



Potato Battery

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Topic

Construction of a battery



Time

45 minutes to 1 hour



Safety

Please click on the safety icon to view the safety precautions. Adult supervision is necessary for the soldering of the alligator clips to the wire and when taking apart the battery. Dispose of the potatoes after the experiment; do not eat them.

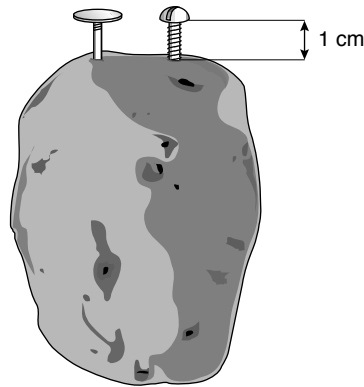
Materials

12 fresh baking potatoes	one high-brightness red LED
24 alligator clips	(SLA-591LT3; available at
1.5 m copper bell wire	Radio Shack # 276-006A)
12 <i>hot</i> -galvanized (not electro-	hammer (optional)
galvanized) 1½-in. zinc roofing nails	voltmeter (optional)
12 solid-brass wood screws	6- or 9-V battery
wire cutters	screwdriver
solder, flux, and soldering iron	

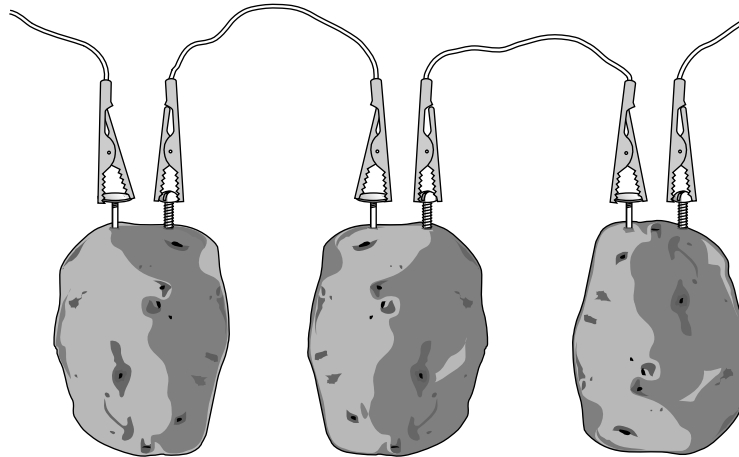
Procedure

PART A

1. Using the wire cutters, cut 12 pieces of copper wire 10 cm long. Remove 1 cm from both ends of each piece of wire.
2. Have an adult solder the alligator clips to the wire pieces, one clip to each end.
3. Place one brass screw and one zinc nail ½ in. apart in each potato. Use the hammer if you find it easier, but be careful not to crush the potatoes. Make sure that the nail and screw don't touch inside or outside the potato. Leave the heads of the screws and nails approximately 1 cm above the potato (see figure 1).
4. Connect an alligator clip to the nailhead. Connect another clip from a different wire to the screwhead.
5. Attach the LED between the two clips left unconnected. Observe what happens. Turn the LED around so that the opposite lead is in the opposite clip. Observe what happens. Use the voltmeter to take a reading.

Figure 1

6. Connect each potato to every other potato by using a wire to connect a nail to the next potato's screw (see figure 2).

Figure 2

7. When all the potatoes are connected, there should be two clips left over, one coming from a screw and one coming from a nail. Attach the LED between the two leftover clips. Observe what happens. Reverse the leads of the LED. Observe what happens. Use the voltmeter to take a reading. (If there is no result, make sure that every connection is from a zinc nail to a brass screw).
8. Remove the potatoes one at a time, and connect the LED to the new free clips each time until it no longer lights. Take a voltage reading with the voltmeter. Observe any differences in the intensity of the LED's glow.

PART B

1. Have an adult help you to take apart the 6- or 9-V battery. Be careful not to cut yourself on sharp metal edges.
2. Try to identify the parts that you observe, and compare them with the potato battery that you constructed in Part A.
3. Why do you think the individual cells (potatoes) are connected to each other in the order that they are?
4. Which parts of the battery you took apart correspond to which parts of the potato battery you constructed?

What's Going On

The flow of electrons in a circuit is from one metal with a higher concentration of electrons to a different kind of metal with a lower concentration. Hooking up a nail to a nail, or a screw to a screw, will not provide this potential difference, so no current will flow. In a 6-V battery, there will be four separate cells. Each one corresponds to each separate potato: It contains an electrolyte (like the acid inside the potato), two different metals (corresponding to the screws and nails), and wires connecting the cells from one metal to the other one.

Connections

Many household appliances make use of dry *cells* to power them. Most use more than one dry cell to provide the necessary amount of electrical current. A cell produces electrical energy by causing a chemical reaction to take place between an electrolyte (a conductive medium) and two different metals. One metal gains a higher concentration of electrons and sends electrons to the other metal, which has a lower concentration, when a path (a wire, for example) is placed between them. A battery is made of several such cells linked together so as to provide the needed amount of electricity. In this activity you used a common food to gain an understanding of how a battery is constructed.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES