**Life Support Systems (Lesson 1 of 3)**

**Introduction to Life Support Systems and Water Filtration**

**STEM Topics -** Water filtration and purification, acids and bases, importance of life support systems in outer space

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**Grade Level:** 6-8 Grade

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**Goals**: Introduce life support systems on the space station and demonstrate the importance of using water filtration to clean water on the space station.

**Learning Objectives:**

1. SWBAT learn water filtration concepts and the importance of using pH to determine the cleanliness of water.
2. SWBAT the principles of what life support systems do on a space station and the names of some of these systems.
3. SWBAT build and experiment with a simple water filtration system using water bottles, cotton, sand and coffee filters.

**Materials:**

Videos :

1.Water and You: The Water Treatment Process : -

<https://www.youtube.com/watch?v=tuYB8nMFxQA> - 4 min 19 s

2.Charcoal Water Filtration in English (Accent from USA) : -

<https://www.youtube.com/watch?v=wsaBIOrjvW4> - 2 min 48 s

Power points:

Introduction to Life Support Systems.pptx

Water Filtration.pptx

Measuring Acidity.pptx

Documents:

Water Filtration Experimental Table.doc

Acidity of Liquids Activity.doc

pH colors to numbers.doc

Experimental Materials (for each student):

2 sets of half cut water bottles (one bottom half, one top half having cap with 4 holes)

1 half cut bottom part of water bottle (500 mL)

2-4 coffee filters

8 cotton balls

1-2 index cards, pen

Scissors, Tape

Spoon

1 8 oz Tupperware container of sand

1 4 oz container of garden soil

Demonstration Materials:

pH paper strips

2 oz cups with lids

Liquids of Soda Pop, Baking Soda Solution, Green Juice Drink

Tea, Coffee, Toffee Syrup (optional), Milk, Propel drink, Vinegar

Grapefruit or Lemon Juice

Videos:

Water Filtration cotton balls dirt.mp4

Website Game or Activity:

LifeSupportMatch.html

LINK

<http://kattsustaineducation.com.s3-website.us-east-2.amazonaws.com/Games/LifeSupportMatch.html>

**Vocabulary:**

**Environmental Control and Life Support Systems (ECLSS):** A series of systems that work together to provide clean water and air for astronauts living on space stations so that they can conduct life essential activities.

**Essential Space Station Activities:** Tasks or activities that astronauts need to do on a daily basis to survive and work on the space station. These include breathing, drinking, hygiene & cleaning, exercising, eating and going to the bathroom.

**Water Filtration:** The process of removing solids, particles, undesired chemical compounds and biological materials from water using a fine physical barrier or other chemical and biological methods.

**Water Purification:** Freeing water from any kind of impurity such as contaminants, toxins, microorganisms, particles and undesired chemicals to be utilized for a specific purpose like providing potable, drinking water.

**Acid:** A chemical that gives off hydrogen ions in water. A molecule that can donate a proton. Acidity is measured on a scale called the pH scale.

**Setup:**

1.Review the power point lesson file **Introduction to Life Support Systems.pptx** for the content in the slides. Afterwards look at the **LifeSupportMatch.html** computer activity in order to help the students work with the game after the Introduction to Life Support Systems presentation has been taught.

2.Review the power point lesson file **Water Filtration.pptx** in order to teach the concepts of water filtration as it applies to why astronauts need water filtration for their water and how we clean water on Earth when it is polluted. Afterwards look over the videos **Water and You: The Water Treatment Process**, **Charcoal Water Filtration in English** since these will be played after the lesson. Think of some possible points or questions to ask the students after they have viewed the videos if desired.

3.Get the materials gathered and setup for the water filtration experiment that are listed in the previous materials section so that you can demonstrate the experiment while the students are attempting to perform it. Also make sure your students have all the materials they need before starting the experiment, maybe go through the checklist of materials with them when this part of the lesson starts.

4.Watch the video **Water Filtration cotton balls dirt.mp4** ahead of time to get instruction and ideas for conducting the water filtration activity. While reviewing the video note places to pause the instructional videos for the students (mentioned in the lesson plan procedure) so that they can perform that specific step in the activity. Review the data and results table file **Water Filtration Experimental Table.doc** after watching the video to understand how the students will use it while doing their experiment. Make sure each student has a copy or access to a copy of the experimental table.

