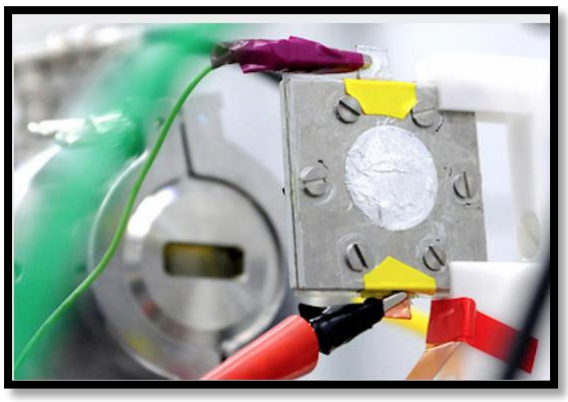
Build Your Own Battery!

Make your own battery and share it with Argonne Education!

From toys and equipment to cars and renewable energy-batteries are everywhere! Batteries have come a long way since Alessandro Volta made the first true battery in 1800. Overtime batteries have advanced with technology and evolved for our ever-changing needs.



Argonne scientists and engineers are working together to develop the next generation of cheaper, more powerful batteries. In this activity, you will build a homemade battery and experiment with different materials to optimize your battery—just like Argonne researchers!

Materials:

- "My Battery" sheet & pencil
  - Print ours from the last page or make your own
- Electrolyte Solution
  - Examples: salt water, sports drink, pop, juice, coffee, soil, etc…
- 6-Pennies (pre-1982) or 1" Copper Disks
- 6-1/2"Aluminum Foil Squares or 1" Aluminum Disks
- Paper Towel
- Small LED light bulb
  - Substitutions: dollar store solar calculator, battery operated candle, stopwatch etc.
- Zinc washers or other metal disks
- Additional electrolyte solutions
  - Examples: salt water, sports drink, pop, juice, coffee, soil, etc..
- Different types of paper
  - Examples: coffee filter paper, construction paper, computer paper

Optional Materials:

- Multimeter
- 2 Alligator wire leads
  - Substitutions: copper wire, aluminum foil

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Introduction:

Batteries come in all shapes, sizes, and materials. A basic battery has two different **metal electrodes** (a "positive" end and "negative" end), an **electrolyte** solution, and a separator or "**membrane**". The electrolyte solution in a basic battery is the liquid, gel, or paste that allows electrical charge to flow between a negatively charged metal and a positively charged metal in a battery. The separator is a membrane keeps the two metals from touching so that the battery doesn't short-circuit.

In this activity you will:

- Prep Materials
- Step 1: Build a basic battery cell
- Step2: Determine how many cells you need to power an LED light bulb
- Step 3: Experiment with different materials.
- Step 4: Optimize your battery and share it with Argonne Education!

Prep Your Materials

Skip this step if you are using Copper Disks

- Make sure pennies are prior to 1982.
- Put pennies in a "ketchup" bath. Make sure both sides are fully covered in ketchup
- Let the pennies sit in the ketchup for about 5 minutes.
- Wipe down and rinse pennies to get all the ketchup off.

How to Create Aluminum Electrode from Aluminum Foil

Skip this step if you are using Aluminum Disks

- Cut aluminum foil into squares or circles that are about same size as the disks or pennies you plan on using.

How to Cut Paper Towels Membranes

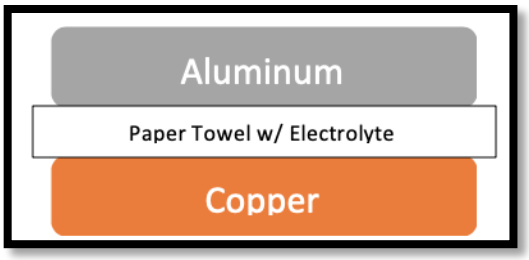
- Cut a paper towel into squares or circles slightly larger than the disks or pennies you plan on using.

