LIVE INTERACTIVE LEARNING @ YOUR DESKTOP

Engineering Design Challenge: Water Filtration

Presented by: Kristy Hill

March 13, 2012
ENGINEERING DESIGN CHALLENGE: WATER FILTRATION
Engineering Design Challenge: Water Filtration
Water Filtration

• Have you had a chance to look at this lesson?

✔ Yes

✖ No
Syllabus

- Lesson overview
- NASA connection
- Lesson in detail
- Extensions
National Standards

• Grade Level: 5-8
• Physical Science
• Science & Technology
• Science as Inquiry
• Measurement
• Design
This Guide offers:

Lesson Plan
Background Information
Career Highlights
Teaching Standards
Materials List
Material Cost Estimate
Student Worksheets
Diagrams
Glossary
The Challenge

• Students will design a water filtration device that will yield the purest water.
• Students will practice using the engineering design process.
Let’s pause for questions from the audience.
NASA Connection

Water Filtration
75% of the Earth’s surface is water
Why is water important?

Type answers into the chat box.
Water: The Essence of Life

• All living things contain water.
• 70% of the human body is water.
• Water is used in every aspect of our lives.
Water Recycling

Water is recycled by

—Nature
Water Recycling

Water is recycled by

– Nature
– Cities
Water Recycling

Water is recycled by

- Nature
- Cities
- International Space Station
Water Recycling by Nature

- Earth has a natural process to recycle water.
City Water Recycling

• Cities and counties recycle water for human consumption.
• Water Treatment Facility
Living in Space

Mercury
Gemini
Apollo
Space Shuttle
International Space Station
Did you know it costs approximately $10,000 per pound (0.5 kg) to launch into space?

How much would it cost to send you into space?
Water is needed for:
Drinking
Food Preparation
Cleaning
Environmental Control and Life Support System (ECLSS)

Shown: Two “Express Racks” that fit into slots at the ISS
Environmental Control and Life Support System (ECLSS)

Shown: Two “Express Racks” that fit into slots at the ISS

- Provides water for drinking, food prep and hygiene
- Provides oxygen and removes carbon dioxide
- Filters particulates and microorganism from air
- Maintains cabin pressure
- Monitors temperature and humidity levels
- Circulates air through the modules
ECLSS lab at Marshall Space Flight Center
Let’s pause for questions from the audience.
Do you already teach the Engineering Design Process in your classroom?

☑ Yes
☒ No
# Materials

<table>
<thead>
<tr>
<th>Classroom materials</th>
<th>Group materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
<td>Water bottles</td>
</tr>
<tr>
<td>Bucket or sink</td>
<td>Cheesecloth</td>
</tr>
<tr>
<td>Graduated cylinder</td>
<td>Plastic wrap</td>
</tr>
<tr>
<td>pH test strip</td>
<td>Cotton balls</td>
</tr>
<tr>
<td>Conductivity tester</td>
<td>Coffee filters</td>
</tr>
<tr>
<td>Vinegar</td>
<td>Activated carbon</td>
</tr>
<tr>
<td>Food coloring</td>
<td>Aquarium gravel</td>
</tr>
<tr>
<td>Plastic cups</td>
<td>Sand</td>
</tr>
<tr>
<td>Paper towels</td>
<td>Uncooked macaroni</td>
</tr>
</tbody>
</table>

*Check guide for a full list of materials.*
Procedures

- Cut off the bottom of the water bottle.
- Cover the drinking end with cheesecloth.
- Select medium for the filtration system.
- Layer the materials in the bottle.
Procedures

• Test the wastewater’s pH and conductivity.
• Pour wastewater through the system.
• Test filtered water for pH and conductivity.
• This is a slow process. Give the water time to filter.
• Pour filtered water through system again, retest, and redesign.
Hint

• In order to reuse your materials, have students stack all materials in coffee filters.
Data Collection Sheets

Class Data Sheet

<table>
<thead>
<tr>
<th>Team Name</th>
<th>Filter Media (Top to Bottom)</th>
<th>UF pH</th>
<th>F pH</th>
<th>UF Conductivity</th>
<th>F Conductivity</th>
</tr>
</thead>
</table>

Design and Evaluation Sheet

Team Name:  
Date:  
Version #: 
Team Members: 

Design Phase

1. Sketch the filtration device. Draw and label the filter media in the order in which they were placed in the device. Label approximately how much was used of each.

