National Aeronautics and
Space Administration

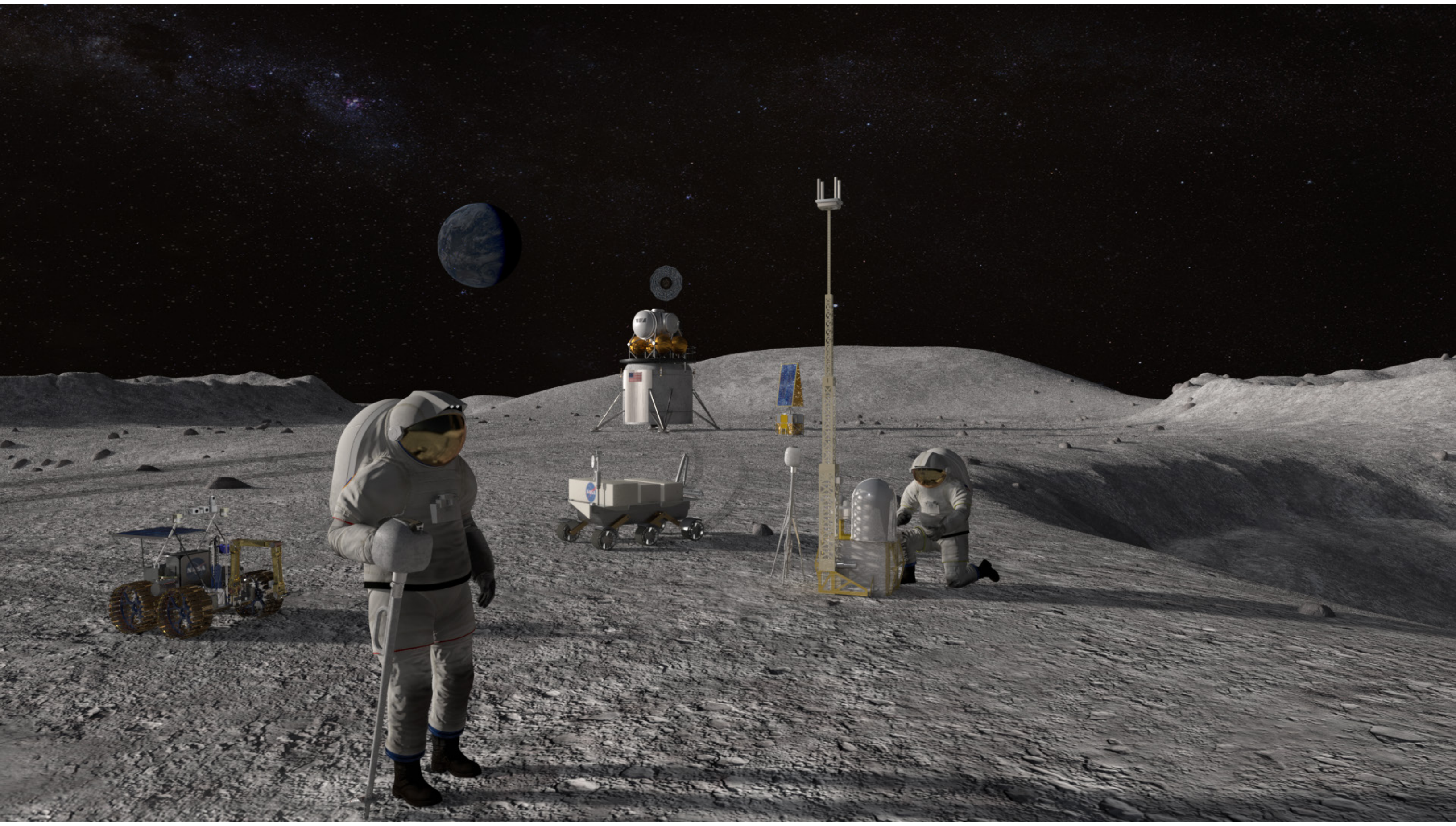
NASA STEM ACTIVITY

CLEANING WATER

OVERVIEW

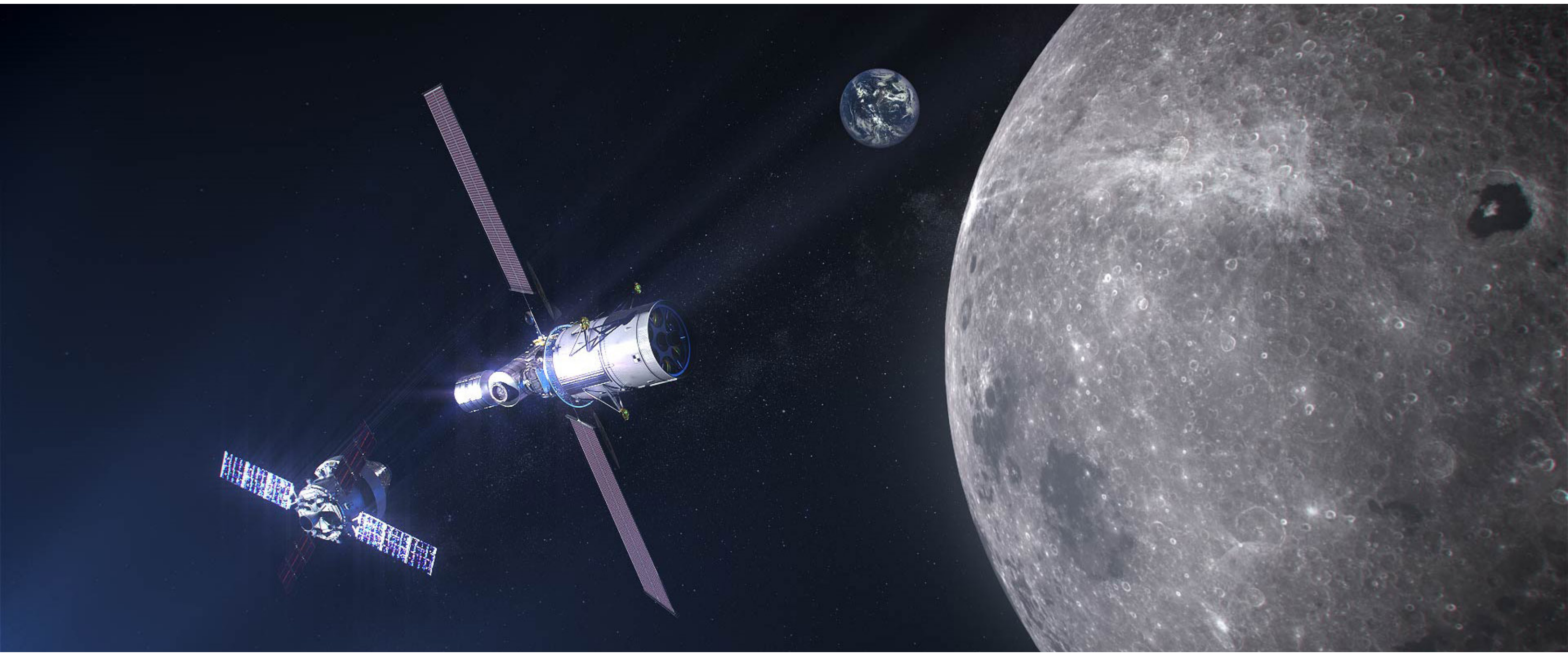
NASA has been given its most ambitious and challenging mission in half a century: to rapidly accelerate its human lunar program and land the first woman and the next man on the surface of the Moon in 2024. This program is named Artemis, after the Greek goddess of the Moon. Artemis is the twin of Apollo, the historic NASA program that first landed humankind on the Moon 50 years ago. Artemis will establish a long-term presence in lunar orbit and on the surface of the Moon. The goal of Artemis is continuous exploration of the lunar surface through a sustainable human presence on the Moon.

This is not an easy task. Even though some of the hardware, such as the Space Launch System (SLS) and Orion, have been in development and are nearing completion, there are several critical technologies, including spacesuits, Gateway modules and a lunar lander, that must be engineered, designed and built at a rapid pace. While NASA and its commercial partners are at work developing this hardware, you can participate as well. These activities simulate some of the same challenges faced by NASA astronauts, engineers, and scientists. It is your mission to solve these challenges throughout the lunar mission, from demonstrating the distance of the Moon from Earth, to launching a rocket and keeping astronauts healthy after landing on the Moon, We are counting on you!



