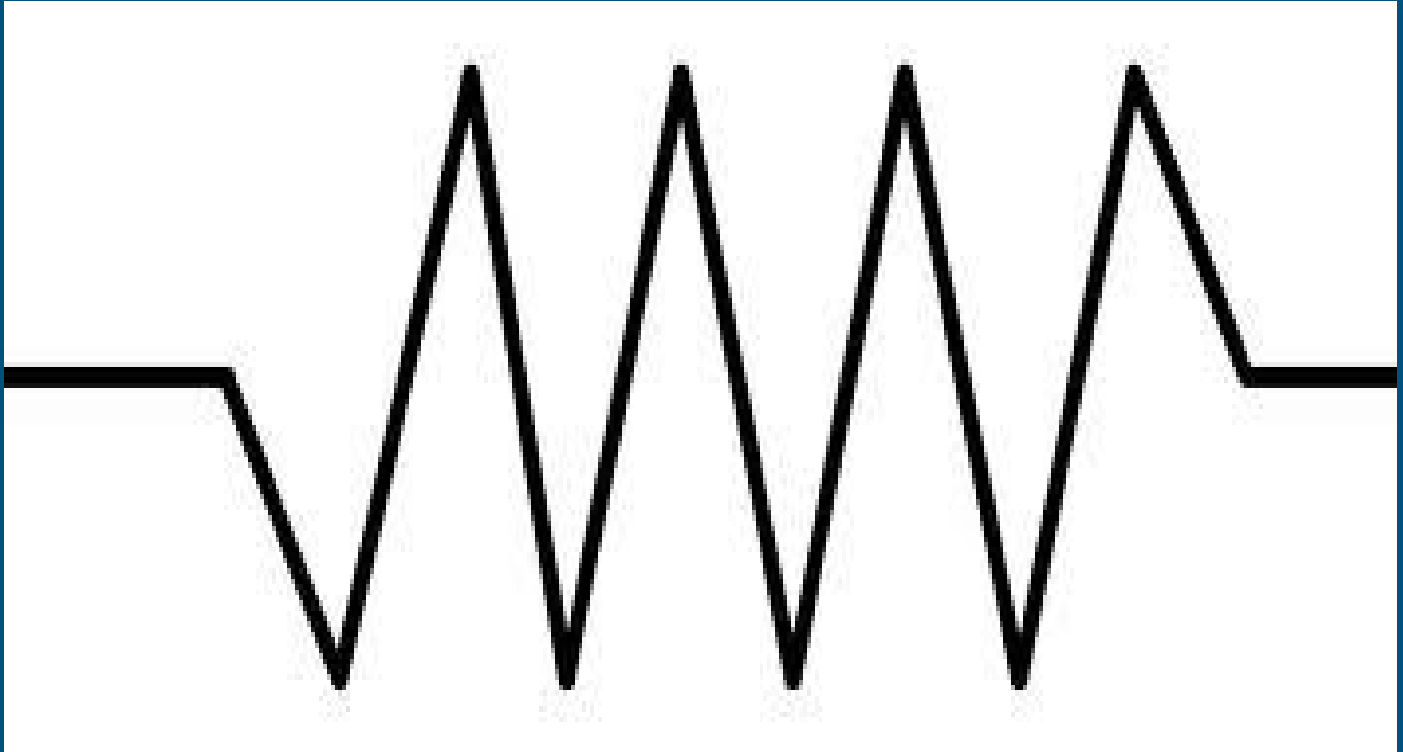


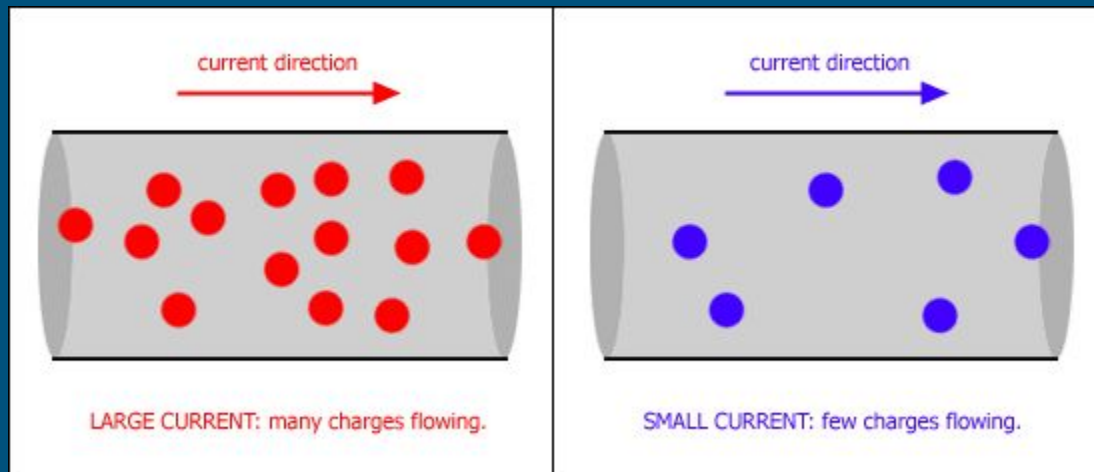
# Resistance



# Current

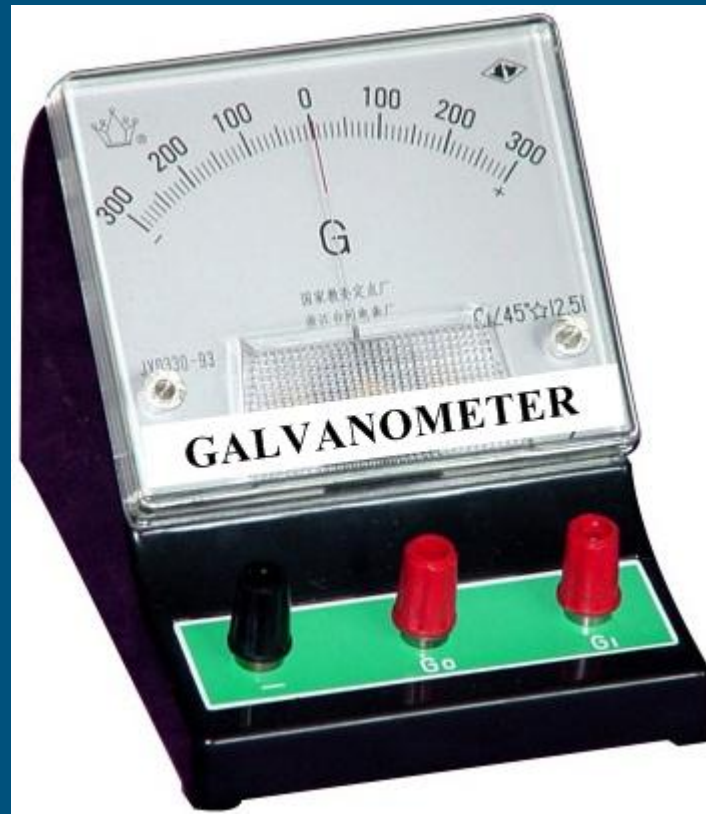
The steady flow of charged particles is called current (I).

The rate at which an electrical current flows is measured in amperes. This flow varies from a fraction of an ampere to many thousands of amperes, depending on the device.



An instrument used to measure very weak electric current is called a galvanometer. It measures in milliamperes.

