Electric Fruit

Citrus fruit are wonderful sources of vitamin C and glucose – just the thing to give your body a boost. With the right combination of metals and some wires, they can deliver energy of different kind, one with some zap.

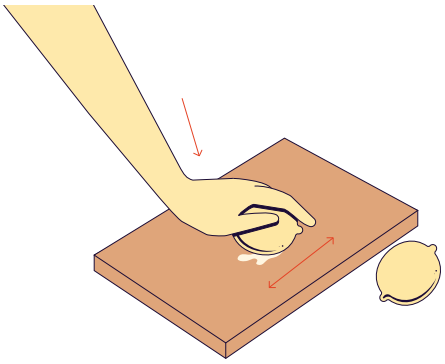
Get this stuff:

- 2 x citrus fruits, such as lemons, oranges, or grapefruit
- 4 x pieces of iron (large nails work well)
- 4 x pieces of copper, no more than 1 centimetre wide or 5 centimetres long (copper coins work well, or check the plumping sections at hardware stores)
- 5 x wires with crocodile clips on each end
- Light-emitting diode (LED)
- Sharp knife and cutting board
- Multimeter (optional)

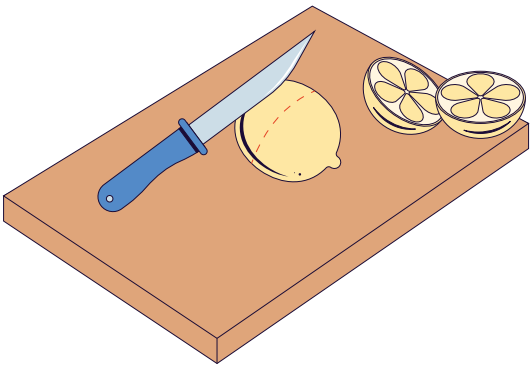
Safety

- Knives, iron nails and pieces of copper can have sharp points and edges. Take care when handling.
- Juices from citrus can be an irritant in eyes and skin breaks. Wear safety glasses.

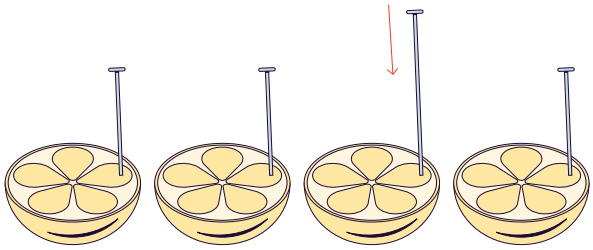
Do these things:



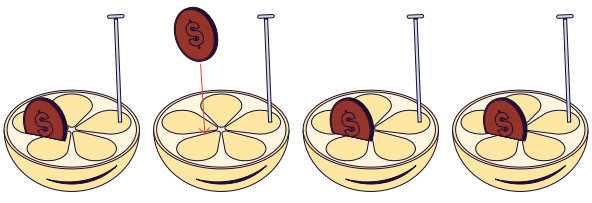
1. Firmly push down on both of your citrus fruits and roll them along a surface to release some of their juice inside.



2. Slice both of your citrus fruit in two to give you four equal-sized halves.

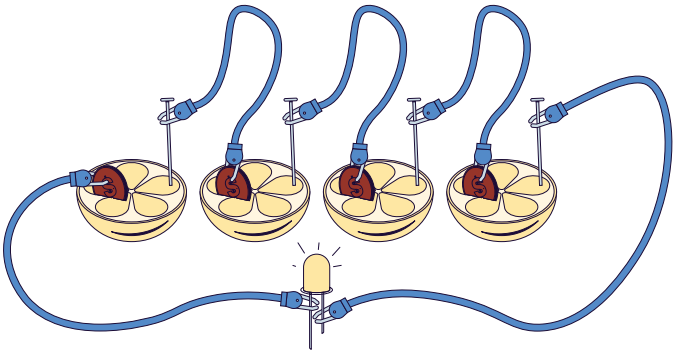


3. Insert an iron nail into each of the citrus fruit halves.



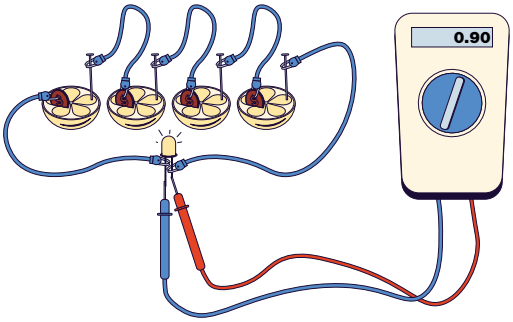
4. Insert a copper piece into each of the citrus fruit halves, away from the iron nail. (You might need to use the knife to make an incision for the copper to pass through the fruit skin).

5. Clip a crocodile clip of one wire onto the iron nail of the first lemon. Clip the clip on the other end of the wire onto the copper piece of the citrus fruit next to it. Repeat for the next two fruit halves.



7. Clip the clip of the last wire onto the copper piece in the first citrus fruit half. Clip the clip on the other end of the wire to the longer leg of the LED.

6. Clip a clip of another wire onto the iron nail in the last citrus fruit half. Clip the clip on the other end of the wire to the shorter leg of the LED.



8. If you have a multimetre, use it to test the current in your lemon battery.
Try using different fruit, and different metals. Use the multimetre to test the currents in each combination, and work out which are best

What's going on?

In simple terms:

This circuit is an example of a series of simple electrochemical cells, or a battery.

Reactions between the two metals and chemicals in the citrus fruit's juice allow electrons to flow from the more reactive metal (in this case, iron) to the less reactive metal (copper) when they are connected as a circuit.

In more complicated terms:

Copper is a metal that doesn't easily let go of electrons. Iron, on the other hand, is a little more reactive, meaning it releases its electrons with slightly less fuss. Highly reactive metals, like lithium, love to throw their electrons away at the first opportunity. These metals can be used as objects called electrodes, which can send and receive electrons as a current of electricity.

When connected, the difference in reactivity between the metals creates what's known as a voltage potential. But before a current of charges can flow from one to the other, they need a source of electrons to exchange.

This is provided by a chemical reaction between chemicals in the solution surrounding each metal. The solution – an electrolyte – reacts with the copper electrode. Charged hydrogen atoms pull away the copper's electrons, which the copper then takes from the iron, which the iron takes from the electrolyte near it.

This cycle can continue until the chemical reaction stops, often because the electrolyte's supply of chemicals have been used up.

How do we use this?

Electrochemical cells, especially when connected together as big batteries, are a great way to store electricity from a renewable power source for use later. Finding ways to store larger, or stronger chargers will be increasingly important in the future as new technology demands strong and efficient power supplies.

New battery technology is being developed with new electrolyte solutions, better combinations of metal for electrodes, and more effective ways to connect the materials together.