Test Results

3. Record the appropriate data.

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Pre-Data</th>
<th>Post-Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color/Clarity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Test Observations

5. What did you learn that will help you design the next version?
Measuring Conductivity

• Conductivity is a measure of a material’s capacity to conduct electricity.
• Completely pure water will not conduct electrical current.
• Instructions are given in guide.
Let’s pause for questions from the audience.
Extensions and Resources

Water Filtration
Extensions

• Test water from different sources.
• Test other filter media.
• Tour a water treatment plant.
• Set a weight limit on the filtration device.
• Research other water treatments such as desalination.
Culminating Activity

• Create a “storyboard” poster that documents the evolution of the water filtration designs from initial to final stages.
NASA eClips

• Our World: Recycling on the International Space Station

• Aimed at grades K-5
WLMR
Waste Limitation Management and Recycling Design Challenge

Middle School Design Challenge

Video for student interest.
This challenge is no longer funded.
Let’s pause for questions from the audience.
NASA EXPLORER SCHOOLS
http://explorerschools.nasa.gov
• Are you a part of NASA Explorer Schools?
  ✔ Yes
  ✗ No
Finding the Guide

Lesson Library

Video Tutorials
Finding the Guide

The Lesson Library provides a comprehensive set of teaching materials for dozens of science, technology, engineering and mathematics, or STEM, concepts.

**Lessons and Support** -- Each lesson is aligned to national standards and includes instructional objectives, supplemental digital resources, and classroom lesson plans. Professional development videos and web seminars are available to provide ideas on to implement the lesson in the classroom. After the lesson has been implemented in the classroom, log participation by taking the survey found on the lesson page.

**Searching the Lesson Library** -- Find lessons using the search below. Narrow the results by selecting a check box for grade, subject or keyword. Hit the view button. 

How to Utilize the Lessons

**Featured Lesson**

**Algebraic Equations:**

- Transit
- Tracks
- Finding
- Habitable Planets

**Grades 9-12**

**Subjects/Topics:** Mathematics:

- Algebra 2 / Physical Science

**Description:** Students investigate light curve data gathered from ten planets by Kepler, then use the data to determine period, orbital distance and size of the planet. Using Newton's third law to find planet size, students compare Kepler planets to planets in our solar system.

To narrow selections, check all boxes that apply. Hit the view button.

- **Grade Levels:**
  - 4  5  6  7  8  9  10  11  12
  - **Science**
  - **Technology**
  - **Engineering**

**Search Keywords:**
**Lesson**

**Video Collection**

**Surveys**

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**Water Filtration**

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**ENGINEERING DESIGN CHALLENGE: WATER FILTRATION**

*Lesson Information*

- **Lesson(s) Covered:** Earth and Space Science, Physical Science
- **Topic(s) Covered:** Waste Water Management, Chemistry of Water, Water Cycle, Engineering, Conductivity, Alkalinity, Mixture, Solution, Evaporation, Condensation

*Activity Type:* Inquiry-based challenge

*Grade Level:* 9-10

*Instructional Objective:* Students develop the abilities to apply the engineering design process, measure pH and conductivity of water, and explain the importance and function of water purification.

*Time to Complete the Activity:* Three to four 45 minute classes

*Materials Needed:*

*National Content Standards:*

**Log Your Participation**

- to become eligible for NEES Recognition
- Completed surveys will be added to your My Activities page

**Additional Resources**

- **Classroom Resources:**
- **Connection to NASA:**
- **Extension Activities:**

**Professional Development**

- Click here to find the live web seminars scheduled for this featured lesson. Web seminars are led remotely by NASA subject matter experts and education specialists.
- Click here to access the teacher video collection for this featured lesson.

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**NASA Explorer Schools**
Video Collection

Video 1 of 6: Activity Overview

In this brief video overview, watch a sneak peak of students engaged in the activity and learn about the objectives and standards addressed in this challenge.
Collaboration
Making Teaching Easy

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NEON - NASA Educators Online Network

NASA Explorer Schools ➔ Engineering Design Challenge: Water Filtration
Collaborate on using the Water Filtration EDC with students.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Date Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eighth grade students complete Waste Limitation Management Water Recyclin...</td>
<td>01/28/2011 11:04 AM Kristy Hill</td>
</tr>
<tr>
<td>I modified this activity by...</td>
<td>10/06/2010 12:50 PM Kristy Hill</td>
</tr>
<tr>
<td>When I do this activity again, I will...</td>
<td>10/06/2010 12:49 PM Kristy Hill</td>
</tr>
<tr>
<td>I need help with...</td>
<td>10/06/2010 12:49 PM Kristy Hill</td>
</tr>
<tr>
<td>Here is a related resource I found...</td>
<td>10/06/2010 12:49 PM Kristy Hill</td>
</tr>
<tr>
<td>My students are great because...</td>
<td>10/06/2010 12:48 PM Kristy Hill</td>
</tr>
<tr>
<td>Participate in a Live Adobe Connect Webinar! 🎫</td>
<td>10/06/2010 12:47 PM Kristy Hill</td>
</tr>
</tbody>
</table>

http://neon.psu.edu
Thank you for participating today!

Kristy.Hill@nasa.gov
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