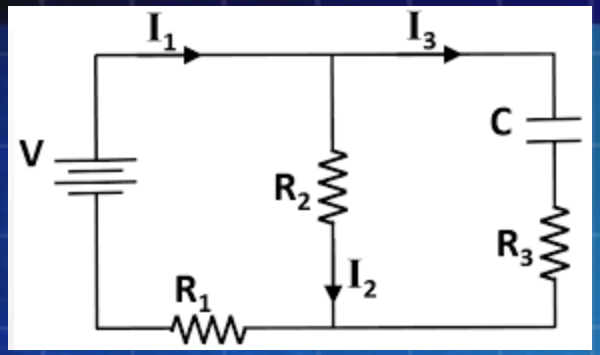
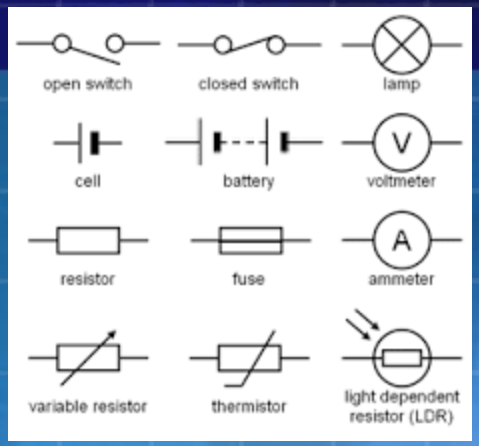
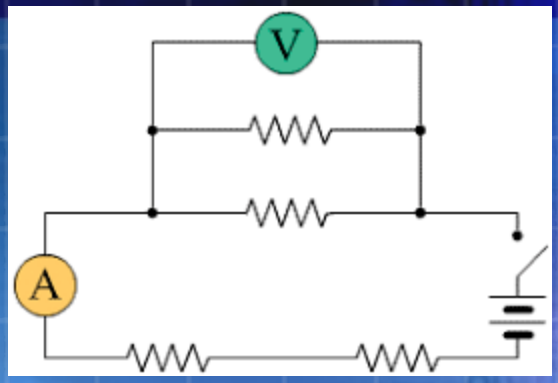






