Potato Battery Experiment

Materials

- 3 potatoes
- 3 galvanized nails (coated in zinc)
- 3 copper coins
- 3 crocodile clips
- Copper wire
- Butter knife
- Scissors
- 1 small LED that needs only 1 or 2Ma current to run, red LEDS work well.

Instructions

1. Insert a copper coin into one end of the potato and a nail into the other end. You may need to use the knife to make a groove in the potato to insert the coin.
2. Cut four pieces of wire, each about 15 cm long. With each piece of wire, use the scissors to remove the plastic covering on both ends of the wire. About 3 cm of covering should be removed on each side.
3. Wrap one end of the exposed wire around the crocodile clip. Make sure there is good contact with the metal of the clip and the copper. Attach the crocodile clip to the penny. Repeat with all three potatoes.
4. Wrap the other end of the wire around a nail on a different potato. Make sure the exposed wire is in tight contact with the nail.
5. Take the fourth wire and wrap one end around the last free nail. Now you have a potato battery!

6. You can use your battery to light up an LED.
7. Wrap the free wire on the coin/crocodile end around the long leg of the LED. Wrap the nail wire around the short end of the LED. Make sure the copper wires do not touch each other!
8. The LED should light up.

Potato Battery Experiment: Tutor's Guide

Notes

This is a great activity to do as a group. Students can work in teams or pairs to create their own light bulb batteries. If you wish to bring additional fruits like tomatoes, lemons, bananas – you can then test which one works best!

The lesson

1. Talk to the students about batteries. Where do we use batteries in daily life? Do you know how a battery works? Have you ever charged a car battery?
2. Tell them you have a unique lesson today – making a battery to light up a lightbulb! (If you would like, use this http://www.bbc.co.uk/guides/z86syrd website as a guide)
3. Do the experiment.
4. Watch https://www.youtube.com/watch?v=9OVtk6G2TnQ
5. Explain why this potato works as a battey. Ask follow up questions and discuss with students

The Science

Potatoes contain phosphoric acid, which acts as the battery acid. The acid reacts with the zinc and copper metals in the nail and coin to start the electricity flowing.

The acid in the potato eats away at the zinc metal that coats the galvanised nail, releasing negatively-charged electrons around it.This is why the zinc nail becomes the negative end of the battery.

The acid in the potato reacts with the copper metal that coats the coin, absorbing electrons from the copper. Electrons have a negative charge – so as they are removed from the copper, the coin becomes the positive end of the battery.

The reactions between the acid in the potato and the two metals create an imbalance in electrical charge – there are more negatively-charged electrons at the zinc end than at the copper end.

The wires let these electrons flow quickly from the zinc to the copper to correct this imbalance, which creates an electrical current. Connecting several potatoes together using pieces of wire combines the power of each potato to create a stronger battery.

The electrical current flows through the LED, making it light up.

Zinc is an active metal, which reacts readily with acid to liberate electrons. The acid's active ingredient is positively charged hydrogen, so a transfer of electrons takes place between the zinc and the acid. The zinc (Zn0) is oxidized (Zn^{++}) and the acid (H^+) is reduced to hydrogen gas (H_2), which you can see bubbling out around the electrodes. The reaction at the penny electrode depletes the electrons from the copper and attaches them to the hydrogen ions in the phosphoric acid.

Oxidation: $Zn \rightarrow Zn^{++} + 2e^-$
(Zinc looses 2 electrons)

Reduction: $2H^+ + 2e^- \rightarrow H_2$
(Hydrogen ions gain electrons)

Net Reaction: $Zn + 2H^+ \rightarrow Zn^{++} + H_2$
(Hydrogen gas and 'power')

Follow Up Questions

- What created the electrical current?
- What would happen if we connected many more potatoes?
- If you have positively charged hydrogen (in potato acid) and a transfer of electrons takes place where Zinc is oxidized, what happens to the H+ acid?

Sources:

http://www.bbc.co.uk/guides/z86syrd

http://www.physlink.com/education/askexperts/ae516.cfm