NASA/NSTA Web Seminar:

21st Century Explorer – Today’s Knowledge for Tomorrow’s Explorer

Explorador del Siglo 21 – El Conocimiento de Hoy Para el Explorador del Mañana

Thursday, May 15, 2008
NASA
Human Research Program
Education and Outreach Project

21st Century Explorer Project
Today’s Knowledge for Tomorrow’s Explorer

Explorador del Siglo 21
El Conocimiento de Hoy Para el Explorador del Mañana
How comfortable are you teaching general science concepts to your students?

Use your emoticons to respond to this question.
How do your students feel about learning science?

Use your emoticons to respond to this question
Introductory Video

- Available in Spanish and English
- Inspire & motivate your students!
- Inform them about what they will learn during the 21st Century Explorer activities!
Project Focus

• Built upon the ‘go to the people’ philosophy.

Project Goals

• To excite and encourage students to pursue their interests in science, technology, engineering, and mathematics (STEM) while involving the community in the process.

• To educate learners of all ages about space exploration.

This project will help build the journey of the 21st century explorer.
Educational Packages

The 21st Century Explorer educational packages contain a series of free bilingual educational materials, focusing on space exploration, for grades 3-5 emphasizing national and state standards-based instruction, problem-based learning, and scientific inquiry. Each of the twelve, bilingual educational packages consists of:

- a 30-second, multimedia, student-hosted newsbreak
- a web explanation of the space exploration topic
- an educator guide and student hands-on activity, and
- supporting materials (glossary, quiz, and book and web resources).

All educational materials are available on a website for free access, download, and use.

Visit the website at: http://education.jsc.nasa.gov/explorers
Seminar Overview

• **WHY** do we need to recycle water?
• **HOW** do we recycle water?
What do you need for life support?

Food to eat

Air to breathe

Water to drink
The Purpose of Life Support in Space

- Duplicate the functions of the Earth in terms of human life support
- Spacecraft do not have the benefit of the Earth’s large buffers --- oceans, atmosphere, and land masses
- How small can the required buffers be and yet maintain extremely high reliability over long periods of time in a hostile environment?
If Water = Elephants . . .

- If you had to carry all your water with you for a year, how many elephants would the water equal?
Human Life Support Requirements

Open-loop life support system resupply mass
12,000 kg/person-year
(26,500 lbs/person-year)

10,680 kg
(23,545 lbs)
(2827 gallons)

- Water 89%
- Oxygen 2.5%
- Food (dry) 2.2%
- Crew Supplies 2.1%
- Gases lost to space 2.1%
- Systems Maintenance 2.1%
The Importance of Recycling

• We **REDUCE** the amount of water we carry to space by . . .

• **RECYCLING** our wastewater to drinking water

• This **CLOSES** the **WATER LOOP**.
<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Terrestrial Water Cycle

Water / wastewater treatment
Why do we recycle water?

Let’s Pause for Two Questions from the Audience
How do we recycle water?

- Many technologies can be used to treat water
  - Some are very similar to terrestrial technology
- Factors we consider when selecting how to treat water
  - Power
  - “Consumables” required
  - How much water can be recovered?
How do we recycle water?

- Space Station will use
  - Distillation
  - Filtration
  - Catalytic oxidation

Filtration media

Prototype Space Station Racks
Clean Water is the Result!

Are you willing to drink the product?
YES (√)
NO (X)
How do we recycle water?

Let’s Pause for Two Questions from the Audience
Educational Materials
Available in Spanish and English
Educator Version - [Link to PDF]

National Aeronautics and Space Administration

CLEANING WATER

Extracted from NASA's 21st Century Explorer newsbreak “Where would a space explorer find water and oxygen?”

Educator Section

Introduction
The astronauts onboard the International Space Station (ISS) join those of us on Earth in the recycling effort. They recycle their water and that includes the moisture they exhale, sweat, and the water they use to shower and shave. These wastewaters are purified and then used as drinking water.

Lesson Objective
This lesson challenges students to create and test a water filtering system.

Problem
What can I do to make clean water?

Learning Objectives
The students will
- design and build their own water filtering system.
- collect data to compare water before and after filtering.
- develop a conclusion based upon the results of this activity.
- compare individual results to class results to look for patterns.