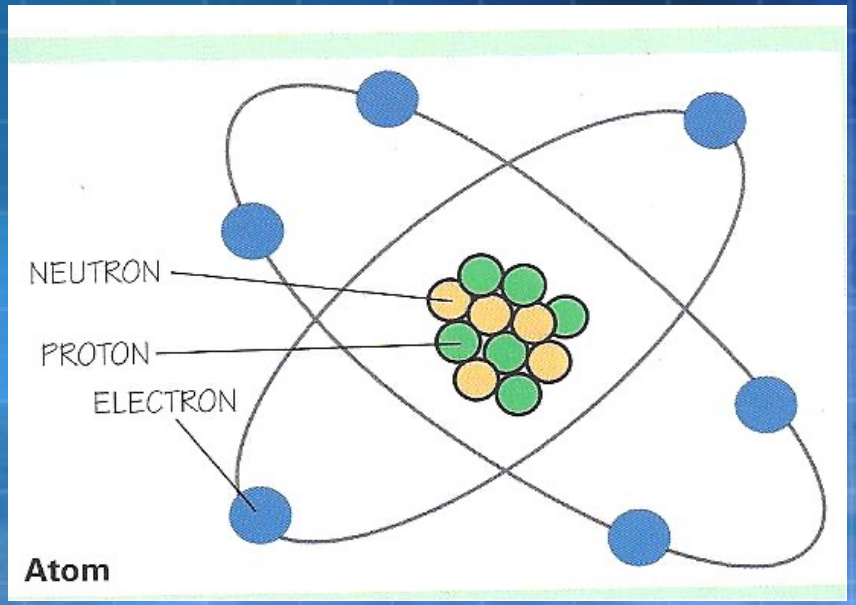
Circuit Lab

Practice #2—Static Electricity, Conductors, Inductors, Making Measurements

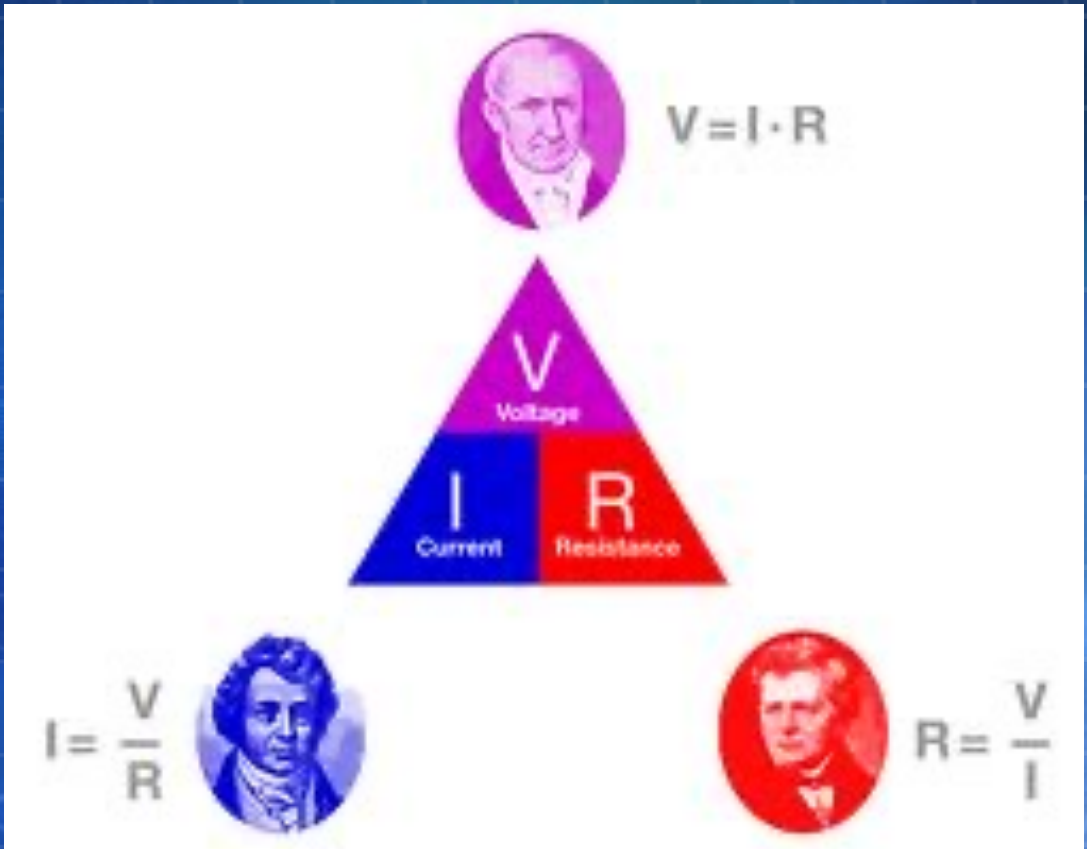
Mr. Burleson
geaux15@hotmail.com

Basics of Electricity

- Atoms
- Protons
- Neutrons
- Electrons
- Electrical current

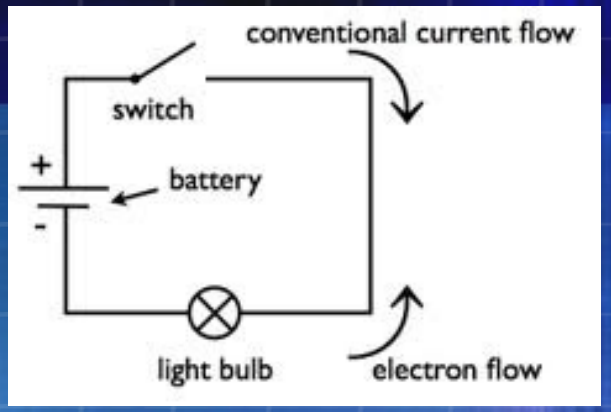


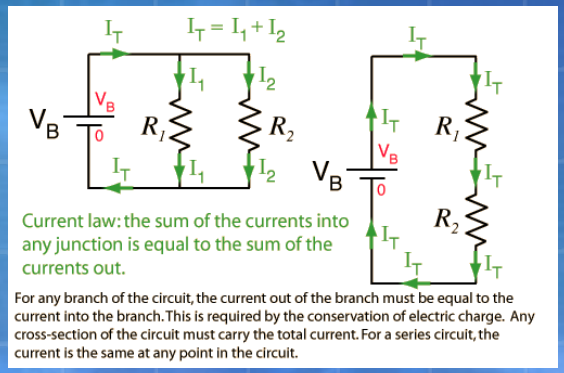
The Big Three—Volta, Ampere, and Ohm

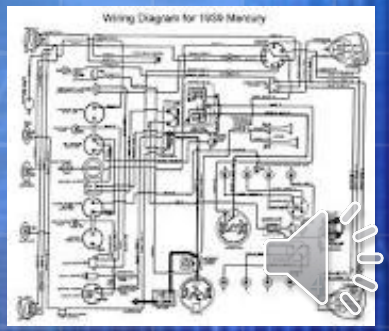


Important Terms

- Circuit is a loop-shaped path through which electric current travels from a source around and back (or to ground)
