Student Worksheet #2

Engineering a Multilayer Resistor: Design Challenge

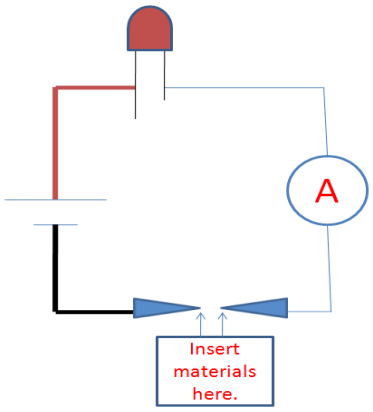
Safety

If any part of the circuit heats, disconnect the battery. Keep electrical equipment, such as probes and wires, out of the food itself. Only allow the probes to touch the aluminum foil.

Materials

- ammeter or multimeter
- LED
- 9V battery
- 9V battery connector
- metric ruler
- 5 alligator clip wires
- 2 alligator clips
- 3 paper plates
- sheet of aluminum foil
- straws
- 1 cup of each type of condiment: mustard, ketchup, mayonnaise
- hot dog
- scissors
- syringe

Before you begin: Create the circuit below. Leave one part disconnected where various materials will insert into the circuit. The long leg of the LED points to the positive battery terminal. ***Do not close the circuit without your resistor. This will burn out the LED.***



Design Challenge Rules:

- You must use at least **2 cm** of a **hot dog** and **at least 1 condiment in the straw.** *Put the hot dog in the straw last.*
- **All** materials must fit in a straw.
- Draw and label your resistor.
- Record the current.
- Modify your first design and improve it.

Challenge #1

Create a hot dog resistor that allows the **most current** to create the **brightest** LED! **Hint:** Use your chart from the last lab. Remember how **length** and **area** affect resistance to create the **most** conductive hot dog resistor!

Challenge #2

Create a hot dog resistor that allows the **least current** to create the **dimmest** LED!

Challenge #3

Combine your Challenge #1 resistor and your Challenge #2 resistor by putting them back-to-back. What is the current? Is the current higher or lower than the current when each resistor is tested individually? Explain.

Record your Observations:

Hotdog Resistor Diagram (Remember to label)	**Current (mA)**
<u>Challenge #1</u>	
Modified and Improved Challenge #1	

Hotdog Resistor Diagram (Remember to label)	Current (mA)
Challenge #2	
Modified and Improved Challenge #2	

Name:_____Date:_____Class:_____

Engineering A Multilayer Resistor: Homework

1. How did stacking various materials on top of each other affect how well it conducted? Did the resistance of the resistor go up or down as you stacked more ingredients on it?

2. What strategy did you use to make the LED the brightest? Why?

3. What strategy did you use to make the LED the dimmest? Why?

4. What complications did you come across? How did you fix them?

5. When would a scientist or engineer want to use a material that has:
   a) a lot of resistance?

   b) a little resistance?

6. Why is it important for engineers to characterize electrolytic materials on the nanoscale?