Resistance is an important concept when you are creating circuits. Resistance is the difficulty a current encounters when it passes through a component. Everything that electricity passes through provides some measure of resistance, wires, motors, sensors, even the human body!

Measuring voltage, current and resistance are all done in different ways. **To measure resistance you disconnect (turn off) your circuit and place both multimeter leads on either side of the portion of the circuit you wish to measure.** For example: for measuring just a component you would place your leads on the power and ground leads of the component. To measure the resistance of multiple components you leave them connected and place the positive (red) multimeter lead closer to the disconnected power source and the negative (black) multimeter lead closer to the ground. Sometimes you will want to measure the resistance of input and output leads, but more often you will find yourself measuring resistance along the power to ground circuit. It is important to know how much resistance is present in components and circuits for many reasons. Too much resistance and the current will never travel through the whole circuit, too little and the current may fry some of your components! But most importantly you can use resistance to choose the path the current takes through your circuit.

Hook up the circuit below using red LEDs. (Don't hook up the power yet.)

Measure the resistance of each of the possible paths the current can take from power (5v) to ground. There are three possible paths. You will have to measure each component separately and then add the resistance up for the total. You will can add the component's resistance together because the components are in series, if they were parallel it would require more math. Record the total resistance for each circuit below. (Hint: you won't be able to measure the LED)

Circuit 1: 996 Ω Circuit 2: 615 Ω Circuit 3: 324 Ω

Now connect the power and, one at a time, press the two buttons. Which circuit makes the LED the dimmest? Circuit # 1

If you press both buttons which path does the current take? Circuit # 3

If the voltage is staying at 5v in this circuit no matter which paths are closed, there is a way to calculate the current given the resistance. **Write the name of the law and the equation that solves for resistance below. Label all variables.**

Now measure the resistance of a potentiometer when it is dialed all the way up and down. Record the highest and lowest values you get.

Highest: 994 Ω

Lowest: .1 Ω

Redraw the schematic below, but use a potentiometer to control the LED brightness instead of the buttons and various resistors. Remember that you must have at least 330Ω of total resistance, otherwise you'll burn out your LED!

Since a circuit or component does not need a current running through it in order to measure the resistance you can take your multimeter and measure the resistance of anything you can think of. Wander around and measure the resistance of various objects. Start with a penny. **Record the most interesting things that have resistance and the value of their resistance below. List at least three.**

_____

_____

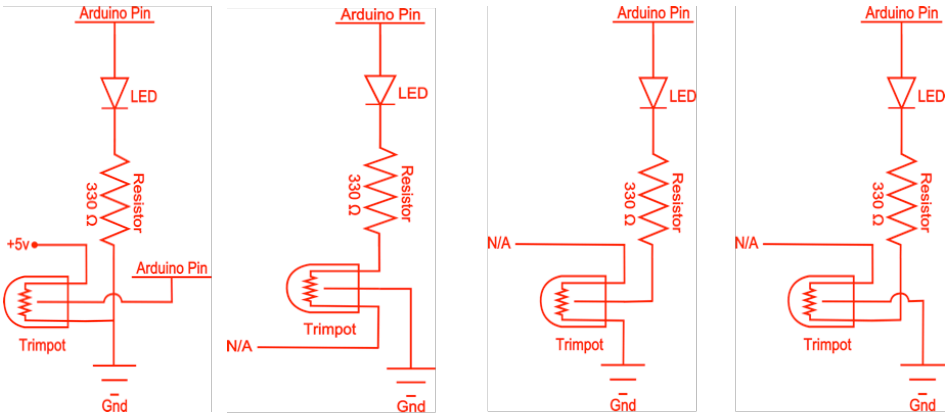
_____

_____

Draw Your Schematic

Schematic can be drawn 4 different ways.

Ohm's Law, V/I=R where V= voltage, I = current and R = resistance



CHAPTER 2
Voltage Drop

Voltage drop is an important concept when you are creating circuits. Voltage drop is the amount that the voltage drops when it passes through a component. The following exercises will show how to measure voltage drop in real life. This is essential when you are fixing your remote control car, electric guitar or even a cell phone.

Measuring voltage, current and resistance are all done in different ways. To measure voltage you connect your positive (red) multimeter lead to the side of the circuit that closer to your power source and the negative (black) multimeter lead to the side of the circuit that is closer to the ground. It is important to know how much voltage is going through a circuit for many reasons. The most important reasons being that too much voltage can damage your components and too little voltage may not allow electricity to flow all the way through to ground.

Hook up the 5v circuit to the right using red LEDs.

Close the circuit so only one LED is grounded with the 300Ω resistor. Insert the end of the resistor not plugged into the ground into a hole on the same row as the first LED's negative lead. The other LEDs don't light up, why is this?

Only the 1st LED is grounded, so it is the only LED with a closed circuit. The others are not grounded. Current takes shortest (least resistance) path to ground.

Measure the voltage drop across just the LED and record.
1.98 v

Measure the voltage drop across the LED and the resistor.
4.92 v

Close the circuit so two LEDs light up.

Voltage drop across one LED = 1.88 v Voltage drop across two LEDs = 3.78 v

Measure the voltage drop across the whole circuit and record.
4.95 v

Close the circuit so three LEDs light up.

Voltage drop across one LED = 1.66 v Voltage drop across two LEDs = 3.3 v

Voltage drop for three LEDs = 4.95 v Voltage drop for whole circuit = 4.96 v

What happened to the LEDs with the last question?

Now hook up the same circuit to the 3.3V power source without the resistor.
Why do you think you don't need the resistor?

They get very dim. The LEDs are drawing less volts than they need to fully light.

Measure the voltage drop across all the LEDs and record.
3.36 v

Close the circuit so only two LEDs light up.

Voltage drop across one LED = 1.68 v

Voltage drop across two LEDs = 3.36 v
Hook up the circuit above to the 5V power source but use the 3.3v as ground.
Wait a second! You can't use a power source as a ground! Or can you?

What is the voltage available and how many LEDs can you light up with it?

Voltage available = 1.7 v

# of LEDs you can light up = 1 (barely)

Many people think of Gnd as the ONLY place to connect a 'negative' pin, but all you need is a voltage drop from the beginning of a circuit to the end. This difference in voltage is what draws the current in the correct direction.