- Short circuit is a circuit with a zero or low resistance path.
  - Can be very dangerous as it may lead to electrocution, fire, or other damage to the system.

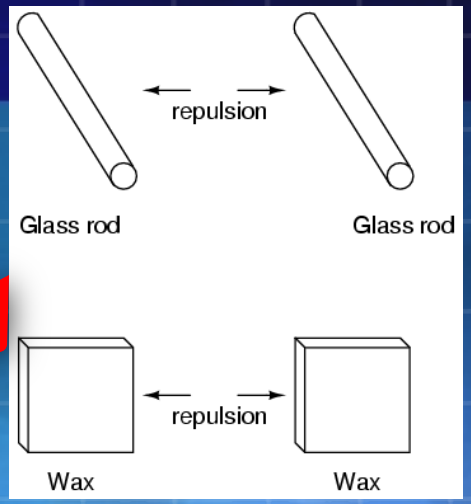


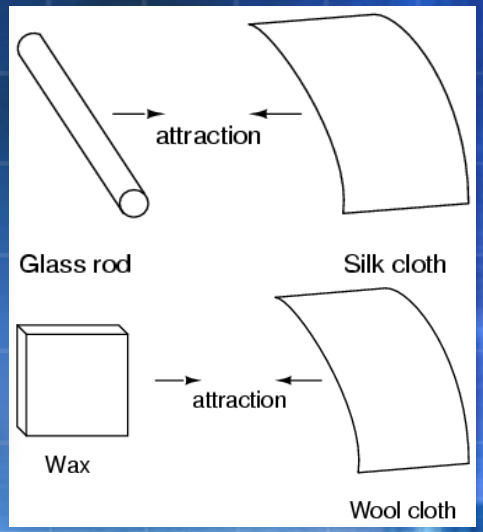


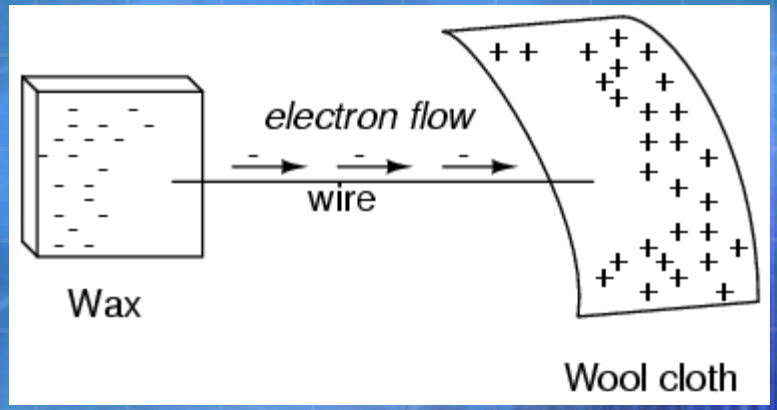


Static Electricity

- Electricity that doesn't flow
- It has a Voltage
- It has zero Current
- Caused by imbalance of electrons in two materials
- Alike charges repulse or push away from each other
- Opposite charges attract or pull towards each other
- Clingy socks and hair standing on end
- Can be changed by electrons moving from one material to another

