International Space Station Water Purification

Mission Team members will construct a filter to demonstrate and simulate the water purification system on the International Space Station.

Standard:

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

Discussion:

Hello, my name is *put name here.* Today we are going to work on understanding what things must be done to live in the hostile environment of space. The International Space Station inhabitants or perhaps the first settlers on a new world will join our world in the effort of recycling. The recycling that is done on the Space Station is different than that which may take place in your home or school. The astronauts recycle their water. This includes respiration, perspiration, shower and shaving water, and even urine. These wastewaters are 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 uses physical and chemical processes to remove contaminants. The Urine Processor removes volatile components in the urine using distillation (heat disinfection is used to prevent microbial growth). Less desirable and volatile components remain as liquid brine, which is returned to Earth and disposed.

The International Space Station also uses filtration and temperature sterilization to ensure the water is safe to drink. Water is 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.

Mission Team Activity – Water Purification for the International Space Station or a Mars trip

Materials and Tools:

(per group, or Mission Team member)

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)

Procedures:

Water Filtration Model Activity

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

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 Questions:

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 Mission Team draw diagrams 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.

Mission Team Leaders notes:

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