How to Set-Up Multimeter-*optional*

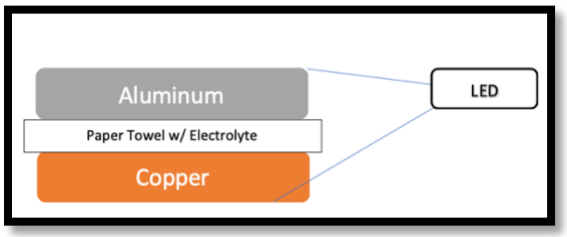
- Move the selector dial on the multimeter so that it is at "20V". This will measure voltages up to 20V with 0.1V resolution. That batteries you will be making will be low-voltage (~0.5V-3V)

Step 1: Build a Basic Cell

1. Place one copper electrode (penny or Copper Disk) down on table.
2. Choose an electrolyte solution.
3. Place 1-2 drops of the electrolyte solution onto one paper towel membrane or dip one paper towel membrane into the electrolyte so that it become saturated. *Note: the paper towel membrane should be wet but not soaking to the point that it's dripping. If it is dripping dry it off a bit with paper towel.*
4. Put the paper towel membrane on the copper electrode.
5. Place one aluminum electrode (aluminum foil or Aluminum Disk) on top of the saturated paper towel membrane.



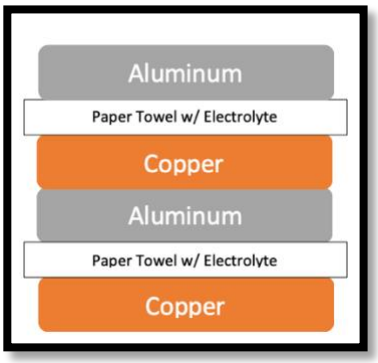
6. **Congrats! You have made your first cell!**
7. ***What is the voltage?*** If you have a multimeter/voltmeter, measure the voltage of your single cell by placing the negative (black) terminal on the aluminum end and the positive (red) terminal on the copper end. Record the voltage in data table.
8. ***Did the light turn on?*** Take your LED light bulb and stretch out the positive terminal (longer terminal) so it touches the copper end and the negative terminal (shorter terminal) touches the aluminum end.



   a. *Note: if you are not using an LED light bulb you may need to use alligator wires to connect your battery to the positive and negative side of your chosen electronic device. Remember that red wire is for the positive side (copper) and the black wire is for negative side (aluminum). If you don't have alligator wires you can make a wire using aluminum foil.*
9. **Record what happened** in data table and make a prediction of how many cells you'll need to turn on the LED light bulb.

Step 2: Determine how many cells you need to power an LED light bulb

1. Build another cell directly on top of your first cell following steps 1-5. See diagram below:



2. If you have a multimeter/voltmeter, measure the voltage of your two cell battery and record the voltage in your data table .
3. Take your LED light bulb and stretch out the positive terminal (longer terminal) so it touches the copper end of your battery and the negative terminal (shorter terminal) touches the aluminum end.

4. ***Did the light turn on?*** Record what happened in data table,
5. Continue to added cells by repeating steps 1-4 until the light comes on.
6. ***How many cells did you need to make a strong enough battery for the light to come on?***

Extension Activities

Step 3: Experiment with different materials

1. Repeat the procedure of Step 1 and Step 2 but experiment with different electrolytes, metals and/or paper membranes to make your cells and battery. **Example questions to investigate**:
    a. Which electrolyte is the best?
    b. Does copper and zinc work better than copper and aluminum?
    c. Which paper membrane is the best?
2. ***Remember to only test one variable at a time*.** For example, if you want to find out which electrolyte is the best, repeat Steps 1-2 with a different electrolyte each time but keep the metals and membrane the same.
3. **Make sure to record your data.**

Step 4: Optimize your battery

1. Analyze your data from your experiments above.
2. Build a 6-cell battery using the best electrolyte, metal combination, and paper membrane.
3. If you have a multimeter/voltmeter, measure the voltage of your optimized battery.
4. **Share your idea with Argonne!** Take a picture of your battery and a list of materials you used and send it to Argonne Education at learninglabs@anl.gov or have an adult tweet it out to @Argonne and #ArgonneAtHome.

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My Battery Data Table

Steps 1-2 *Edit/expand table as needed or use your own.*

Metal 1:_____Metal 2: _____Electrolyte: _____Membrane: _____

# of Cells	Light Observations *Did the light turn on? Is the light dim or bright?*	Voltage (V)

Step 3 *Edit/expand table as needed or use your own.*

Materials *Remember to only test one variable at a time.*	Light Observations *How many cells do you need to turn on the light?* *Is the light dim or bright?*	Voltage (V)
Metal 1: _____ Metal 2: _____ Electrolyte: _____ Membrane: _____		
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Step 4

Take a picture of your optimal battery and a list of materials you used and send it to Argonne Education at learninglabs@anl.gov or have an adult tweet it out to @Argonne and #ArgonneAtHome

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