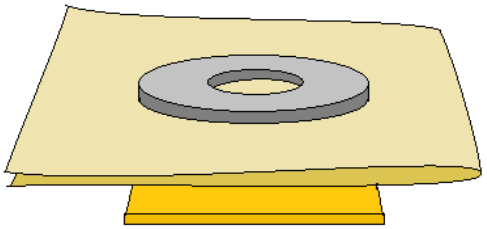
Making a Simple Battery

Equipment	Quan.
galvanized washer	1
piece of copper	1
paper towel	1
scissors	1
water	1 oz.
vinegar	1 oz.
plastic pipette	2
multi-meters	2
wires & alligator clips	mult.
10 Ω resistor	1
clothes pin	1
3 finger clamp	1
table clamp	1
rod	1
double V clamp	1

There are many ways to use chemical reactions to make electrical energy. That is, there are many ways to design a battery. One very simple method involves the metal zinc and acetic acid, which makes up 5% of vinegar.

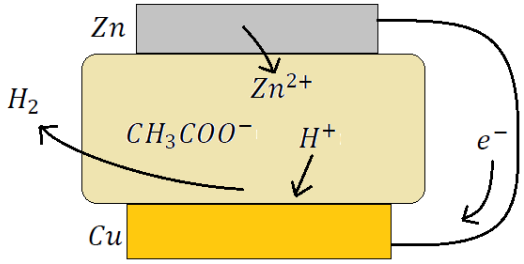
The figure below illustrates the structure of the battery. A piece of paper towel is sandwiched between a galvanized washer and a piece of copper.



The washer and copper will be the two electrodes of the battery. Electrons will flow from the washer to the copper. This can happen if they're connected by a wire, **and** if we soak the paper towel with a weak acid like vinegar. The acetic acid molecules in vinegar naturally break into ions:

$$CH_3COOH \rightarrow CH_3COO^- + H^+$$

And some of the zinc atoms can become ions by liberating electrons into the zinc metal (the reaction equation is shown below). If we create a circuit by connecting the washer and copper with a wire, as in the next figure, then those electrons will flow through it and join H^+ ions to make hydrogen gas, H_2.



The two processes, zinc atoms losing electrons and hydrogen ions gaining them (below), are both exothermic, and the released energy drives the electrons through the circuit, so that the current can be used to do run something.

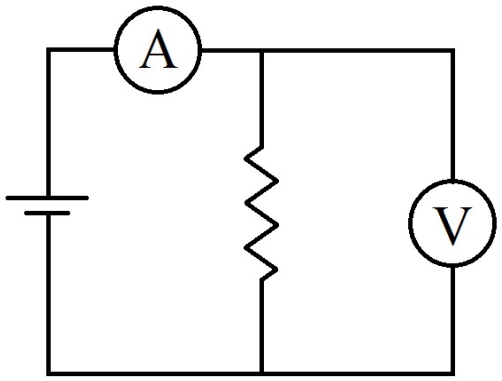
$$Zn \rightarrow Zn^{2+} + 2e^-$$

$$2H^+ + 2e^- \rightarrow H_2$$

Thus we have a simple battery. When the wire is removed, the electrons cannot escape from the zinc electrode. They build up a little and prevent more electrons from leaving zinc atoms (electrons repel each other), stopping the reaction. This is why batteries are depleted only when they're used.

Procedure

1. Make some paper towel strips by cutting a paper hand towel crossways. Make the strips about 1 inch wide.
2. Wrap up one of the strips up to make a postage stamp sized pad.
3. Sandwich the pad between the piece of copper and the washer, and then clamp it together using a clothes pin.
4. Mount the clothes pin in the 3 finger clamp and mount this using the table clamp and rod. The instructor can show you how this can be done.



5. Construct the circuit as instructed. The circuit diagram is shown above and will be explained by the instructor.
6. The volt meter should be set to measure up to $200\ mV$ and the ammeter to $200\ mA$.
7. When everything is set up, use the plastic pipet to put a few drops of water on the paper towel pad between the electrodes.
8. The voltage and current should both register. Let them settle down for about 10 seconds and then record them

$$V = \_\_\_\_\_\ mV$$
$$I = \_\_\_\_\_\ mA$$

9. Remove the wires from the battery and remove the battery from the clothes pin. Take out the wet pad, dry the washer and copper, and put in another pad.
10. Rewire the circuit to do the experiment again using vinegar instead of water.
11. When the procedure is repeated using vinegar, record the voltage and current.

$$V = \_\_\_\_\_\ mV$$
$$I = \_\_\_\_\_\ mA$$

12. Were the results different for the two trials (water & vinegar)? Describe the difference.