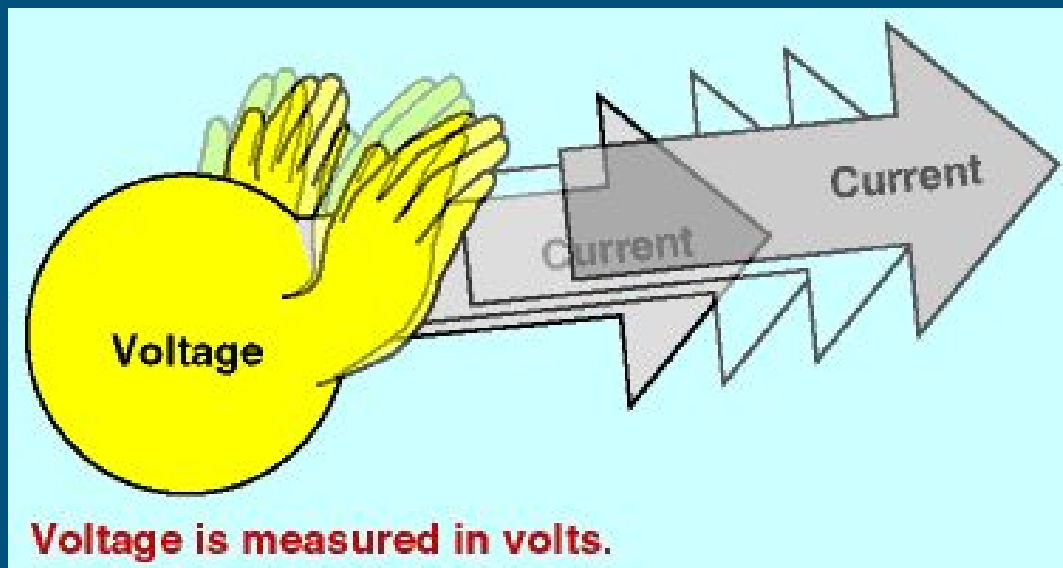
Larger currents are measured with an ammeter. It measures in amperes.



# Voltage

Electrical energy is the energy carried by charged particles.

**Voltage** is a measure of the difference in energy per unit of charge between one point in the circuit and another point in the circuit.



The higher the energy (voltage) of each charged particle, the greater the potential difference or ability of electrons to move their way through a circuit.

Also called potential difference.

Voltage units are volts (V).



A simple way to measure voltage is with a voltmeter.

Red leads connect to positive (+) and black leads to negative (-)

