**Simple Electrical Circuits**

In this activity we will explore simple circuits involving batteries, carbon resistors, light bulbs, and light emitting diodes (LEDs).

Light Bulb

Take a single battery, a light bulb, and one wire. Figure how to make the bulb light up.  
Sketch your circuit. Is there a continuous path for the current to flow from one side of the battery to the other side? If so, then trace the current path.

Resistance and Power

BULB

You can determine the resistance of the **bulb** by measuring the voltage and current. The diagram to shows how to insert the multimeters into the circuit to measure voltage and current. Calculate your resistance using *R = V/I* for the bulb.

*[Caution: Don’t place the multimeter in the ammeter setting directly across the battery and resistor. It will draw excessive current which may result in a blown fuse or damaged meter.]*

How do you find the electrical power “burned” in the bulb?

Power **P = I \* V**, or – using Ohm’s Law I = V/R for substitutions,

**P = I \* V = I2 R = V2 / R**

**Power (bulb) =**

LED

Power one of your LEDs using the circuit shown. Use two batteries in series so V ~ 3 volts and use R = 100 Ω. In powering a LED it is essential that you use an appropriate series resistor to limit the current. If the LED does not light up, then reverse the leads.

Measure the voltage drop across the LED and the current flowing through it.  
Compute the power of the LED  
  
**Power (LED) =**

Which one appears more energy-efficient, the bulb or the LED?  
Touch each of them while powered – do you sense a difference?

Resistor Combinations

Two resistors can be connected either in series or in parallel, as shown below.



The addition rules for the equivalent resistance are

Series: 

Parallel: 

Resistors in series.

**Predict:** Select two different resistors and calculate the series combination of them.

**Measure:** Place them in series and measure the resistance with the multimeter and compare with your calculation.  
*Note: Do NOT connect them to the battery when measuring the resistance.*Do you find the calculated value? What is the % error?

**Predict**: Which of the two resistors in series should have the higher electrical power, the smaller or the larger resistance?

**Measure:** Can you confirm your prediction? What do you need to measure?

Repeat with the resistors in parallel.

**Predict:** Select two different resistors and calculate the parallel combination of them.

**Measure:** Place them in parallel and measure the resistance with the multimeter and compare with your calculation.  
Do you find the calculated value? What is the % error?

**Predict:** Which of the two resistors in series should have the higher electrical power, the smaller or the larger resistance?

**Measure:** Can you confirm your prediction? What do you need to measure?

Additional activity (for further study at home)

(*Note: Use clear LEDs*.)

An LED can also work in reverse. That is, it can be used as a light sensor.

Measure the voltage across one of your LEDs. Bring a white light source near the LED and note the increase in voltage. This should work for all of the LEDs, but may work best for the red LED. (Why?)

You can use the LED to observe the dependence of light intensity on the distance (~ 1/r2). There is a maximum possible voltage output for the LED, so your measurements would have to be well below this value.

If you have a red laser pointer and a green laser pointer, you can note the effect of the laser light on the voltage output. A green laser will excite a red or yellow LED, but a red laser will not excite a yellow or green LED. Why is this so?

