

Hydrogen Fuel from Water



Can you turn ordinary water into energy?

Water can be broken down into hydrogen gas and oxygen gas by a process called electrolysis. Hydrogen gas is a great fuel! In this activity you will perform an electrolysis of water to create hydrogen and oxygen gases.

Materials:

- large bowl of water
- two small tubes
- salt
- aluminum foil
- 2 pieces of 10 inches of copper wire (old electrical wire is fine)
- 9 volt battery
- tape (electrical or duct)



Safety:

- Hydrogen gas is flammable. Be sure to do this experiment away from open flames.
- Be careful to not short the two battery terminals together with the wire. This could result in a burn.

Introduction:

What is hydrogen?

Hydrogen is the simplest element known, the most abundant element in the universe. When it is in the form of hydrogen gas (H_2), it is an ideal fuel. But H_2 isn't found in natural deposits like coal or natural gas, so it must be made from molecules that contain hydrogen. Luckily water (H_2O) contains hydrogen and we can use water to produce hydrogen gas (H_2).



Splitting water molecules into oxygen gas and hydrogen gas using electricity is called "electrolysis". Through electrolysis, we convert electrical energy into a storable fuel namely hydrogen gas.

Creating hydrogen gas can be a good way to “store “ the energy contained in wind or solar power. When hydrogen gas is produced from wind or solar or any non-fossil energy it is a super clean fuel. No CO₂ or air pollutants are created in making the fuel.

In this experiment we will use electricity from a 9 volt battery to “electrolyze” (split) water into hydrogen gas (H₂) and oxygen (O₂) and thus create our own hydrogen fuel. Have you ever heard of hydrogen fuel cars? They use hydrogen gas as their fuel instead of gasoline. The hydrogen gas will burn as long as it is in the presence of oxygen. The cool thing about burning hydrogen with oxygen is it produces WATER! So no CO₂ or air pollutants are created.



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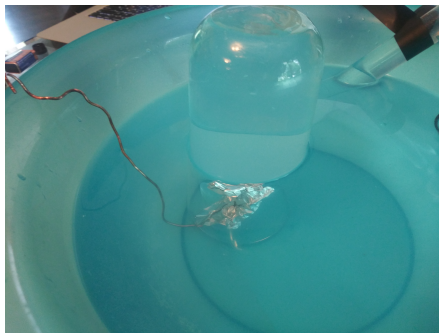
Setup:

Step 1: Fill the bowl with water and add enough salt to saturate the water

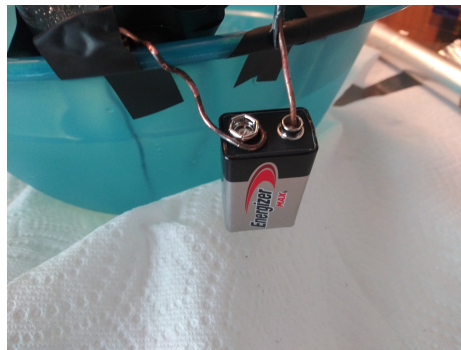
Step 2: Sink your small tubes or jars in the water so that no air is inside, invert them so that the bottom end is a bit above the water but the open end is still under water (if you don't have small tubes you can use an inverted glass like in picture)



Step 3: Bend the copper wire into the shape of an N. On the side that goes up crumble a piece of aluminum foil and insert that end, one in each tube or glass.



Step 4: Touch the other end of the copper wire to the ends of a 9 volt battery. You can try it with a loop as shown.



Results

- ❖ Wait for 15 minutes and see how much gas is in each tube. Knowing that each water molecule has two hydrogen atoms and one oxygen atom can you guess which tube has the oxygen gas and which one has the hydrogen gas?
- ❖ If there is a way to mark on the side of your glass indicating volume, do so and then compare the volume of each gas that has accumulated. How much more of one gas is there? Why?

Further Investigation

- ❖ Try using different types of wire, metals, and water solutions (lemon juice, sugar) to see which combination gives the most gas.
- ❖ Investigate a summary of Argonne's work with fuel cells and hydrogen at <https://www.anl.gov/es/fuel-cell-and-hydrogen>
- ❖ Various articles on work done at Argonne with hydrogen at <https://www.anl.gov/topic/hydrogen>
- ❖ Check out the Nova documentary Making Stuff Cleaner with David Pogue (think Bill Nye type) in which hydrogen used as a fuel in cars is talked about extensively along with other cleaner types of energy at <https://vimeo.com/286477784>