

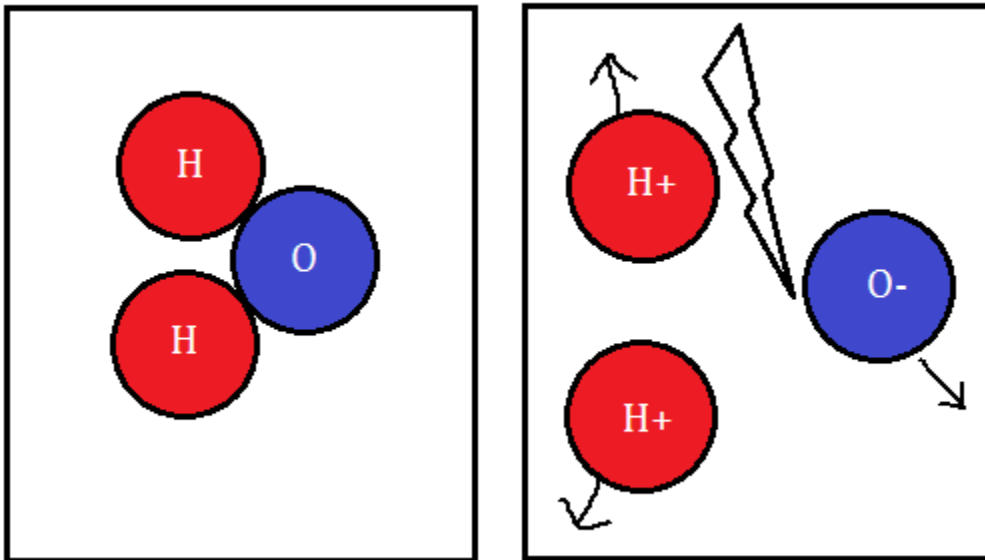
ELECTROLYSIS OF WATER

BECOME THE DESTROYER OF WORLDS

Water is split apart into its constituent hydrogen and oxygen molecules in various chemical reactions, including those that take place in the human body, plants and animals. However, some percentage of water molecules have been around since the Earth formed, or maybe even before that. You have the opportunity to destroy something that has existed for billions of years!

BACKGROUND

Water is composed of two hydrogen atoms bonded to one oxygen. One way to separate them is to pass an electric current through the water. Water is normally not very conductive, so if we add something to the water, such as salt (sodium chloride, or NaCl), to increase its conductivity. Once the atoms are separated, the hydrogen atoms are positively charged, and collect at the cathode (negative terminal), and the oxygen atoms are negatively charged, and collect at the anode.



One water molecule separating into two positive hydrogen ions and one negative oxygen ion

Water is a very stable molecule, so it takes some input of energy to blast it apart. Once separate, the hydrogen and oxygen would slowly recombine back into water molecules, but we could cause them to explosively recombine by igniting them. This process is one way that a car could be powered by water! Hydrogen is extremely flammable, and could be produced in this process in a cell in the engine, collected, and used to run the engine (much in the way that gasoline is now used). Interestingly, when hydrogen is burned, it reacts with the oxygen, and recombines into water! The car would run on water, and the only byproduct is water! No carbon dioxide, no noxious gases, just water! Although the electricity needed to separate the hydrogen and oxygen would need to come from somewhere (possibly by plugging it into an outlet in your garage). So you have to put in energy, in the form of electricity, and then you would get that energy back out, through ignition.

EQUIPMENT

Coffee Mug

Two lengths of wire

AA Battery

Two Pieces of Tape

Table Salt

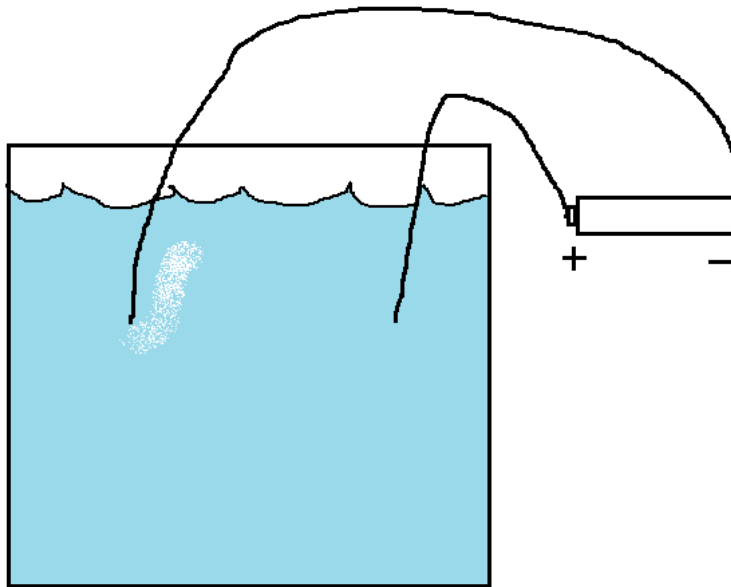
Bottle Cap

Lighter or Match



PROCEDURE, PART 1

We're going to try to reproduce the set up shown here:



Saltwater, with hydrogen gas bubbles appearing around the cathode

First, we'll be satisfied just producing hydrogen. When we add salt to the water, the sodium and chlorine ions increase the conductivity of the water (by a factor of a million!), but their presence means that we will only produce hydrogen, and no oxygen. Add about two teaspoons of salt to the water, stirring until most of it dissolves.

Tape one length of wire to the cathode of the battery, and one length to the anode. Then put the other ends of the wire into the salt water, so they are close not touching. The reaction should begin immediately. Hydrogen bubbles should begin appearing around the cathode. Experiment with wire placement. Does moving them closer together yield more hydrogen?

Please do not allow the active ends of the wires come into contact for any length of time. This will short circuit the battery, and while it won't explode, it will run the battery down and heat it up.

PROCEDURE, PART 2

If we want, we can try to capture the hydrogen. Take the bottle cap and puncture a hole in it with a nail or screwdriver, just big enough to get the wire through. Then, force the cathode wire through the hole, as shown here

Image bottle cap

Try to get as snug a fit as you can, so that no hydrogen leaks out!

When you put the cathode into the water this time, upend it so that there is no air inside. Then insert the anode wire, so that the hydrogen produced rises up into the bottle cap and is captured. After enough hydrogen is built up, tip the bottle cap so that it can escape and rise to the surface. Use the match or lighter to ignite the hydrogen. Don't worry, this much hydrogen is not dangerous to explode, in fact it will just "bark," producing a sound, but no light or heat.

Congratulations, you have destroyed ancient water molecules, only to turn them right back into water!

