



The Messy Meter

Recommended Grades:
Pre K - 2, 3 - 5

Estimated Time:
25 minutes

Subject:
Electricity

WHAT YOU'LL NEED

PANTRY STAPLES:

- Pennies
- Galvanized (zinc-coated) nails
- Citrus fruit (lemons, oranges, limes)

SPECIALTY SUPPLIES:

- Alligator clips
- LED Bulb

Optional Add-Ons:

- Voltmeter

Fruit Batteries

Did you know that fruit bowls are brimming with electrical potential? Forget about making lemonade - generate home-made electricity instead! This activity teaches kids about the key parts that make a battery work and the chemical reaction that makes it possible! Kids can also use this activity to attempt breaking a **Guinness World Records™** title, instructions for this are included in the Bonus Fun section below.

STEPS

The following steps can be used to make a successful fruit battery, but try experimenting with different types of fruit and different metals for electrodes.

1. Give your lemon a quick roll to make sure the insides are extra juicy.
2. Carefully use a knife or scissors to cut two slots/holes in in opposite ends of the lemon.
3. Insert the copper penny and the zinc nail into the pre-made holes. (If you're doing this to attempt a **Guinness World Records** title, you'll start the time at the beginning of this step.)
4. Connect the nail and the coin (your electrodes) with the alligator clips. Make sure that one end is attached to the nail and the other to the coin.
5. Once you've joined up the lemon battery you should be left with two free clips at either end - one coming from the nail and the other coming from the coin.
6. To complete the circuit, attach the clips to the LED.
7. If you're doing the Bonus Fun, now connect the voltmeter, take a reading of the output, and photograph the display to send as evidence for the **Guinness World Records** title attempt.

Tip: If you hook up the LED and it doesn't glow, switch the alligator clips attached to its legs.



Bonus Fun:

Try to beat the Guinness World Records title for the Fastest time to light an LED with a fruit battery!

A typical fruit battery uses citrus fruit, copper coins,galvanized nails and alligator clips; other materials. All fruit incisions must be made before the attempt. The mini LED used must have a forward voltage between 1.6 and 4.2. The bulb must be fully lit and the output measured with a voltmeter.

For the Record: For more information on the rules to make your record attempt official, check out the make and break section of our website <https://goo.gl/ejBnNm>

Questions to Engage Youth:

- How many pieces of fruit were needed to power one LED?
- What did you observe? Are there any changes in the fruit?
- Try substituting a lemon for a different piece of fruit. What difference does this make to the battery's performance?



Explanation:

Bio batteries work because two different metals suspended in an acidic solution create a chemical reaction that generates electricity. All batteries (including bio-batteries, like the one you've just made) consist of three key parts: a cathode (the positive end of a battery), an anode (the negative end of a battery) and an electrolyte solution (the medium that allows the electric charge to flow between the cathode and anode).

With the fruit-powered battery, the copper penny serves as the cathode; it goes through a chemical reaction called reduction when it interacts with the citric acid solution that exists inside a

lemon. This reaction creates an excess of electrons. Electrons repel one another, so as they build up they begin moving through the electrolyte solution (the lemon) to find free space away from other electrons. At the other end of the lemon where the zinc nail is - the anode - another chemical reaction, oxidation, is taking place. Oxidation makes the nail lose electrons. This means that the nail now doesn't have enough electrons and is primed to receive more. So, once you connect the nail (anode) and the penny (cathode) to an LED, you're completing a circuit allowing the electrons to flow in a continuous loop through the wire and the lemons, powering the LED.

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