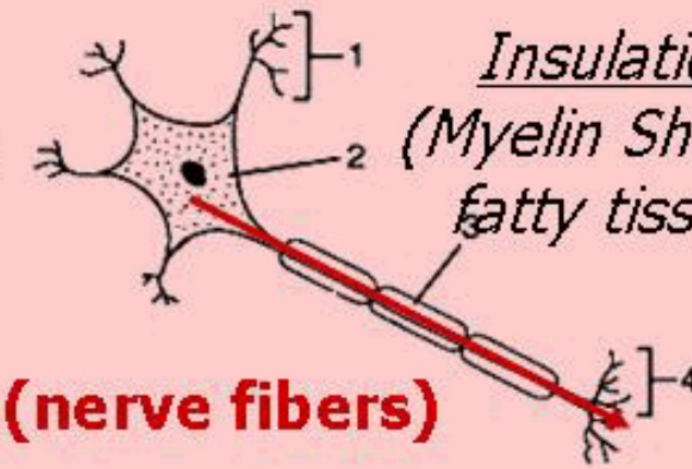
Semiconductors

- material that falls between conductor and insulator in terms of electrical conductivity
- computer chip (silicon), LED's, some lasers

Wires carry an electrical charge.

Copper wire covered in rubber insulation

The "human" wiring system:
The neuron (nerve cell)



Insulation
(Myelin Sheath, fatty tissue)

Wires (nerve fibers)

Match the word on the left to the phrase on the right.

Resistance

(R) in Ohms Ω

Current

(I) in Amps

Voltage

(V) in Volts

How Fast?

How much?

How much is it slowed down?

Household Current

Alternating current

- direction of the current goes back and forth, 60 times per second,
- example wall socket, 120 volts

Direct current

- current flows in one direction
- batteries only-AAA, AA, C, D cell batteries all are 1.5 volts each, the difference in size means it should last longer

Safety devices

fuse-small piece of metal that melts if the current becomes too high opening switch

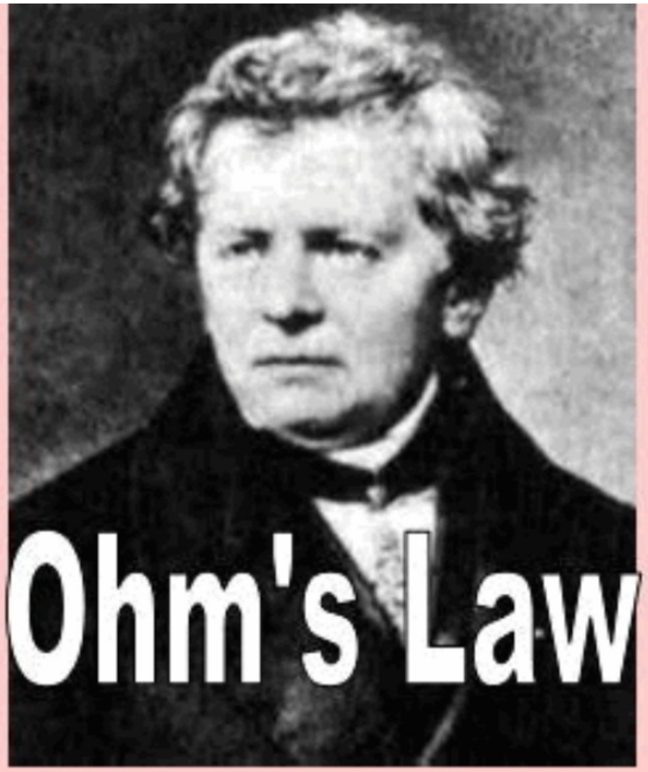
circuit breaker-piece of metal that bends when it gets over heated opening switch because current is too high

GFI-ground fault interrupter, usually found in bathrooms or garages shuts off plug when current if too high.

Electrical Measuring Instruments

- Voltmeter-used in parallel to measure voltage
- Ammeter-used in series to measure current
- Galvanometer-use to detect a current
- