

# **ELECTRICITY AND CIRCUITS**

# WHAT IS ELECTRICITY?

Before we can understand what electricity is, we need to know a little about atoms.

Atoms are made up of three different types of particle: protons, neutrons, and electrons.

Protons have a positive charge, neutrons are neutral, and electrons are negative charged.

An atom can become positive or negatively charged by losing or gaining electrons.

If an atom losses an electron it becomes positively charged.

If an atom gains an electron it becomes negatively charged.



# WHAT IS ELECTRICITY?

Electricity is a force due to charged particles.

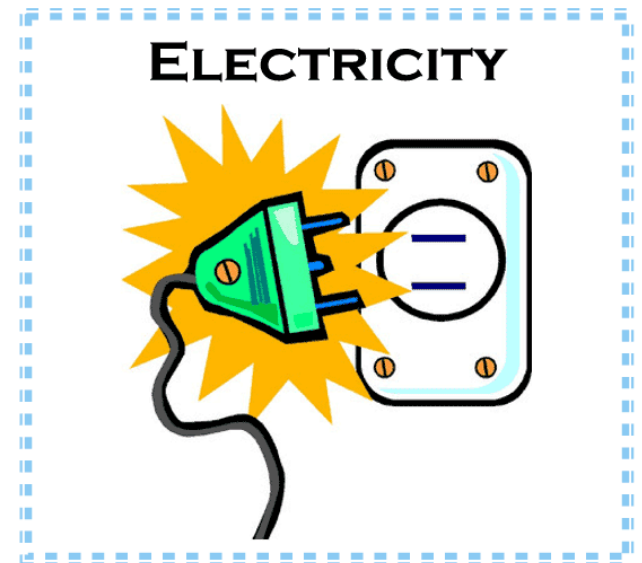
This can be static electricity, in which charged particles gather.

Current, or the flow of charged particles, is also a form of electricity.

Current is the ordered flow of charged particles.

Often current flows through a wire.

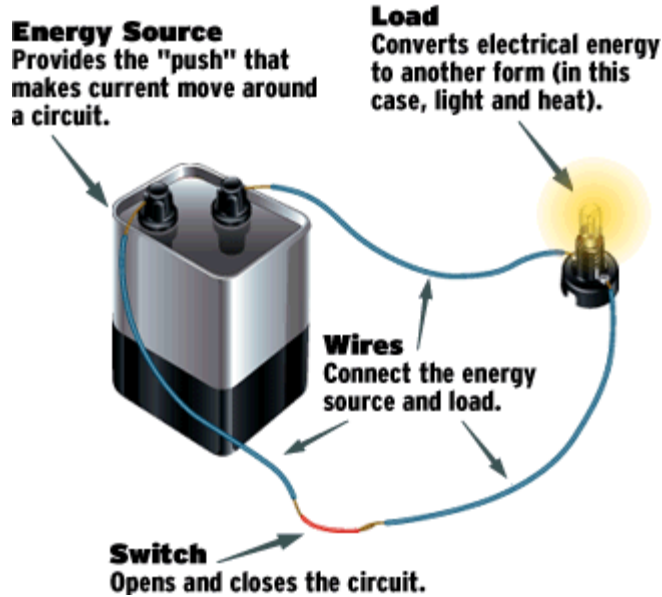
This is how we get the electricity we use everyday!



# WHAT ARE CIRCUITS?

A circuit is a path that electric current flows around.

## Four Parts of the Circuit



Current flows from a power source to a load. The load converts the electric energy into another type of energy

A light bulb is a load that converts electrical energy into light and heat energy.

What are some other types of loads?  
What type of energy do they convert the electric energy into?

# WIRES

Why are circuits connected with wires?

Wires are made out of metal which is a conductive material.

A conductive material is one that electricity can travel through easily.

Which of these material are conductive?

Water (dirty)

Aluminum Foil

String

Styrofoam

Cotton (fabric)

Wood

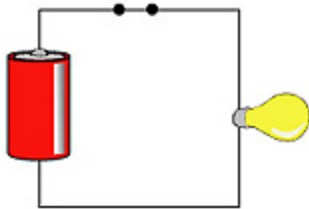
Glass

Graphite

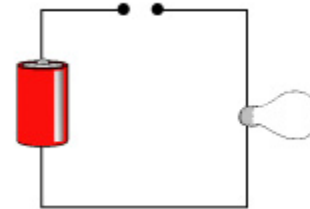
Concrete

Air

# OPEN VS. CLOSED CIRCUIT



CLOSED!

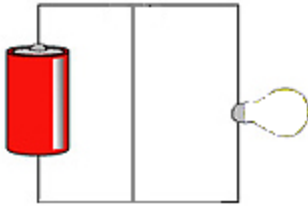


OPEN!

Why didn't the light bulb turn on in the open circuit?

In the open circuit the current can not flow from one end of the power source to the other. Because of this there is no current flow, and therefore the light does not turn on.