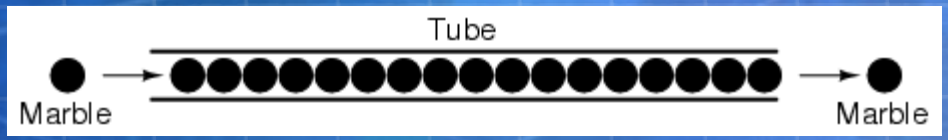






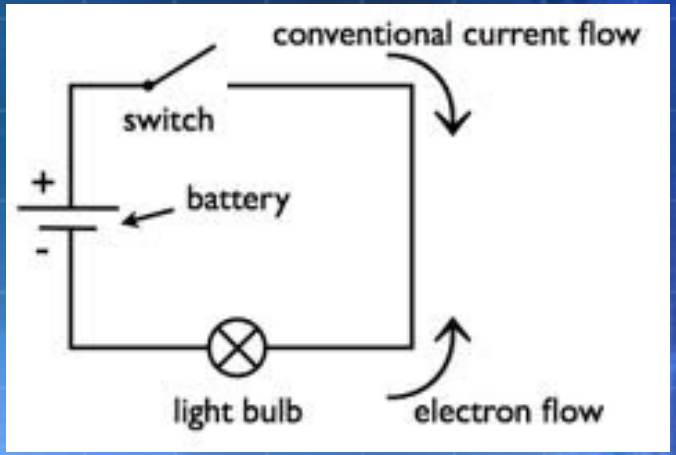
How do the electrons move or conduct?

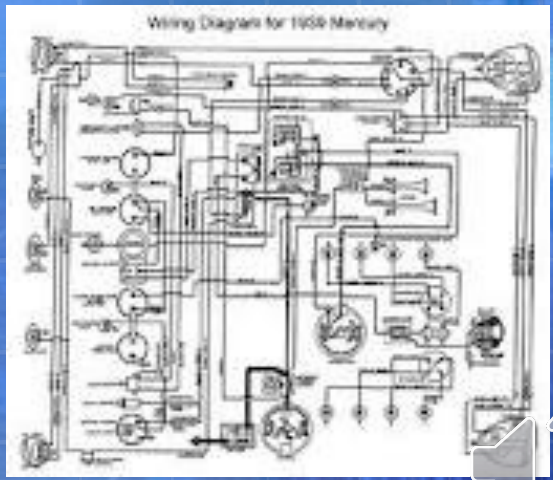
- Electrons need to conduct/move through a material that allows electrons to easily pass.
- The materials that electrons most easily pass through are called **CONDUCTORS**
- The materials that electrons have the most difficulty passing through are call **INSULATORS**
- See notes for examples
- The electrons flow through the materials like marbles in a tube.



What is a circuit?