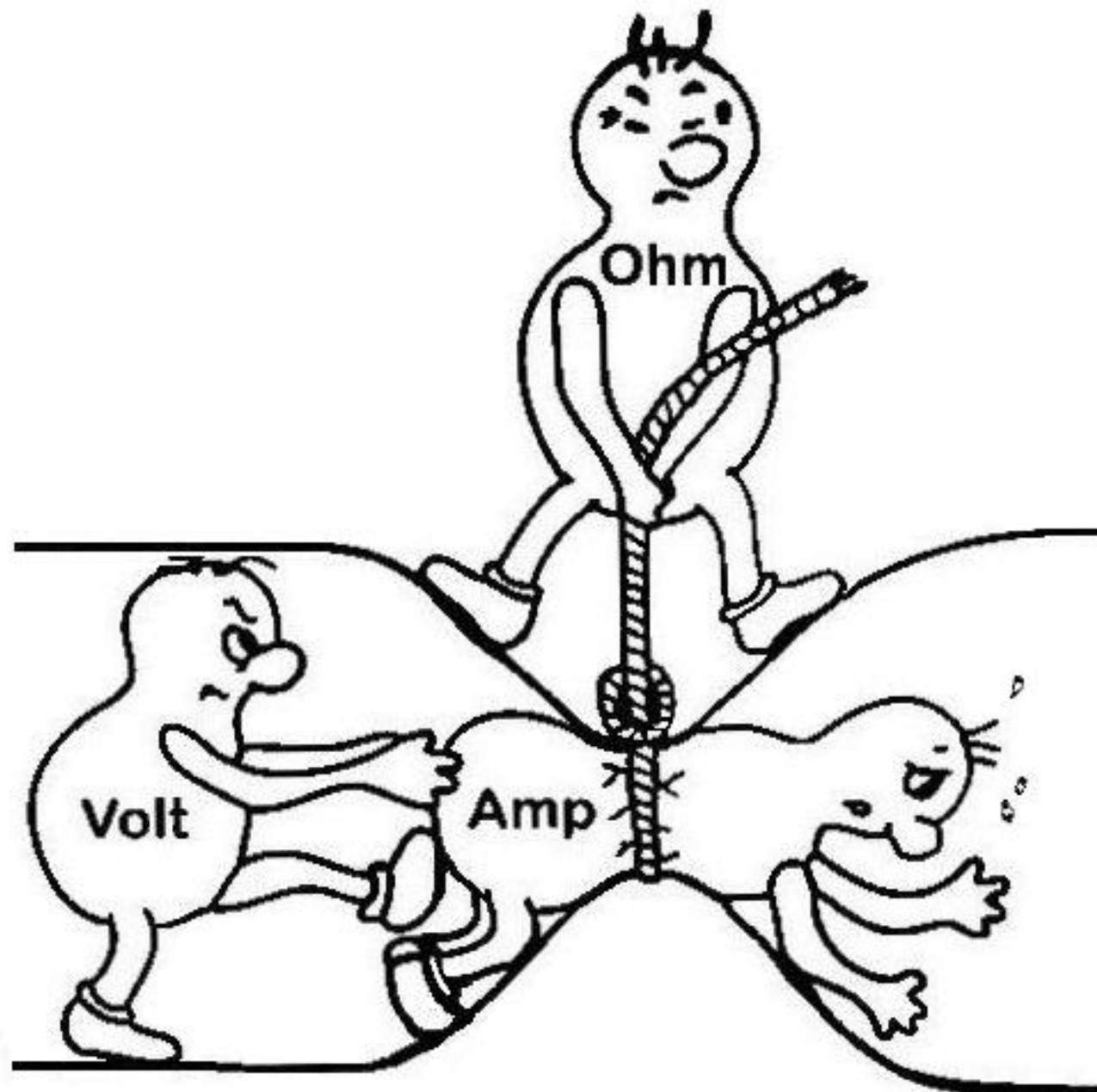


# Slowing the Flow

**Resistance** is what opposes the movement of electrons

→ It also converts electrical energy into other forms of energy.

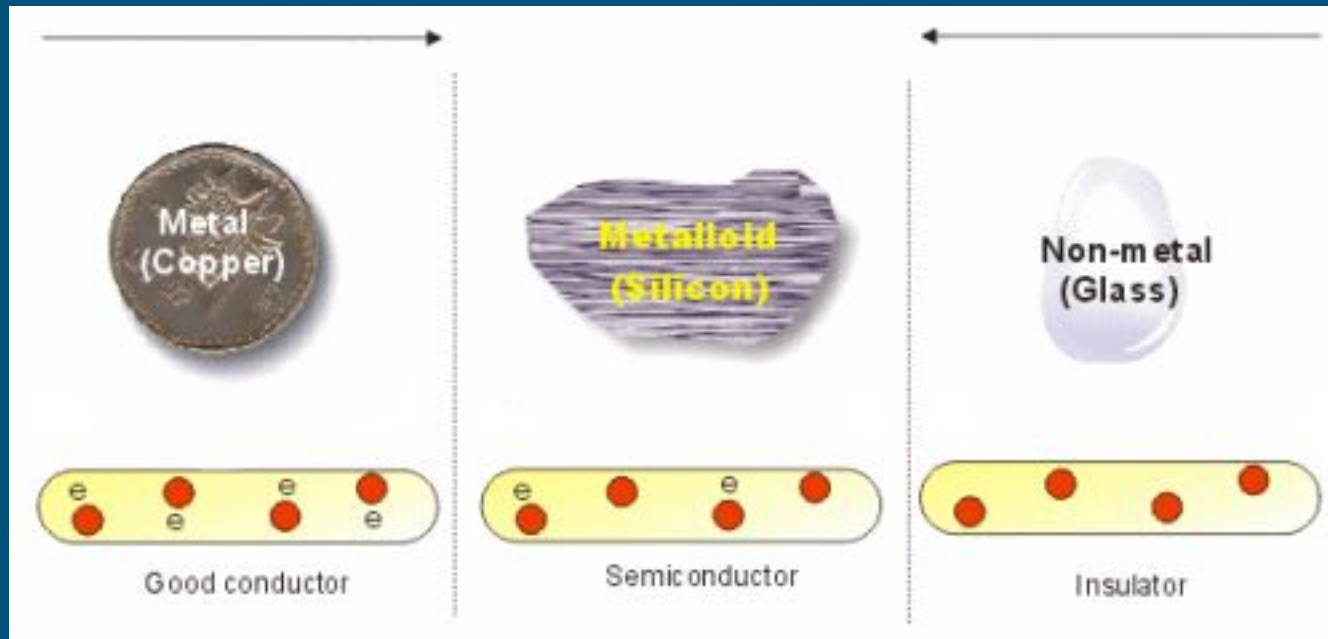
<b>Resistor</b>	<b>Useful Energy</b>
Light bulb	Light
Toaster	Heat
Electric Heater	Heat





# Low vs. High Resistance

→ Conductors have LOW resistance.