# SHORT CIRCUIT

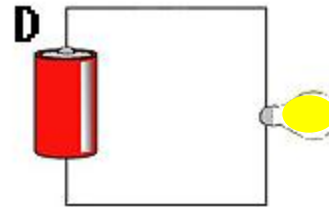
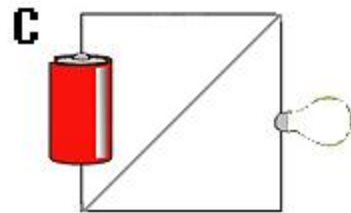
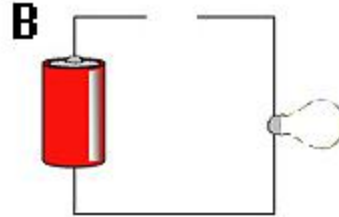
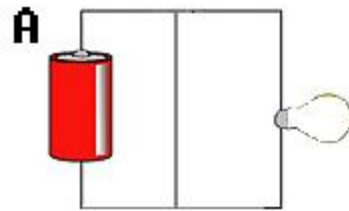


Current follows the path of 'least resistance'

Resistance is provided by the light bulb.

In this case the light bulb will not turn on because all the current will flow through the path with just a wire and none through the path with the light bulb.

# WHICH OF THESE LIGHTBULBS WILL TURN ON?





# CIRCUIT ELEMENTS

Circuits are not only made up of power sources and loads.

What are some other circuit elements?

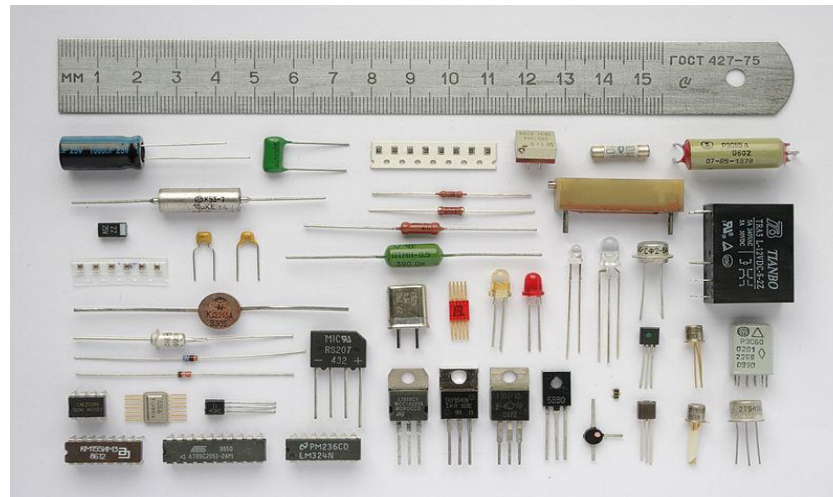
Switches

Resistors

Capacitors

Inductors

Transistors



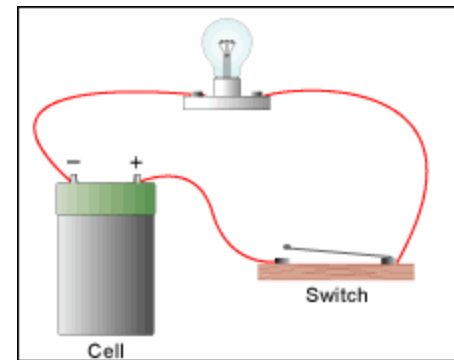
# SWITCHES

A switch has two states

Open or closed

When a switch is open no current can flow through it.

When a switch is closed current flows through it.



# RESISTOR

A resistor is a circuit element that can control the current flowing through a circuit.

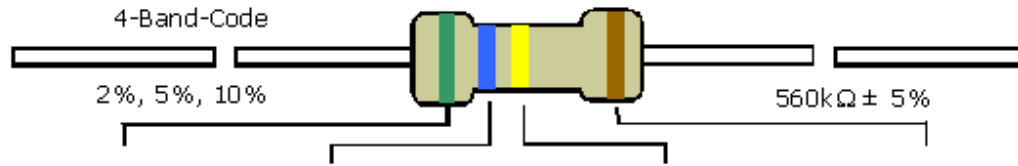
A resistor with a small resistance value will allow more current through the circuit.

This is governed by Ohm's Law:  $I = \frac{V}{R}$

Where I is the current, V is the voltage (provided by the power source) and R is the resistance (from the resistor)



You can tell the resistance value by color of the strips on the resistor



| COLOR  | 1st BAND | 2nd BAND | 3rd BAND | MULTIPLIER | TOLERANCE  |
|--------|----------|----------|----------|------------|------------|
| Black  | 0        | 0        | 0        | 1Ω         |            |
| Brown  | 1        | 1        | 1        | 10Ω        | ± 1% (F)   |
| Red    | 2        | 2        | 2        | 100Ω       | ± 2% (G)   |
| Orange | 3        | 3        | 3        | 1KΩ        |            |
| Yellow | 4        | 4        | 4        | 10KΩ       |            |
| Green  | 5        | 5        | 5        | 100KΩ      | ±0.5% (D)  |
| Blue   | 6        | 6        | 6        | 1MΩ        | ±0.25% (C) |
| Violet | 7        | 7        | 7        | 10MΩ       | ±0.10% (B) |
| Grey   | 8        | 8        | 8        |            | ±0.05%     |
| White  | 9        | 9        | 9        |            |            |
| Gold   |          |          |          | 0.1        | ± 5% (J)   |
| Silver |          |          |          | 0.01       | ± 10% (K)  |



The resistivity value of a resistor can be determined by the colored stripes on the resistor.



# FLASHLIGHT ACTIVITY

Construct a flashlight with your partner using wire batteries LEDs and resistors.

Your flashlight should have a switch (it should be able to be turned on and off)

If you finish early:

Add more LED's to your flashlight.

Can you make two switches that do two different things.