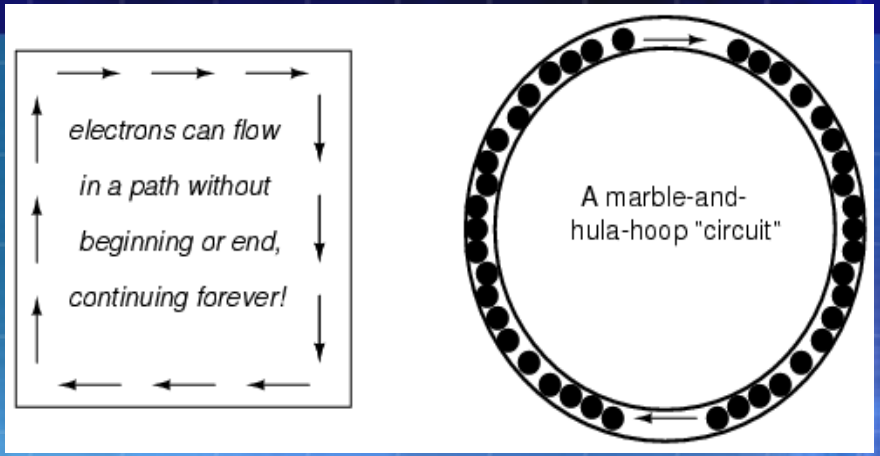
- Circuit is a loop-shaped path through which electric current travels from a source around and back (or to ground)
- Short circuit is a circuit with a zero or low resistance path.
  - Can be very dangerous as it may lead to electrocution, fire, or other damage to the system.
- Open circuit is a circuit that is broken and therefore nothing can flow.
  - Switch in OFF or OPEN position

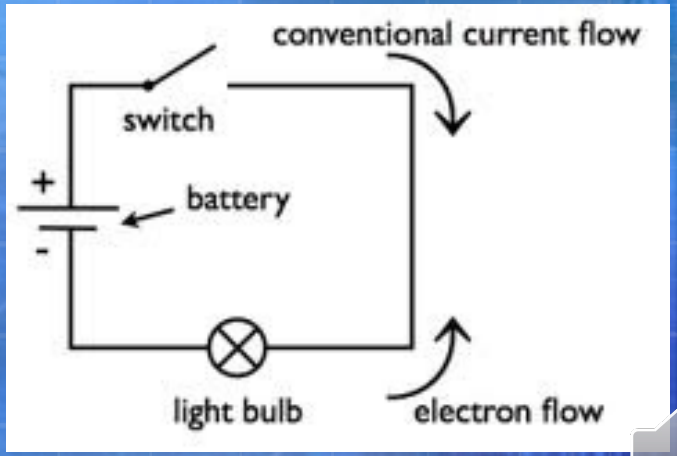




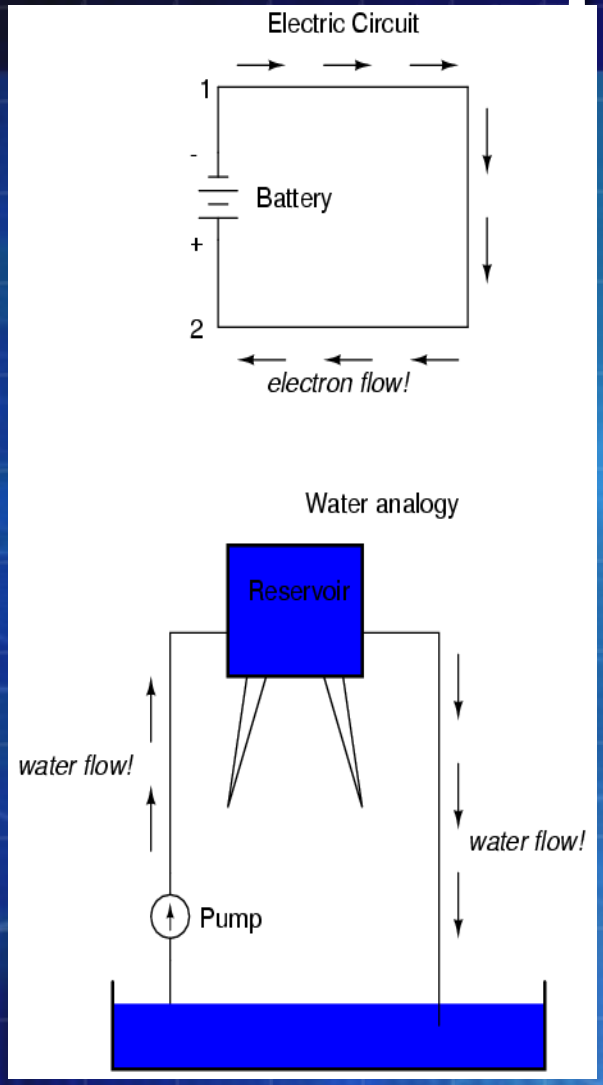
What direction does the current flow

- Current flows from the **POSITIVE (+)** terminal of the source/battery to the **NEGATIVE (-)** or GROUND.
- Electrons flow in the opposite way to current because of the way Ben Franklin thought they flowed.
- If the circuit is OPEN, no current flows.