5.Gather together the materials for the Acid/Base pH demonstration that will do with the students. Get the various types of liquids a day or two ahead of time and put them in the 2 oz cups the day before. Review the power point presentation file **Measuring Acidity.pptx** in order to know what to present for introducing concepts of acids, bases and pH paper. Next, review the documents **Acidity of Liquids Activity.doc** and **pH colors to numbers.doc** to know how to conduct the demonstration. Use the columns in the Acidity of Liquids to guide you through it where you would first introduce the liquid, have them guess if it’s an acid or base, measure the pH and then write down the result.

**Lesson Plan Procedure:**

1.Start by giving the power point presentation **Introduction to Life Support Systems.pptx.** The presentation should cover the 8 different types of Life Support Systems and how they help astronauts realize their essential activities they do every day. Make sure to tell the students that to pay attention to the pictures and titles of each system as they will be used in the LifeSupportMatch.html game. During the middle of the presentation they should help you fill out the Life Essential Processes and Activities chart on slide #5. Have them guess some of these activities first, give them hints and then fill it out. [15 minutes]

2.Next have the students play the **LifeSupportMatch.html** game where they match the pictures on the right side of the console shown in the Introduction to Life Support Systems to the titles on the left side. [10 minutes]

3.After they have finished the LifeSupportMatch game introduce the water filtration experiment by discussing the **Water Filtration.pptx** power point lesson. Make sure to emphasize why cleaning water is important to astronauts and the activities they do and what specifically filtration cleans in the water. Talk about the importance of eliminating germs, the purpose of the water recovery system and then switch to Earth related water purification by covering the types of pollutants, wastewater treatment plants and then compare to the space station water treatment system. The last slide introduces the concept of doing a water filtration experiment. Mention that they will build a filter after the videos and presentation using a system similar to what is seen in the slide. The goal is to filter dirty water (water with dirt and fertilizer in it).Next, show the two videos **Water and You: The Water Treatment Process**, **Charcoal Water Filtration in English**. Perhaps ask a few questions about the videos or prepare some comments about them [20 minutes].

4.Introduce the water filtration experiment by showing the students the pieces of equipment which are the two cut out half water bottles, coffee filters, cotton balls, sand, fertilizer dirt and spoon. Next, have the students account for their materials by going through the list with them as well. Afterwards, start the instructional video **Water Filtration cotton balls dirt.mp4** to start the experiment and tell them that everyone will view the video while doing the experiment in different parts. The parts of the video are listed below or the points where you pause and do certain steps.

5.Go over and show the materials for the experiment (0 to 2:50). Label the bottles with amounts of filtration media for each (cotton balls and sand) (2:50 – 5:09). Insert coffee filters in each set of bottles (5:10 – 6:42). Place two scoops of dirt into each bottle as a bottom layer (6:43 – 7:34). Put in 2 cotton balls and 4 scoops of dirt in first bottle (7:35 – 8:22). Put in 4 cotton balls and 2 scoops of dirt in the second bottle (8:23 – 9:20). Mix fertilizer dirt with water (9:21 – 10:40). Add dirty water into each of the filter bottles with media and let the water filter out (10:41 – 12:30). Fill out data observation table (12:31 to 14:24). [45 minutes].

6. Next, introduce the acid/base pH measurement demonstration with various liquids. Show all 8 types of liquids, what each one of them is and then show the pH paper. Explain briefly what the demonstration does with the pH paper. Afterwards initiate an introduction into the topic by showing the **Measuring Acidity.pptx** power point presentation. Make sure to talk about the different types of filtration and how contaminants can be clear and are harder to filter out. Talks about what makes liquids acidic or basic, why this is important and how microbes and algae live in certain different pH ranges. Next, cover what an acid and a base are, and then measuring pH with paper and cover what the pH scale is.

7. Start the demonstration by showing the different liquids again with the pH paper. Next show the **Acidity of Liquids Activity.doc** data table and briefly explain what you will do with each of the liquids listed in each row. Tell them you are going to ask them to guess whether the liquid is an acid or a base first. Then you will measure the pH of the liquid, note the color of the paper and write that down. Next, show them the **pH colors to numbers.doc** picture and let them know you will refer to it in order to get the specific pH of the liquid and whether it is acidic or basic. Afterwards you will write down that pH value and if it is an acid or base in the last column. Follow this procedure for each of the 8 liquids that you will demonstrate on. [30 minutes]