Materials
- safety glasses
- 2-liter bottles
- cheesecloth
- rubber bands
- pH testing strips (litmus paper)
- metric rulers
- plastic cups
- paper plates
- metric liquid measuring cups
- mask bag (empty base)
CLEANING WATER

Student Section

This lesson challenges you to create and test a water filtration system.

During this lesson, you will:
- design and build your own water filtering system.
- collect data to compare water before and after filtration.
- develop a conclusion based upon the results of this activity.
- compare individual results to class results to look for patterns.

Problem
What can I do to make clean water?

Observation
The astronauts onboard the International Space Station (ISS) join those of us on Earth in the recycling effort. This recycling is different from that which may take place in your home or school. The astronauts recycle their water. This includes the moisture they exhale and sweat, as well as the water they use to shower and shave. These wastewaters are purified and then used as drinking water.

The ISS 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. The pH scale ranges from 0 to 14 and is a tool used by scientists to measure the strength of an acid or base. Proper pH balance of 7 is important to a human body.

pH COLOR CHART

<table>
<thead>
<tr>
<th>pH</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Acid</td>
</tr>
<tr>
<td>1-2</td>
<td>Red</td>
</tr>
<tr>
<td>3</td>
<td>Orange</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
</tr>
<tr>
<td>5</td>
<td>Green</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
</tr>
<tr>
<td>7</td>
<td>Blue</td>
</tr>
<tr>
<td>8</td>
<td>Blue</td>
</tr>
<tr>
<td>9</td>
<td>Blue</td>
</tr>
<tr>
<td>10</td>
<td>Blue</td>
</tr>
<tr>
<td>11</td>
<td>Blue</td>
</tr>
<tr>
<td>12</td>
<td>Blue</td>
</tr>
<tr>
<td>13</td>
<td>Blue</td>
</tr>
<tr>
<td>14</td>
<td>Base</td>
</tr>
</tbody>
</table>
Activity: Cleaning Water

Lesson Objective
This lesson challenges students to create and test a water filtering system.

Learning Objectives
The students will:
• design and build their own water filtering system.
• collect data to compare water before and after filtering.
• develop a conclusion based upon the results of this activity.
• compare individual results to class results to look for patterns.
Activity: Cleaning Water

Materials for Cleaning Water

- safety glasses
- 2-liter bottles
- Cheesecloth
- rubber bands
- pH testing strips
- metric rulers
- plastic cups
- paper plates
- metric liquid measuring cups
- mesh bag (panty hose)
- metric liquid measuring cups
- packing materials (Styrofoam peanut)
- Italian dressing
- aquarium gravel
- tap water or bottled water
- play sand
- activated carbon/activated charcoal
- Marbles
- cotton balls
- coffee filters
Activity: Cleaning Water
Activity: Cleaning Water

Safety

Remind students about the importance of classroom and lab safety!

Review the rules for smelling (wafting) in the science lab.

Students should wear eye protection during this activity. Materials Safety Data Sheets (MSDS) are required for this activity. You can find MSDS at http://www.msdssearch.com/msdssearch.htm.

This activity requires proper clean up.
Activity: Cleaning Water

**Construct the water filtering system structure:** (one per group)

Punch a hole in the top of each cup, just below the rim to avoid a vacuum.
Remove the labels on the 2-liter bottles and then cut off the bottom of the bottle, just above the curve of the bottle.

Construct the structure of the water filtering system by covering the mouth of the bottle with at least 10 layers of cheesecloth and secure with a rubber band.
**Activity: Cleaning Water**

**pH SCALE (Summary)**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 7</td>
<td>Acid</td>
<td>citrus juices such as lemon, orange, or lime sodas such as cola</td>
</tr>
<tr>
<td>7</td>
<td>Neutral</td>
<td>pure, clean water</td>
</tr>
<tr>
<td>Above 7</td>
<td>Base</td>
<td>toothpaste, baking soda</td>
</tr>
</tbody>
</table>
Activity: Cleaning Water

Test

• Put on your safety glasses.
• Place the bottle upside down with its mouth over the clear plastic cup to catch the filtered water.
• Choose three slips of paper from the teacher.
• Gather your filtration materials on the paper plates; one on each plate.
• As a group, decide the order in which to layer your materials.
• Fill the bottle with the first filtering material to a depth of 5–8 centimeters (cm).
• Obtain 350 ml of clean water. Observe the properties of the water before you filter it.
• Collect data and record your observations on the Cleaning Water Data Sheet.
• Run clean water through your water filtering system to make sure it will allow water to flow through.
• While you are waiting for the clean water to run through the water filtering system, draw and label your diagram to match your filtration system.