How it compares to water flowing



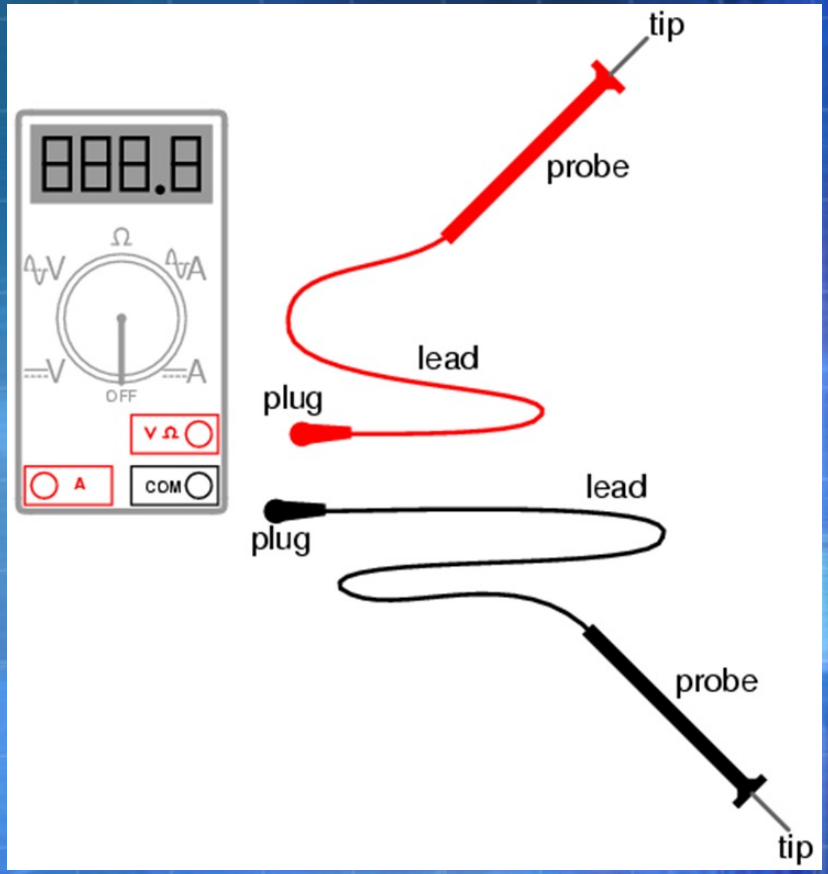
- Pressure is like voltage (the higher the tank the more pressure/voltage)
- Flow is like amperage
- Resistance is how difficult it is for the water to flow
- The pump is the voltage source, like a battery

How to identify batteries?

- All batteries are Direct Current (DC)
- They are usually denoted by their Voltage
  - Normally 1.5V, 3V, 6V, 9V, 12V, and 24V
- POSITIVE (+) terminals are either marked or painted RED, sometimes with a cover to reduce chance of a SHORT CIRCUIT
- NEGATIVE (-) terminals are normally marked or painted BLACK or BLUE.
- A popular hands on activity is to identify voltages and polarities of batteries by inspection only.

