8.5. Even though the Space Station water system specifications range from 6.0 to 8.5, the recycled water on the International Space Station is almost sterile and much better than water from a tap at home or at school. There is no odor or bad taste.

For Space Shuttle missions, it is not necessary to recycle the water or waste products. The Shuttle fuel cells produce water as a byproduct; however, water recycling will be imperative for long-duration missions such as on the Space Station or possible trips to Mars. There will be no fuel cells on the Space Station; therefore water will not be produced. In addition, a spacecraft on a lengthy trip to Mars would be limited to the amount of water it could carry because of weight restrictions.

Water Filtration Model Activity

Note: This experiment only demonstrates a type of water filtration. The experiment will not purify water for drinking purposes.



Activity Procedure

Step 1: Cut the bottom off the soda bottle. Cover the mouth with several layers of cheesecloth and secure them with a rubber band. Suspend the bottle upside down with its mouth over a glass to catch the filtered water.

Step 2: Fill the bottle with charcoal to a depth of 5–8 cm. Place 8–10 cm of sand on top of the charcoal. Place 5–8 cm of gravel on top of the sand.

Step 3: Stir the muddy water and pour it into the filter. Watch closely as the water seeps down through the three filtering layers of gravel, sand, and charcoal.

Discussion

1. What happened to the water while it passed through the different layers of the filter?

2. Compare the muddy water to the filtered water. Is there a difference?

3. Would it make a difference if one of the layers had been left out?

Assessment

1. Have the students draw a diagram of the water filter.

2. Write a list of instructions for building a water filter.

Extensions

1. Collect and filter other samples of water containing suspended particles. A clay/water mix or flour/water mix works well.

2. If possible, check the pH level of filtered water samples and compare to unfiltered water samples.

3. Filter particle/water mixtures to which food coloring has been added.

4. Design and build a water filter using different materials.

5. Write a description of how the water filter works and the results obtained from the different samples tested.

6. By checking the water clarity and the pH, determine how many gallons of muddy water can be treated by the filter before the filter is expended.

For more information about the International Space Station, please visit: **http://station.nasa.gov**

Please take a moment to evaluate this product at ***http://ehb2.gsfc.nasa.gov/edcats/educational_topic*** *Your evaluation and suggestions are vital to continually improving NASA educational materials. Thank you.*