→ Insulators have HIGH resistance

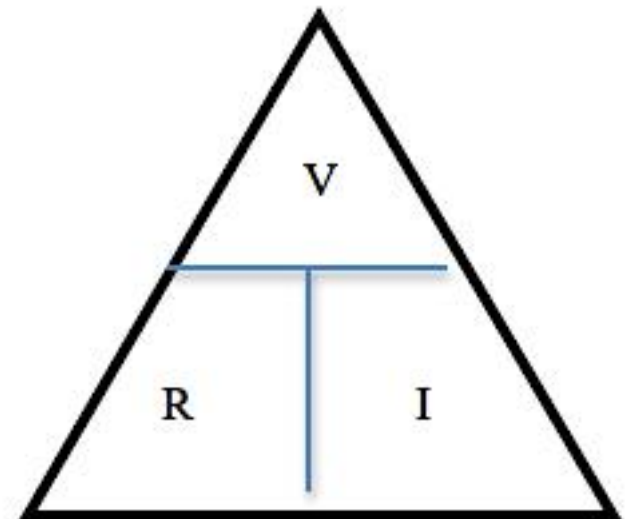
# Measuring Resistance

Resistance is measured in ohms ( $\Omega$ ).

Ohm's law allows us to determine the resistance of something when we know the current and voltage

Resistance = voltage / current

$$R = \frac{V}{I}$$



What is the resistance of a heater, if a current of 12.5A runs through it when connected to a 120V wall outlet?

$$R = ?$$

$$I = 12.5\text{A}$$

$$V = 120\text{V}$$

$$R = \frac{V}{I}$$

$$R = \frac{120\text{V}}{12.5\text{A}}$$

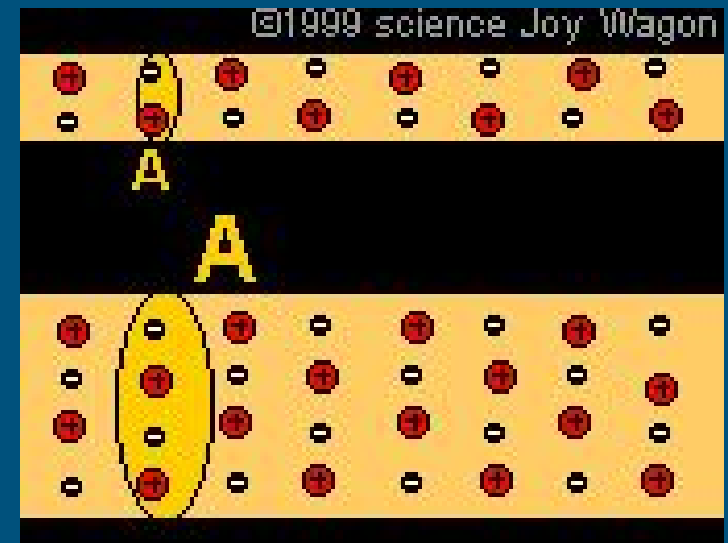
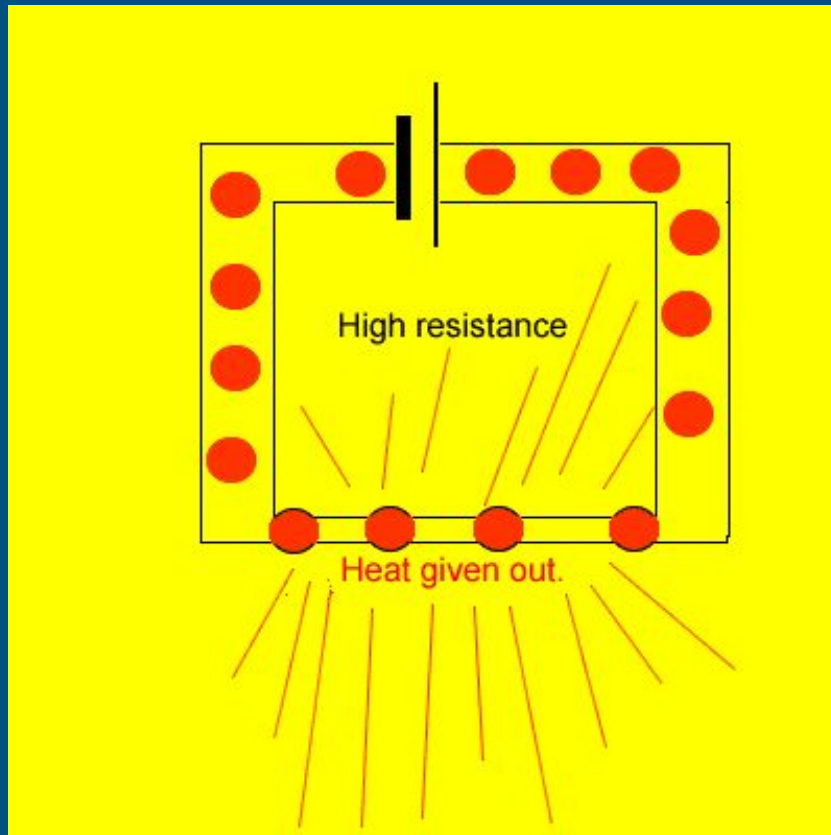
$$R = 9.6 \, \Omega$$