ORBITING THE MOON ON GATEWAY

It takes three days to go to the Moon from Earth. When astronauts head to the Moon, it will also be orbiting the Earth, and will no longer be in the same spot where they aimed. Instead, astronauts must travel in a trajectory where Orion, and the Moon arrive at the same place, at the same time. Astronauts will also use the Moon's gravity to help them get into its orbit so they don't miss the Moon and keep traveling into space. There, they will dock on NASA's Gateway, an orbiting spaceship near the Moon serving as an outpost and rest area for astronauts visiting the Moon and eventually Mars. Gateway's first phase will be there for Artemis 3's crew. It will have a power and propulsion module for energy and movement in orbit, a living space, supplies for visiting astronauts, and a lunar landing module to take astronauts to and from the Moon. Today, we can get supplies to the International Space Station (ISS) very quickly because it is much closer to Earth. With Gateway, NASA scientists have taken what they learned on ISS so astronauts can recycle water using a water filtration system to keep themselves healthy as they live and work in space.



Related Videos:

Exercise STEMonstration

Nutrition STEMonstration

Challenges of Spacewalking

CLEANING WATER

Objective

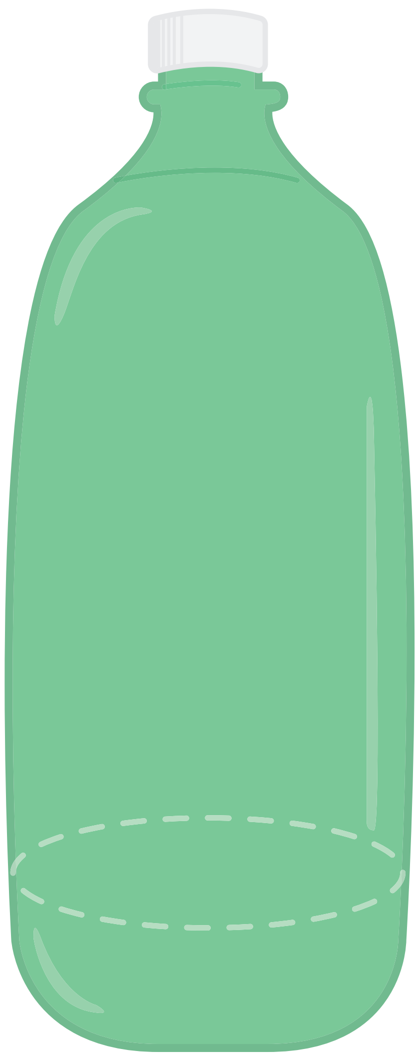
Following this activity, you will be able to:

- Design and build your own water-filtration system.
- Collect data to compare water before and after filtration.
- Develop a conclusion based upon the results of this experiment.

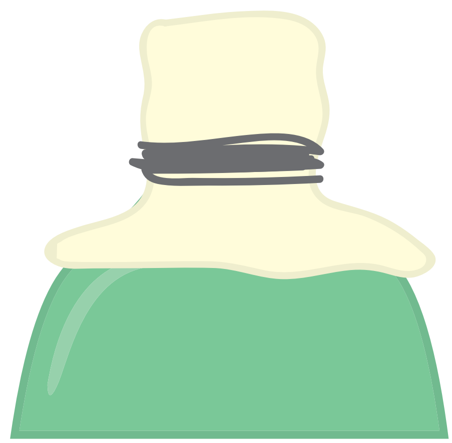
Materials

- Safety glasses
- 2-liter bottle with the bottom cut off and cheese cloth secured around the top
- 3 filtration materials (examples include: aquarium gravel, play sand, activated carbon, activated charcoal, marbles, cotton balls, coffee filters, packing materials)
- 5 litmus paper strips (Note: If you are unable to locate litmus paper, search for an alternate pH detection system using red cabbage)
- 1 metric ruler
- 3 large, clear plastic cups with a hole punched just below the rim
- 3 paper plates
- 1 metric liquid measuring cup
- 500 ml of clean water
- 500 ml of gray water (1 part Italian salad dressing to 5 parts water, shaken, in a large, clean container)

Punch hole near the top of cup.



