Recycling on the Moon

Grade Level: 5 - 6

Time Required: 3 - 4 class periods

Countdown:
- Hot Plate
- 1 Candle
- Small Pot
- 3 Jars (different sizes) 1 Jar per student
- Cookie Sheet
- Ice Cubes
- Seeds (alfalfa, radish, soybeans, etc.)
- Masking Tape
- Plastic wrap/foil
- Strainers

Ignition:
The moon, according to our most recent information, is a “dead world”. There is no air to breathe, no vegetation, no life of any kind. The temperatures are extreme – 266 degrees F during the day and -200 degrees F during the two week lunar night. Nevertheless, human beings have already visited the moon briefly, NASA's Lunar Prospector orbited the moon collecting data, and many scientists have begun making ambitious plans for possible permanent human bases on the moon.

At first, people who are traveling and planning to visit the moon will be required to bring all of their food, water, and air with them from Earth. Eventually, though, these necessities will need to be generated and recycled on the moon by means of life-support Systems designed for long-duration space missions.

Liftoff:

Experiments with Water
1. Emphasize that water in a life-support system needs to be reused or recycled.
2. Demonstrate the recycling of water as follows:
   - Fill the small pot with water, and heat the water until it boils.
• Put the ice cubes on the cookie sheet, and hold the sheet carefully over the pot of boiling water.
• Have the students describe what happens.
• Compare the results with the Earth water cycle. Define the terms condensation, precipitation, and evaporation.

3. Emphasize that water, when recycled continuously in a life-support system, needs to be cleaned. Elicit from the students different methods of purifying the water.

4. Ask the students to design their own water-purification devices. This could possibly be a home assignment or group classroom assignment. The experiments should meet the following criteria:
   • The device will be designed to remove 10 grams of dirt from 250 ml of water in a time period of 5 minutes.
   • At least half of the water will be returned to the collecting jar.
   • A water clarity scale will be used to assess the device’s ability to cleanse the water.
     

<table>
<thead>
<tr>
<th>Water Clarity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no difference noted</td>
</tr>
<tr>
<td>1</td>
<td>very dirty</td>
</tr>
<tr>
<td>2</td>
<td>somewhat dirty</td>
</tr>
<tr>
<td>3</td>
<td>slightly dirty</td>
</tr>
<tr>
<td>4</td>
<td>mostly clear</td>
</tr>
<tr>
<td>5</td>
<td>clear</td>
</tr>
</tbody>
</table>

• Student record keeping should include the following:
  • Written plan of design
  • Sketch of design
  • List of materials used (inexpensive materials – recycled, if possible)
  • Step-by-step instructions for constructing the device
  • Data observed and recorded in a table or chart
  • After the students present and test their devices for the class, elicit ideas about which materials achieved the best results and why. Discuss also which designs were the most effective.

One example of a possible device is shown below:

![Drawing of filtration system]

- Cotton
- Sand
- Coffee Filter
- Jar

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SpaceExplorers http://www.tsgc.utexas.edu/spaceexplorers/
Life Sciences: Recycling on the Moon
Texas Space Grant Consortium http://www.tsgc.utexas.edu/
More ideas:

♦ Visit a water purification plant.
♦ Invite a guest speaker. Possibilities include:
  - City Water Department on conservation
  - Health Department on water contamination and possible diseases
♦ Observe your home practices. What methods are used to reduce water consumption? How can this effect your family? Your environment? (Examples: low flow toilet and shower devices, take shower instead of bath, use bath water to wash cars, etc.)
♦ Design a media campaign (mailout, article, story, TV advertisement, radio PSA, etc.) on water conservation.

Computer:

Research and write a paper on where your city gets its water. Check city water rates. How can you reduce your home water bill?

Art:

⇒ Prepare a salt map on the route your water takes to get to your city.
⇒ Design a poster on the importance of water conservation.

Experiments With Air

1. Discuss that the air in a life-support system has to be recirculated. Ask why people in such a system don’t breathe up all the air.
2. Conduct the following experiment:
   • Carefully set the candle in a safe place, and light it.
- Set the smallest jar upside down over the candle.
- Record the time it takes the candle to go out.
- Predict what will happen with the other 2 jars. Follow the same procedure with both.
- Why did the candle go out? Ask the students to predict how long the candle would burn in a domed moon base.

**Experiments With Food**

Explain that in NASA’s Advanced Life Support System (ALSS), green plants will be used to convert carbon dioxide to oxygen through photosynthesis, provide potable water through evapotranspiration, recycle organic wastes, and produce food. Synthetic soil containing plant-growth nutrients plus water will be used to grow these plants.

1. Ask students if it is possible to grow food without soil.
2. Perform the following experiment:
   - Give each student a jar and several seeds (one type).
   - Have jars labeled with student names and seed type.
   - Put seeds in the jar and add 100 ml of water.
   - Cover with foil/plastic wrap. Leave overnight.
   - Discuss with students the data to be observed, i.e., water absorption, rate of growth, weight, and length.
   - On the second and succeeding days, drain the seeds, rinse them twice, and cover lightly. Store the jars in a dark place.
   - After the first leaves begin to appear on the sprouts, set the jars outside in the sun for a few hours daily to develop the chlorophyll.

Students will measure plant growth daily in cm.
Students will chart their findings.

**Computer**

Have students research the seed that they sprouted. What is the nutritive value of these sprouts as a food source? Determine if they are low in fat, high in minerals, vitamin content, etc. Find or create a recipe using this sprout.

- At the conclusion of the experiment, discuss the value of sprouts as a food source.
Discuss the life support systems in the diagram below. Write a paper that will compare and contrast these life support systems with our own way of living at the present time on Earth.