# Factors that Affect Resistance:

- Length - resistance **increases** with length (travels further)



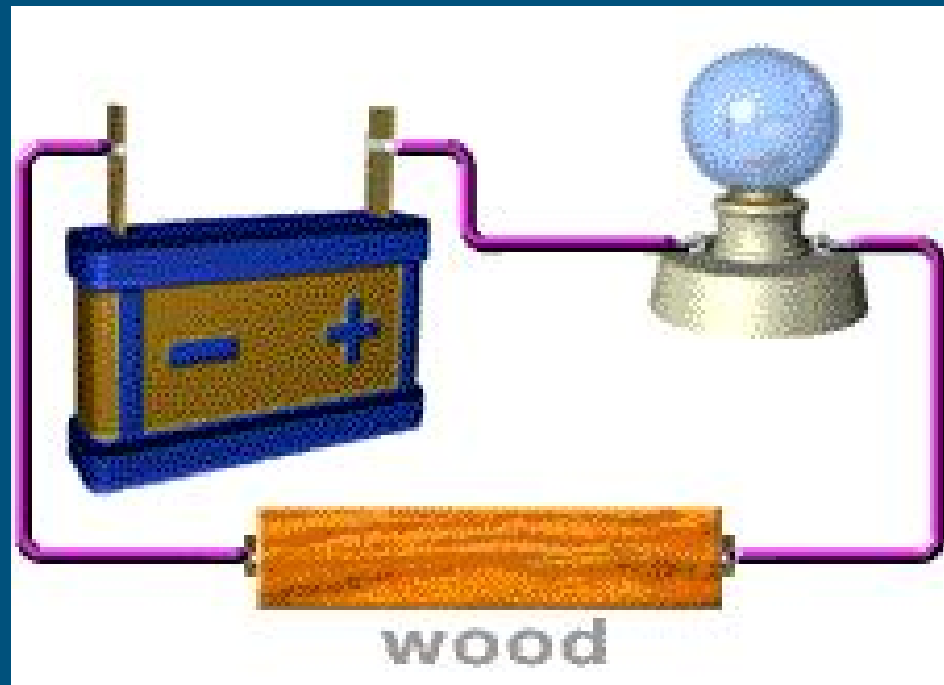
- Cross-Sectional Area (thickness) - resistance **decreases** with area



- Temperature - as temperature increases the resistance **increases** (moves faster in cold)



- Material - structure of the atoms in the material (some allow electrons to flow easier)



From Topic 2:

Draw a circuit containing two lamps in series with a switch and a single cell.



Draw a circuit containing a battery of four cells with a motor and lamp in parallel.

Draw a circuit containing three lamps in parallel with three switches that each control one lamp and a battery of two cells.

Draw a circuit containing a battery of two cells, two bulbs and one switch to control both bulbs. In addition, include one motor that will not be affected by the switch.

Draw a circuit containing two motors and two lamps in parallel with two switches and a battery of two cells. One switch controls one of the motors and the second switch controls the other three devices.