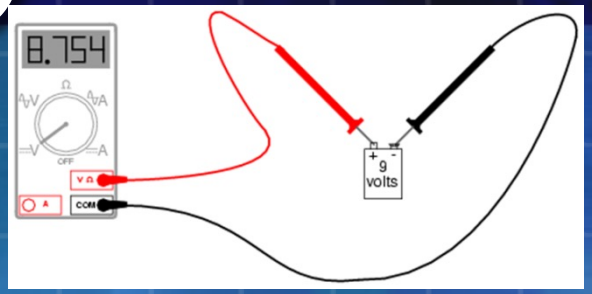
Making Measurements

- Multimeters can measure "multiple things"
  - Voltage
  - Resistance
  - Current (very dangerous and we will avoid this measurement normally)
  - Voltage and Current can be either DC or AC (we will NOT use AC for Circuit Lab)
- Parts of a multimeter are shown to the right

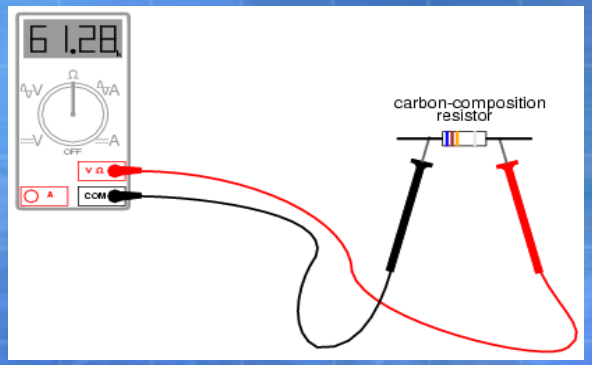


Making Measurements (cont)

- Turn the switch in the middle to select what you want to measure
- <u>These are the two you should use</u>
  - Put the leads in the V/Ω and Com or Ground Positions
  - The resistance of the device is very large and can be considered Open
  - VDC or V with straight lines is DC Voltage
  - Ω or R is Resistance
- Never use VAC or V/A with wavy lines (this is for AC circuits and not used in Circuit Lab)
- Try to AVOID EVER using Amperage (A) DC or with straight lines to avoid a short circuit



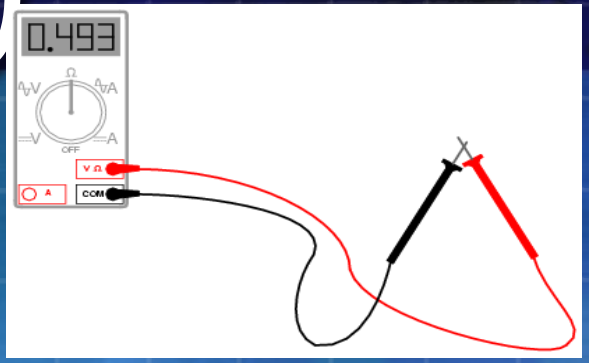
Measuring voltage with a 9V DC battery



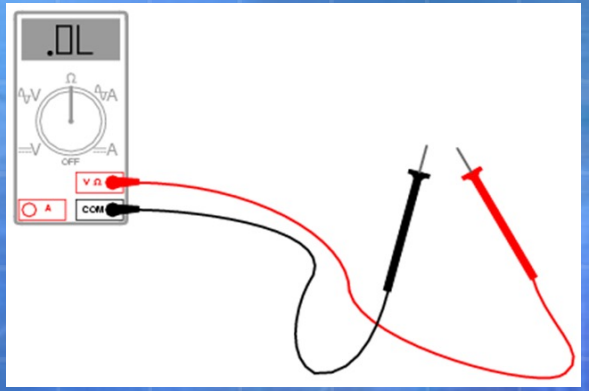
Measuring resistance for a 61.28 Ω resistor

Making Measurements (cont)

- To calibrate, you can measure the resistance in the leads and “zero it out”
- An Open Circuit may be displayed by Blinking numbers or by OL



