

Elementary Electrolysis and Hydrogen Fuel Cells

Objective:

Students will be able to explain how hydrogen can be extracted from water and design and conduct an experiment demonstrating how water can be broken down into hydrogen and oxygen.

Materials and Curriculum
Correlations ▼

► Introduction

Hydrogen can be obtained by electrolysis of water. Electrolysis is the process by which water is separated into its two components: hydrogen and oxygen. In a fuel cell, hydrogen gas combines with oxygen from the air and produces electricity for the motor and its emissions are heat and water.

Electrolysis takes place in a unit called an electrolyzer. There are different types of electrolyzers all needing an energy source to work. Renewable energy sources or nuclear energy are good carbon-free sources.

Water used for electrolysis is used with substances like sodium, potassium hydroxide or solid plastics and ceramics, all of which increase the water's ability to conduct electricity. When electricity is applied, bubbles of oxygen gas (O_2) form at the anode and bubbles of hydrogen gas (H_2) form at the cathode. The bubbles are easily seen. Twice as much hydrogen gas is produced as oxygen gas.

Once the power source is taken off the electrodes, some gas bubbles remain on the electrodes. Due to these gas bubbles, a voltage difference will be seen when measured.

Procedure

1. Distribute copies of the student sheet.
2. Have students work in groups.
3. Prepare the pencils: Have students sharpen both ends of the pencils. These will act as the electrodes.
4. Set up the battery: Students should poke holes the same distance as the positive and negative terminals on the battery.
5. Attach the pencils: Poke pencils through the holes.
6. Fill the container: Have students fill the container with water. Add a pinch of salt to the water to increase its conductivity
7. Place the pencils in water: Students should place the pencils in the water, making sure the graphite ends are submerged but not touching each other.
8. Observe the reaction: Watch with students as bubbles form on the tips of the pencils. These bubbles are hydrogen and oxygen gas being produced from the water.

Answers to Questions on "Electrolysis" 1. Bubbles are formed. 2. Electrical energy is transformed into chemical energy.

To Know and Do More

1. How does varying the concentration of the salt (the electrolyte) in the water affect the number of bubbles produced by the electric current?
2. How could you capture and measure the amount of gas produced?
3. Where is hydrogen currently being used in your community? How much is used per year? Where is it produced?
4. Are there any hydrogen fueling stations in your area for hydrogen fuel cell cars? Where is the nearest one to your location? Visit the U.S. Department of Energy's Alternative Fuels Data Center at afdc.energy.gov to research hydrogen fueling locations.
5. How does the research and production of hydrogen in your state help the economy? The environment?

Materials Needed:

- Student sheet
- 9 Volt battery
- Two pencils (sharpened at both ends)
- Small glass or plastic container
- Water
- Salt
- Cardstock notecard

Curriculum Correlations

K-ETS1 - 1	5-PS1 - 2	MS-ETS1 - 4
1-ETS1 - 1	5-PS1 - 3	HS-PS1 - 2
2-ETS1 - 1	5-PS1 - 4	HS-PS1 - 3
3-ETS1 - 1	5-ESS3 - 1	HS-PS1 - 4
3-ETS1 - 2	5-ETS1 - 1	HS-PS1.A
3-ETS1 - 3	5-ETS1 - 2	HS-PS1.C
4-PS3 - 2	MS-PS1 - 2	HS-PS2 - 6
4-PS3 - 4	MS-PS1 - 4	HS-PS3 - 1
4-ESS3 - 1	MS-PS1 - 6	HS-PS3 - 3
4-ESS3 - 2	MS-PS3 - 3	HS-ESS3 - 4
4-ETS1 - 1	MS-ESS3 - 3	HS-ETS1 - 1
4-ETS1 - 2	MS-ETS1 - 1	HS-ETS1 - 2
4-ETS1 - 3	MS-ETS1 - 2	HS-ETS1 - 3
5-PS1 - 1	MS-ETS1 - 3	HS-ETS1 - 4

Electrolysis

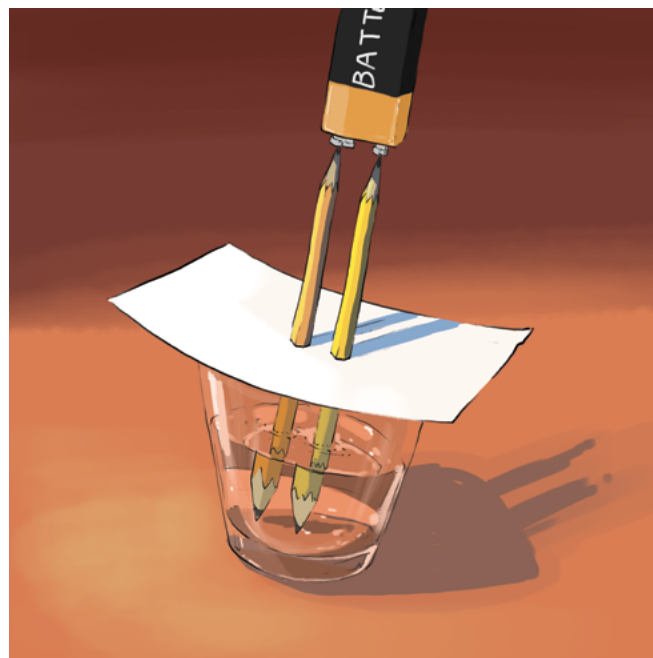
Electrolysis is a technique used by scientists to separate a compound or molecule into its component parts. By adding electricity to a liquid and providing a path for the different particles to follow, a liquid, such as water, can be separated into hydrogen and oxygen.

Materials

- 9 Volt battery
- Two pencils (sharpened at both ends)
- Small glass or plastic container
- Water
- Salt

Procedure

1. Prepare the pencils: Sharpen both ends of the pencils. These will act as your electrodes.
2. Set up the battery.
3. Fill the container: Fill the container with water. Add a pinch of salt to the water to increase its conductivity.
4. Place the pencils in water: Place the battery on each end of the graphite pencils. Place the pencils in the water, making sure the graphite ends are submerged but not touching each other.
5. Observe the reaction: Watch as bubbles form on the tips of the pencils. These bubbles are hydrogen and oxygen gas being produced from the water.
6. What do you notice happens when you attach the complete the experiment?



7. What is this scientific process called?