** If you stop the activity here, the filtering materials may dry-out before you resume. The filtration system will need to be “wet” again with another 500 ml. of clean water when you are ready to resume the activity.
Activity: Cleaning Water
Activity: Cleaning Water

My favorite experiment was when we filtered the water because we got to pick all of them and we used them all but it was dirty. Then we used all of them with the dirty water and it was cleaner.

By [name redacted]
Activity: Cleaning Water

Test continued:

• Get 350 ml of gray water. Observe the properties of the water before you filter it.
• Collect data and record your observations on the Cleaning Water Data Sheet.
• 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.
• Replace the clear plastic cup with a new one. Pour the filtered water back into the water filtering system.
• Filter the water again. While the gray water is running through the water filtering system, discuss in your group what each layer in your filtration system did to the water.
• Observe the properties of the water after it has been filtered for the second time. Collect data and record your observations on the Cleaning Water Data Sheet.
Activity: Cleaning Water

<table>
<thead>
<tr>
<th>Cleaning Water Data Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Odor</td>
</tr>
<tr>
<td>Appearance</td>
</tr>
<tr>
<td>pH</td>
</tr>
</tbody>
</table>
# Activity: Cleaning Water

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student developed a clear and complete hypothesis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student followed all lab safety rules and directions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student followed the scientific method.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student recorded all data on the data sheet and drew a conclusion based on the data.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student asked engaging questions related to the study.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student described at least one recommendation for NASA in the area of water recycling and water filtration.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Point Total**
21st Century Explorer Website

http://education.jsc.nasa.gov/explorers
21st Century Explorer Website

Spanish Version

Contact us!!

Educational Packages

Educational Packages

Explorador del Siglo 21  21st Century Explorer  39

National Aeronautics and Space Administration

Explorador del Siglo 21  21st Century Explorer  39

National Aeronautics and Space Administration
Incorporate these educational packages into:

- Existing Science Curriculum
- Summer School Program
- After-School Program
NASA’s 21st Century Explorer After-School Program
Houston, TX

Experiences:

* 3-Day Educator Training
* Hands-On Activities
* Flexible After-School Schedule
* Student Mentors (Universities/High Schools)
* Engineer and Scientist Speakers
* Final Project (media arts, language arts, engineering design, fine arts)
* Culminating Event
NASA’s 21st Century Explorer After-School Program
Las Cruces, NM

**Elementary Feeder 1**

**Elementary Feeder 2**

**Elementary Feeder 3**

**Middle School**

**What’s different?**

* Elementary Transition to Middle School

* Team-Teaching
  (Elementary and Middle School Teachers)
What kind of program could you implement using 21st Century Explorer materials?

1. 

2. 
Contact Information

Jaqueline Cortez, 281-212-1439
jaqueline.m.cortez@nasa.gov

Lisa Neasbitt, 281-204-1572
lisa.a.neasbitt@nasa.gov
Thanks to our presenters, Dr. Karen Pickering, Lisa Neasbitt, and Jaqueline Cortez, and to NASA for sponsoring this program.
Welcome to Your Professional Development

The Learning Center is NSTA's e-professional development portal to help you address your classroom needs and busy schedule. You can gain access to more than 2,600 different resources that cater to your preference for learning. Over 700 hundred resources, such as journal articles, science objects and web seminars are available for free. A suite of practical tools such as My Library, My Transcript, and My Professional Development Plan and Portfolio tool help you organize, personalize, and document your growth over time.

Explore Learning Opportunities

By Subject
- Earth & Space Science
- Life Science
- Physical Science

By Grade Level
- Elementary
- Middle School
- High School
- College

By State Standards
Find resources based on their correlation to your state standards.
Coming Soon!

Do-It-Yourself Learning
Learn at your own pace online with these 1-2 or 6-10 hour interactive activities.

Live Online Seminars & Classes
Learn online from certified instructors with your colleagues. 1-2 hour seminars, week and month long courses are available. Earn state
National Science Teachers Association
Gerry Wheeler, Executive Director
Frank Owens, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

NSTA Web Seminars
Flavio Mendez, Director
Jeff Layman, Technical Coordinator

LIVE INTERACTIVE LEARNING @ YOUR DESKTOP