Circuits

Electricity needs a complete circuit (loop) before it can flow though a wire and do work.

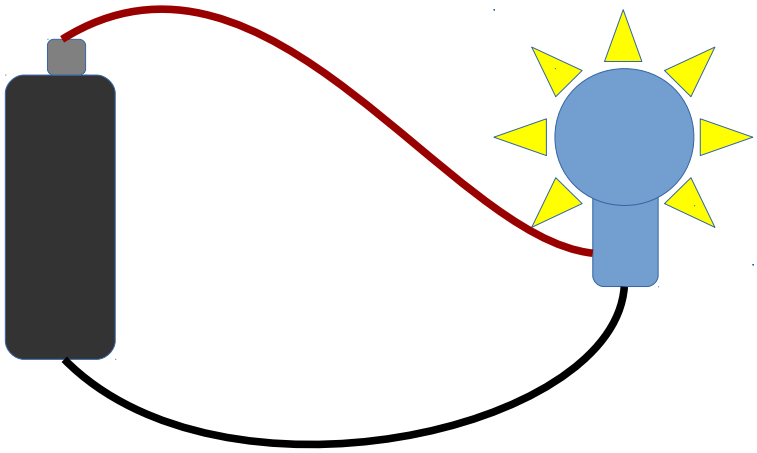
All circuits have 3 parts:

① a source of electrical energy (batteries, outlet, generator, solar cell)

② a load that uses electricity (anything that uses batteries or is plugged in: stove, TV, flashlight, phone, lamp, ...)

③ wires to connect everything.

Example:



Note that electrons do not get used up in the light bulb.

They transfer energy and dump it in the light bulb, then return to the battery to pick up more energy.

Other things that are circuits:

source	***wires***	***load***
pedals	chain	wheels
The chain does not get used up. It just transfers energy. If it breaks, then nothing works		
heart	blood and blood vessels	muscles
Blood does not get used up. It just transfers energy (oxygen). If you lose your blood, you die		
motor	escalator steps	people going up
The escalator steps go round and round in a circuit too.		

Circuit Symbols

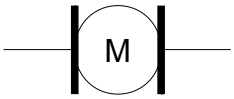
Instead of having to draw light bulbs and batteries, we use standard symbols

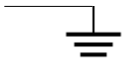
battery 

light bulb  or 

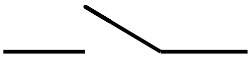
many batteries 

LED 

motor 

ground 

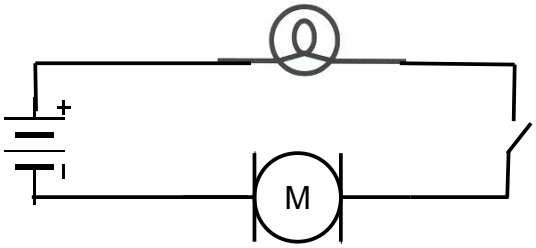
resistor 

switch 

an outlet (AC) 

Series and Parallel circuits

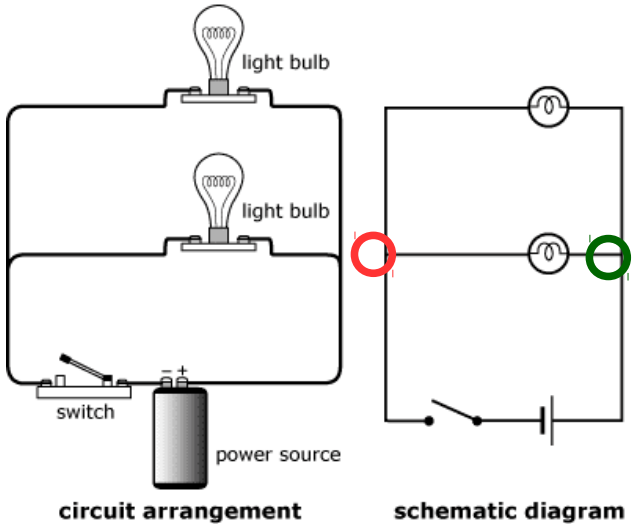
A series circuit has only one loop. Electricity goes through each device one after the other: first through the light, then the switch, then the motor and back to the battery. If the light burns out then nothing works, the circuit is broken.



A switch should always be in series. It wouldn't make sense otherwise.

(more below)

A parallel circuit has more than one loop. The electricity flows to a junction and then some goes one way and some goes the other way.



There are two paths for the electricity to go. At the **red** circle, some electricity goes to the top light and some goes to the bottom (middle) light. At the **green** circle the two parts of the current join up and go back to the battery.

If you remove one light, the other stays lit. Most of your house wiring is done this way so that if one lightbulb goes out, everything else will still work.

Other terminology:

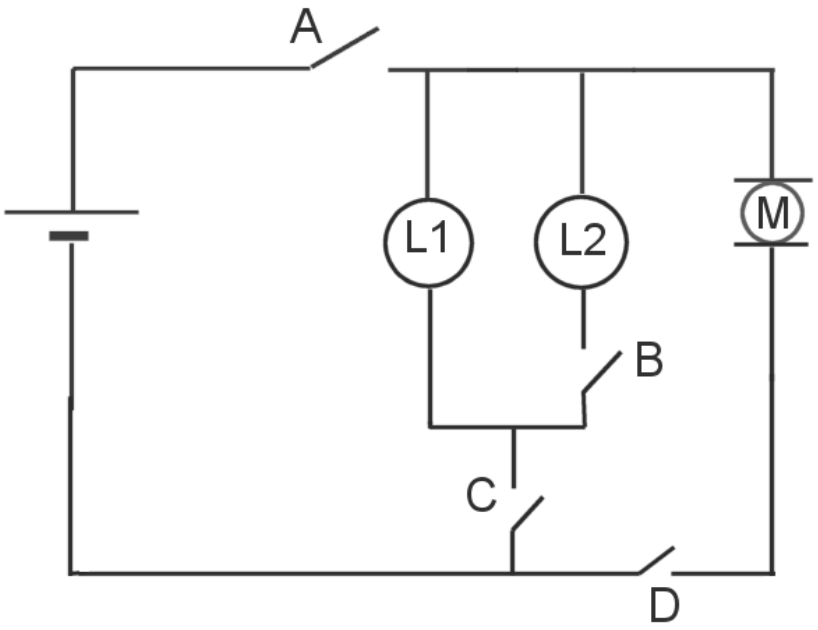
Open circuit: a circuit with no load.
If there is a load, then there is an open switch so that no electricity flows

Closed circuit: a normal, complete, working circuit

Short circuit: a complete connected circuit, but with no load! THIS IS VERY BAD AND DANGEROUS. Either the battery or the wires will become the load and overheat and maybe catch fire.
We have circuit breakers or fuses which will "blow" in order to protect against fire.

Overload: too many things plugged into one outlet (or powerbar).
The effect is the same as a short circuit as there will be too much current in the wires.

Practice:



Here there is a battery on the left, a motor on the right, and two lights labelled L1 and L2 in the middle. There are also 4 switches labelled A ,B, C, D.

1. What does switch B do? What turns off if it is open?
2. What does switch A control?
3. What does switch D control?
4. What does switch C control?

Answers :

"A" controls everything. If "A" is open, then no electricity will get anywhere.

"D" controls the motor. The lights are on another circuit and may be on or off. "D" won't affect the lights, it only turns the motor on or off.

"B" controls L2. You can see that it's on the wire that L2 is on. L1 can get electricity even if "B" is open.

"C" controls both lights together. It will turn them both on or off (except that "B" can turn off just L2).

L2 won't light up unless both B and C are closed.