Electrolysis

Time
Set-up: 30 minutes
Exploration: 5-10 minutes

Key Question
Under certain conditions water conducts electricity. In the process, the molecules of water are transformed. How? Why is this important to the Astronauts on Space Station Alpha?

Materials and Preparation
- Two carbon rods from large 6V lantern battery
- A jelly jar with lid
- Masking or electrical tape
- Silicone glue
- 9V battery
- 2 – 20", 20 gauge (thin) coated copper wire
- Distilled water
- Salt or H2SO4
- A set of measuring spoons/eyedropper
- Rubber gloves and Safety Goggles ((for use with sulfuric acid)

Overview
The astronauts rely on water for both drinking and breathing Water plays two key roles on the Space Station. Pure water is needed for drinking. Water is also needed for breathing. Why? Think about it. What is the chemical symbol for water? . Water and a continuous supply of electricity are, very simply, a matter of life and death on Space Station Alpha.

On Earth, water and air are so abundant that we tend to take them for granted. On Space Station Alpha, water and air are worth their weight in gold. The lives of the astronauts depend upon the chemical characteristics of water molecules and the reaction that takes place when they are exposed to electrical currents.

Mission Specialists must become sensitive to the conditions in which water becomes a successful conductor of electricity and how this feature of water can be altered to ensure the safety of the astronauts.

Teacher Notes:

1. To save time, this exploration should be set-up beforehand at a "station" in your room so that the students can proceed as rapidly as possible with their observations.
2. Use of H2SO4 should be carefully monitored for it is a strong acid that can harm your students. Salt is not as effective as an electrolyte but far safer.
3. Electrolysis is a significant source of breathable oxygen on Space Station Alpha (the International Space Station).

Part One- Preparing for the exploration
Take care in preparing for this exploration. All components must be firmly attached so that the "electrical circuit" can be tested a number of times without breaking or requiring alterations.

SET-UP PROCEDURE
1 Take care in dismantling the 6V battery and removing the carbon rods.

2 Pierce two holes, each one large enough to insert a carbon rod, in the lid of the jelly jar. The holes should be close to the outer rim and opposite each other. Pierce the jelly jar with a small, third hole to permit gas to escape. Insert 7/8's of one carbon rod into each hole. Secure the carbon rods to the lid with silicon glue.

3 Tape one wire to the end of each carbon rod at the end that protrudes above the top of the lid. Make sure the wire coating at both ends of each wire is removed. Attach the two wires to the two poles of the 9V battery, one to each pole.

4 Begin each observation by filling the jelly jar 7/8's full with distilled water.

5 Rinse jar after each observation.

CLOSURE QUESTIONS FOR PART ONE

Part Two- Exploration and Observations

Water becomes a conductor of electricity if an appropriate substance, called an electrolyte, is added to it. As electricity passes through the water-electrolyte solution, oxygen and hydrogen gases are produced.

PROCEDURE FOR PART TWO

1 Add a tablespoon of salt to the water in the jelly jar. Screw on the lid with the carbon rods. (If sulfuric acid is used, start with 10 drops of acid from the glass eyedropper.) Repeat this process at appropriate intervals.

2 Observe the carbon rods carefully after adding electrolyte. Small bubbles of gas should begin to form at the lower end of each rod.

3 Increase the amount of salt or acid in the water and continue to make observations.

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Data Analysis

1. How much electrolyte had to be added before you noticed the formation of gas bubbles on the rods?
2. Which carbon rod produced the most bubbles? To which pole of the battery is this rod attached?

3. Which pole is producing hydrogen gas? Why? (Hint: Consider the chemical equation for water- H_2O. As each water molecule breaks down, will there be more hydrogen or oxygen atoms?)
4. Which gas, hydrogen or oxygen, is attracted to the carbon rod that is attached to the positive pole of the 9V battery. Why? (Hint: Remember that opposite electrical charges attract. The bond between the Hydrogen and Oxygen atoms is formed by the attraction of opposite electrical charges. Which atoms in a water molecule are positive? which negative? This electrical attraction is the foundation of every chemical compound known to man.)

CLOSURE QUESTIONS AND OBSERVATIONS

1. Write down you observations and ideas in your Mission Specialist log.
2. The separation of water molecules into hydrogen and oxygen is called electrolysis. The oxygen producing system on Space Station Alpha, called Elektron, represents one of the most important electrical circuits on Space Station Alpha.
3. If the electricity to Elektron is interrupted in the case of an electrical failure, what other resources can the Astronauts use to provide oxygen?
4. Record what you observed regarding the process of electrolysis, the addition of more and more "electrolyte" to the water.
5. What, in your opinion, does the electrolysis system do with the oxygen and hydrogen produced? (Continue to the next exploration.)

Extension Activities

1. Under the guidance of your teacher, you may try adding other substances to the water to see if you can find a more effective electrolyte.