Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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Where Do We Get Clean Water?

Length of Lesson: 50min

Grade Level: K-4

I. Overview
This lesson is a demonstration of a filter.

II. Resources, materials, and supplies needed
- Clear 2-liter bottle with labels removed
- 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)

Pre-Lesson Instructions:
Gather materials for a demonstration. A hairdryer on low heat can be used to remove the label on the 2-liter bottle. Hold the bottle about 6 inches from the hair dryer. Move the hot air up and down the seam of the label. When heated, it can be easily removed. Once the label is off, cut the bottom of the bottle off, just above the curve of the bottle. Note: This experiment only demonstrates a type of water filtration. The experiment will not purify water for drinking purposes!

Background Information:
The International Space Station (ISS) inhabitants will join the world in the effort of recycling. This recycling will be different from that which may take place in your home or school. The astronauts will be recycling their water. This includes the moisture they exhale, sweat, shower and shaving water, and even urine. These wastewaters will be purified and then used as drinking water.

Biological treatments are used to purify water on Earth. This process uses microorganisms to destroy contaminants in the water. The ISS crew will use physical and chemical processes to remove contaminants. The Urine Processor will remove contamination in the urine using distillation (heating of a liquid to prevent microbial growth). Components that cannot be eliminated will remain as liquid brine, which will be returned to Earth.

The ISS will 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

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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 ISS water system specifications range from 6.0 to 8.5, the recycled water is almost sterile and much better than tap water 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 ISS 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.

Guidelines:

This activity is a demonstration for the class.

1. Cover the mouth of the bottle 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.
2. Fill the bottle with charcoal to a depth of 5-8 centimeters (cm). Place 8-10 cm of sand on top of the charcoal. Place 5-8 cm of gravel on top of the sand. See the diagram below.
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/Wrap-up:

- What happened to the water while it passed through the different layers of the filter?
- Compare the muddy water to the filtered water. Is there a difference?
- Would it make a difference if one of the filtering layers had been left out?
- Have the students draw a diagram of the water filter, and explain how it works.

Extensions:

- Collect and filter other samples of water containing suspended particles. A clay/water mix or flour/water mix works well.
- If possible, check the pH level of the filtered water samples, and compare them to the unfiltered water samples.
- Add food coloring to mixtures before filtering them.
- Design and build a water filter using other materials.
- By checking the water clarity and the pH, determine how many gallons of muddy water the filter can treat before it is expended.

References and Resources:

- *Hot Science – Cool Talks #42, "Fighting Deadly Diseases", Dr. Laurel Ancel Meyer*, www.hotsciencecooltalks.org
- NASA Explores, http://nasaexplores.nasa.gov/show_k4_teacher_st.php?id=021123154706
- *"NASA* Spacelink—Clean Water…Where Does It Come From?" and "Environmental Protection Agency — Ground Water Quality: Contamination Menu"