PHYSICS IN MOTION
gpb.org/physics-motion

Unit 5E
Current Electricity
Current Electricity Lab

Name:

Date:

Oh no! Just minutes before your end-of-semester presentation is set to begin, you realize that your video camera will not turn on! Quick testing reveals the culprit: one dead AA battery (1.5 V). How will you record your presentation? Seeing no readily available replacement, you set to work building your own battery.

Part One: Building a Battery

Materials:

- vinegar (¼ cup)
- salt (1 Tbsp)
- small bowl or glass
- multimeter
- pennies
- nickels
- aluminum foil (small strip)
- dish soap
- scissors
- paper towels

Procedure:

a. In the small bowl, mix together the vinegar and salt. Stir well.

1. Why do you need a solution of salt and vinegar?

____

____

b. Wash the nickels and pennies with the dish soap. Make sure they are dry before use.

c. With the scissors, cut a 2 cm by 8 cm strip of aluminum foil. Fold the strip lengthwise in three so that it measures 8 cm long with a folded width of $\frac{2}{3}$ cm.

d. Use the scissors to cut a paper towel into small squares, each measuring about 2 cm by 2 cm.

e. Make an assembly area by placing a paper towel on a flat surface and laying the folded foil on the paper.

f. Place a penny at the end of the folded foil, on the last 2 cm.

g. Dip a paper towel square in the vinegar solution. The square should be wet but not dripping.

h. Place the square on top of the penny.

i. Put a nickel on top of the square, then add another wet square on top of the nickel.

j. Repeat until you have a battery of two pennies and two nickels, each separated by a wet paper towel.

Important: Make sure the paper towel squares are not dripping wet, and do not let them touch each other.

questions continued on next page

2. **Why do you think it is important to follow the precaution noted above?**

____

____

k. **Using the voltage setting on your multimeter, measure the battery output by touching one multimeter lead to the top nickel and the other to the aluminum foil underneath the stack.**

# of Pennies	2	3	4	5
Measured Voltage				

l. **Add a paper towel square, penny, paper towel, and nickel to the stack, and measure the voltage again. Do this for up to five penny/nickel pairs in the stack. Record your measurements in the table.**

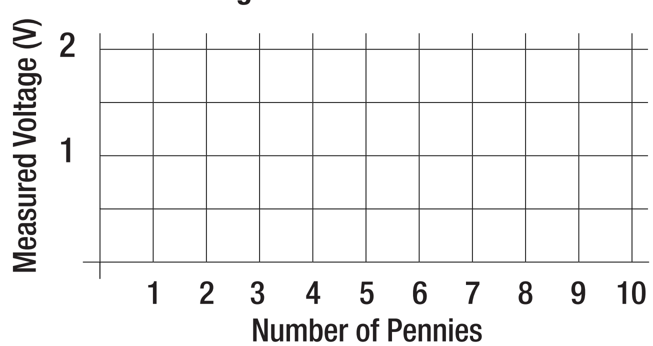
3. **Why is it important to always alternate a penny with a nickel in the battery stack?**

____

____

m. **Plot your measured values on the graph below:**

Voltage Grows With Coin Stack



4. **Draw a line through the points. How many pennies are needed in the stack to replace a 1.5 V AA battery?**

____

____

questions continued on next page

PHYSICS IN MOTION
gpb.org/physics-motion

Unit 5E
Current Electricity
Current Electricity Lab

Name:

Date:

Part Two: Voltage, Current, and Resistance in a Circuit

Materials:

- Java software installed: https://www.java.com/en/
- Circuit Construction Kit (DC Only) from PhET website: *https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab*

Procedure:

In preparation for an upcoming camping trip, you decide to install a light in the top of your tent so that you can see clearly when getting in and out of the tent at night. You collect several electrical parts: a bulb, some wires, a battery, and an on/off switch.

a. Draw a diagram showing how you think these parts should be connected:

b. Test your diagram by running the Circuit Construction Kit simulation and creating the circuit.
c. Draw another way you can connect a wire, a light bulb, and a battery to make an effective tent light.

1. What could you change about the circuit to create a dimmer light?

questions continued on next page

PHYSICS IN MOTION
gpb.org/physics-motion

Unit 5E
Current Electricity
Current Electricity Lab

Name:

Date:

Now that we've created a working circuit, let's see how current, voltage, and resistance work together. Insert a voltmeter that measures across the light bulb (one lead on one side, the other lead on the other side).

Next, add an ammeter to the circuit to measure current. You will need to add the ammeter into the same current loop as the bulb, which will require removing a wire and rewiring the ammeter into the loop.

Run the circuit so you can see charge traveling around the loop. When you change the bulb's resistance, what happens to the current and voltage readings? Add your observations to the table below:

Resistance (Ω)	Voltage (V)	Current (A)
100		
75		
50		
25		
0		

2. When resistance increases, how do current and voltage change?
   (Note: Disregard the results when R = 0 Ω because short circuiting occurs under this condition.)

3. Consider the change from 100 Ω to 50 Ω. When resistance is halved, does current change by the same factor?

4. Write a letter responding to a friend who makes two claims:
   a. Batteries are too complicated to understand or make. You can only buy them from a store.
   b. There is no relationship between current, resistance, and voltage in a simple circuit. They change randomly. (Note: In your response, include what you believe to be the connection between these three.)

Courtesy of:
PhET Interactive Simulations
University of Colorado Boulder
https://phet.colorado.edu