

Penny Battery		
Steps:	Summary	Written Descriptions, Diagrams, and Examples
1: Introduction	In this LOOM VIDEO you will find: - Objective(s) - Example/Demo - Materials list	Objective: To make a multi-celled battery that powers a red LED light with some pennies and a few household items. Materials: - Five or more post-1982 U.S. pennies 100-grit sandpaper - Chipboard/chipboard - Salt - Vinegar - A red LED; high-intensity ones are easier to see - Scissors - Cup with water (not shown) - Paper towel (not shown) - other LEDs of a different color  OPTIONAL: Electrical tape, A voltmeter (not shown)
2. Prep	This LOOM VIDEO describes how to prepare the following materials: - A saturated salt solution with vinegar - Chipboard disks - Zinc and copper sided pennies	- Make a saturated salt solution by adding salt to water and stirring until it doesn't dissolve anymore. Add a splash of vinegar to this solution. - Cut your chipboard into four 1/2-inch squares, each about the size of a penny. Soak the pieces in the salt-and-vinegar solution. - Use sandpaper to remove the copper from ONE side of FOUR pennies. Leave the fifth penny intact. Sand until you see zinc (shiny silver color) covering the entire face of the coin. This takes some time and effort, so be patient. Try placing the sandpaper on a hard surface and moving the penny instead of the sandpaper. The "tails" side may be easier to sand because the Lincoln Memorial (or Union Shield) doesn't protrude as far as Lincoln's head. When you're done, the sanded coins should have a bronze-colored copper side and a silver-colored zinc side.
3: Assemble	This LOOM VIDEO describes what to do with all of your prepared materials: - Remove the chipboard from the salt solution - Make a stack alternating layers of pennies and chipboard - Tidy up your stack - Connect your LED	- Once the pieces of chipboard are thoroughly wet, take them out and place them on a paper towel so they are still damp, but not dripping. - Take one of your sanded pennies with the zinc side facing up (copper side down), and place a damp piece of chipboard on it. Then stack another sanded penny (again, zinc side facing up) on top of this. Take your next piece of chipboard and place it on top, and continue stacking pennies and chipboard on top of each other to make a neat pile. Finally, place the unsanded penny at the very top. - When you're done, you should have alternating layers of pennies and chipboard with all the zinc sides facing up, and both the very top and the very bottom of your stack (facing down) should be copper. Make sure the pennies aren't directly touching each other and, likewise, that the pieces of chipboard aren't touching each other. - Test your battery by connecting your LED. Touch the RED lead to the intact penny on the top and the BLACK lead to the bottom of the stack. Make sure that the leads don't touch any other layer. Did the LED turn on? If not, make sure the LED leads are oriented correctly and use a paper towel to wipe off any excess water from the penny-chipboard stack.

		5. OPTIONAL: If you want your LED to stay lit without having to hold it, wrap the entire assembly together with electrical tape. The LED will grow fainter as the chipboards dry out, but it should stay lit for 24 hours! To recharge, just re-soak the chipboards and reassemble. 6. ALSO OPTIONAL: Check the voltage of the battery with a voltmeter by placing the leads on the top and bottom of your penny battery.
4: What is Going on?!	This LOOM VIDEO describes what's going on: Batteries are objects that perform energy transformations: chemical energy into electrical energy Flow of electrons = electricity Two chemical reactions on the surfaces of the penny generate a flow of electrons.	Batteries are devices that convert chemical energy into electrical energy. When two different metals are connected by an electrolyte, a chemical reaction occurs at each metal surface, called electrodes, that either releases or uses electrons. When these electrodes are connected by a wire, electrons will move from one surface to the other, creating an electric current. Pennies that were made after 1982 have zinc cores that are plated with copper. By sanding off one face of a penny, you create a zinc electrode that can pair with the copper electrode on the face of the next penny. The chipboard soaked in salty vinegar water serves as the electrolyte between the two terminals. Each zinc-chipboard-copper stack represents one individual cell. By stacking additional chipboards and sanded pennies, you've created a battery!
5: Trouble shootin g	This LOOM VIDEO describes what to try if your battery doesn't work right away: 1. Make sure your battery doesn't have a short! 2. Make sure that you sand off ALL the copper from one side of your four pennies. 3. Make sure your LED is oriented correctly.	My Battery doesn't work! What went wrong?! There are a few things that will prevent your battery from working; 1. It is relatively easy to create a "short" in your battery...Electricity will take the path of least resistance, so if any of your chipboard pieces are touching each other you are effectively reducing the number of cells in your battery. Because each cell adds about .5 Volts and the LED will only light up if there are 4 cells. Maybe your chipboard squares are too big and are touching? Maybe they are too wet and a drop is connecting the chip board layers? Maybe you REALLY want your battery to work, so you are squeezing REALLY hard causing one of the chipboard pieces to touch? 2. Make sure you sand off the copper side of your penny completely, your battery will not work as well if there are still bits of copper on what should be a zinc surface. 3. LEDs only work in one direction, make sure that your red wire is in contact with the non-sanded penny.
6: Extensi on	NERD ALERT!! This ZOOM VIDEO describes how we measure electricity and challenges you to take your project to the next level!	This series of electrochemical cells involves an oxidation reaction occurring at the zinc electrode that releases electrons and a reduction reaction occurs at the copper electrode that uses them. This stack of reactions is also known as a "voltaic pile", which is named after Alessandro Volta, who created the first battery in 1800 by alternating zinc and copper electrodes with sulfuric acid between LED Color Red Yellow Voltage @ 20 Min 2.1 2.1

	- Electrochemical cells; oxidation and reduction reactions. - Voltaic Piles (Alessandra Volta) - What is a volt and how do we measure it? - Added challenge: how many more individual cells would you need to light a green LED?	them. - With a voltmeter, you can see that each cell can generate over 0.6 volts. The penny battery you created has four cells. A stack of three cells should generate enough voltage to light a red LED, which usually requires around 2 volts. - For an added challenge, how many more individual cells would you need to light a green LED? Try making a battery powerful enough to light a green LED! **Legal disclaimer: LISD and Ms. Ryan do not take responsibility for any damaged coinage, and certainly don't try to sell your completed battery for more than 5¢!
7: Celebrate!!	This ZOOM VIDEO explains how to: - Access padlet and - Post a photo there...	We would be DELIGHTED if you would share an image of you and your tinker project from this week on this Elementary Enrichment Celebration Padlet! Use this QR code from your phone to take you straight there: Your next TINKER LAB enrichment will be the week of: Monday, November 16 - Friday, November 20th! 

Source: <https://www.exploratorium.edu/snacks>

Thursday, October 8th, 2020

Hello 4th and 5th Graders!

I'm so glad you've picked up your Take and Make TinkerLab Kit this week! I really miss working with you all; building creative projects and experimenting with them together. I hope you and your families can find some time to build this cool battery out of pennies that lights an LED this week! When you're done, please share a photo and a bit of your experience on [this](#) enrichment padlet (see details below).

The table below outlines the directions for the project. If you have access to a computer and the internet, you can click the loom links where I've prepared videos that explain and demonstrate how to do everything. If you'd rather not be on the screen, simply read and follow the steps in the right hand column.

For quick access to a digital form of these directions, you can scan this QR code:

Best,
Kristen

Kristen Ryan



STEM Teacher
Lopez Island School District