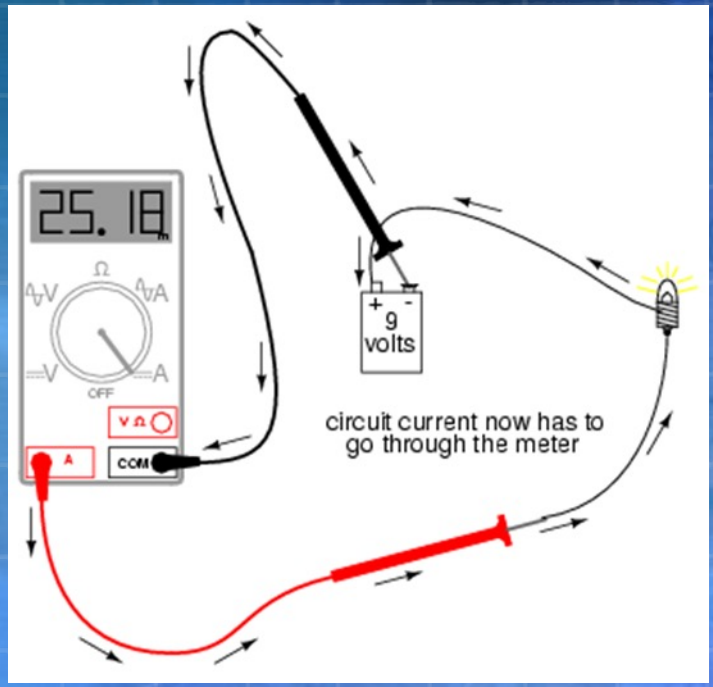
These leads have 0.493 Ω resistance (needs to be Zero’d out)



Measuring resistance for Open Circuit

Making Measurements (cont)

- If you are required to measure Current, recommend that you measure Voltage and Resistance separately and then calculate using Ohm's Law.
- However, if you have to measure current directly—make sure it has a load attached.
- The Leads have to be attached to the A instead of the V/Ω.
- When a multimeter is set to measuring current it is like a Short Circuit wire, so a load must be in place in parallel.



Measuring Current Directly (please note the leads are attached to a Load in parallel.

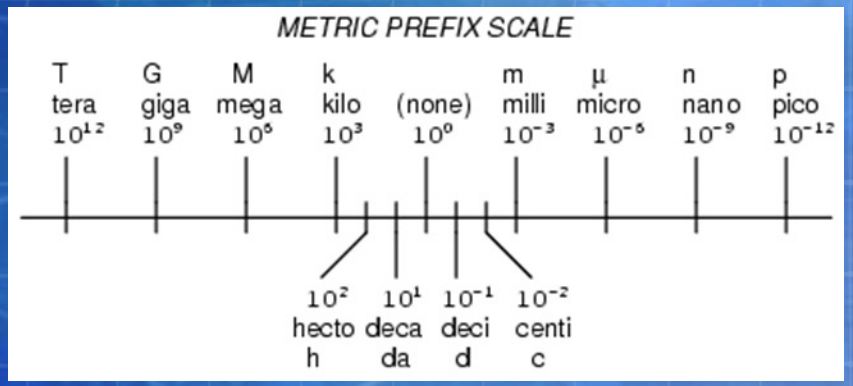
Points to remember

- Try to measure Voltage and Resistance because the multimeter acts as an Open Circuit and won't blow a fuse
- When measuring Current, the multimeter acts as a Short Circuit—so make sure there is a load in series with the multimeter.
- Voltmeter schematic sign is 

- Ammeter schematic sign is 

Metric Prefix Scale

- Resistance is normally in kΩ—kilohms (thousands of Ohms) or MΩ--Megaohms (millions of Ohms)
- Voltage can be in the Volts range, but often is in mV--millivolts (thousandths of Volts) up to MV--Megavolts (millions of Volts)
- Current is normally in mA—milliamps (thousandths of Amps), but can sometimes be in Amps
- 12 V on a 3 kΩ resistor would produce 4 mA.



Practical

- Have your coach and teammates gather different types of batteries. Also set up a simple circuit with a switch.
- Each team will identify the parts of a battery and set up a circuit with a switch
  - Show the direction of the current.
  - Any break in the circuit is an Open Circuit (demonstrate with the switch)
  - Describe a Short Circuit, but NEVER EVER DEMONSTRATE
  - Make measurements of the voltage from the source and load using the multimeter.

Homework

- Using the internet find two (2) ways to remove static electricity and explain how they work.
  - Look for hair and clothing suggestions
- Make a list of at least 10 conductors and 10 insulators.
- Do another sheet of Homework Generator Level 1 VIR