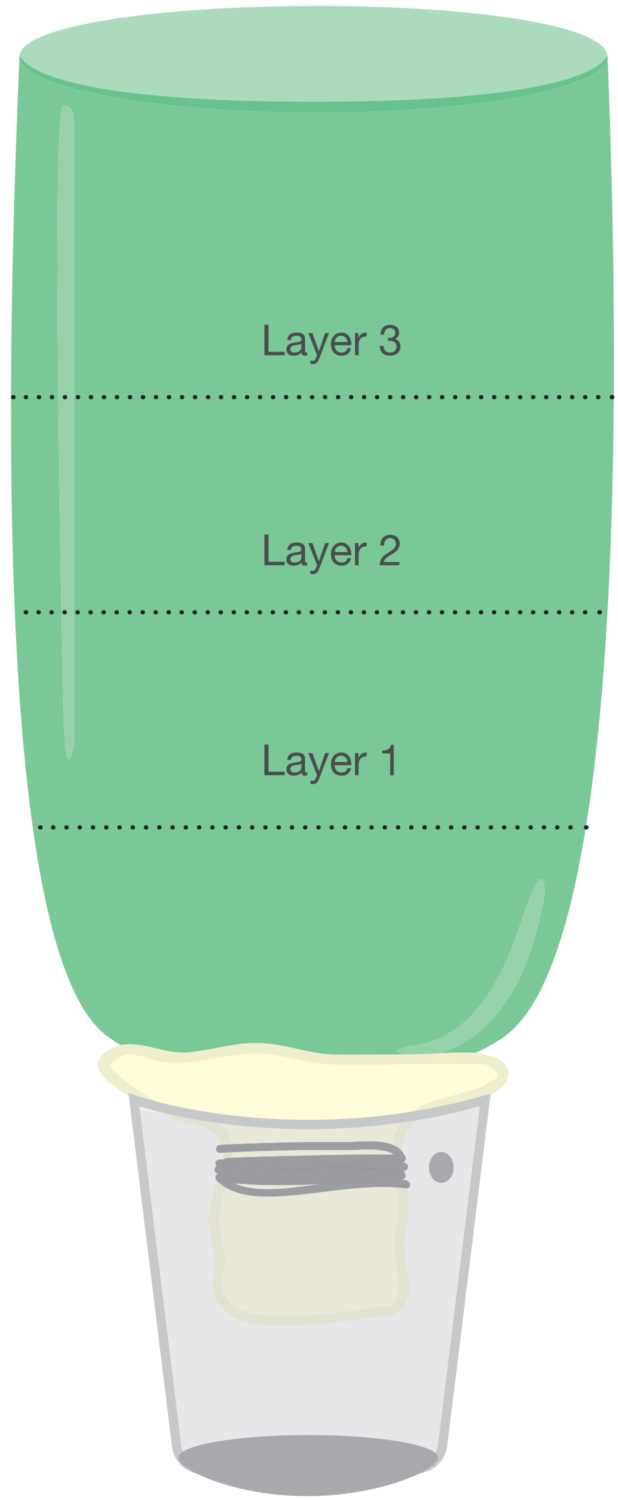
Cut off bottom of the bottle, just above the curve of the bottle.



Cover the mouth of the bottle with at least 10 layers of cheesecloth and secure the lid.

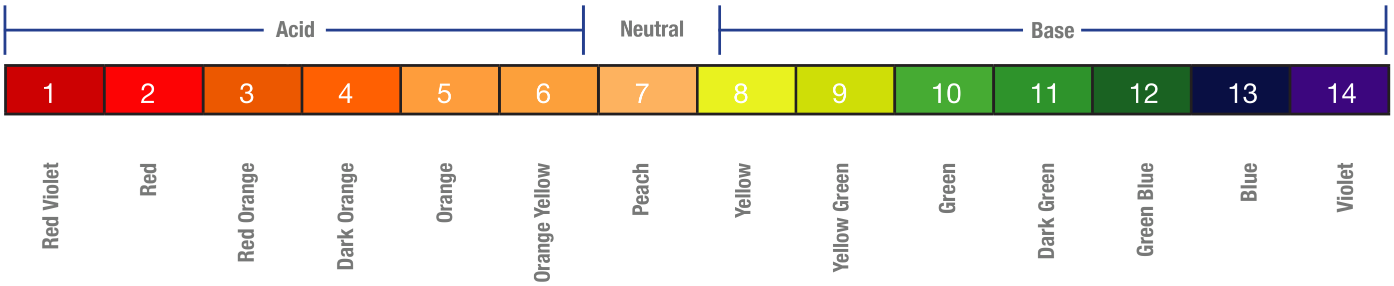
Procedure

1. Put on your safety glasses.
2. Watch the STEMonstration: Water Filtration video on YouTube.
3. Place a bottle upside down with its mouth over the clear plastic cup to catch the filtered water.
4. Choose three of the filtration materials listed above.
5. Gather your filtration materials on the paper plates, with one on each plate. Decide the order in which to layer your materials.
6. Fill the bottle with the first filtering material to a depth of 5 to 8 centimeters (cm). Note: Coffee filters and cotton balls will need to be packed down.
7. Place the second filtering material to a depth of 5 to 8 cm on top of the first one.
8. Place the third filtering material to a depth of 5 to 8 cm on top of the second filtering material.
9. Obtain 350 ml of clean water. Observe the properties of the water before you filter it by using the wafting technique to smell the water. Measure the pH of the water with litmus paper and compare it to the pH color chart below.
10. Collect data and record your observations on the Cleaning Water Data Sheet below. Remember the smelling rules in the science lab and do not taste.Run clean water through your water-filtering system to make sure it will allow water to flow through.
11. Once the clean water has gone through the water-filtering system, replace the clear plastic cup with a new one. If the water is sandy, it should be disposed of outside. Otherwise, it can be disposed of in the sink.
12. Get 350 ml of gray water. Observe the properties of the water before you filter it. Check the odor of the water. Measure the pH of the water with litmus paper and compare it to the pH color chart. Collect data and record your observations on the Cleaning Water Data Sheet.
13. Run the gray water through your water filtering system. Observe the properties of the water after it has been filtered once and record your observations on the data sheet. Measure the pH of the water with litmus paper and compare it to the pH color chart. Collect data and record your observations on the Cleaning Water Data Sheet.
14. Replace the clear plastic cup with a new one. Pour the filtered water back into the water-filtering system.
15. Filter the water again. While the gray water is running through the water-filtering system, reflect on what each layer in your filtration system did to the water.



16. Observe the properties of the water after it has been filtered for the second time. Check the odor of the water. Measure the pH of the water with litmus paper and compare it to the pH color chart. Collect data and record your observations on the Cleaning Water Data Sheet.

pH COLOR CHART



Properties	Clean Water	Gray Water Before Filtering	After 1st Filtering	After 2nd Filtering
Odor				
Appearance				
pH				

Conclusion

- What happened to the water as it passed through the different layers of the filter? *Some of the contaminants were absorbed by or stuck to the different filter materials, and the water returned to its original clear form.*
- What changes occurred to the properties of the gray water as it was filtered (pH, appearance, odor)? *The gray water lost the gray color and odor after processing through the filtration system. The smell became fainter.*
- Compare your filtered water to the clean water. Did your gray water become “clean?” What properties told you it was or was not “clean?” *Yes, the pH value (varies) was an indicator of the cleanliness of the water.*
- Does this data support your hypothesis? Why or why not? *Answers may vary.*
- If you could build a water-filtering system by using any of the materials available in the class, which three materials would you use, and in what order would you layer them? Why? *Answers may vary. Examples of efficient materials include activated carbon/charcoal and sand.*
- Based on your findings, what would you suggest to NASA scientists and engineers designing filtration systems and water-recycling methods? *Answers may vary.*

Reference

Modified from Cleaning Water Activity: https://go.nasa.gov/30w2s53

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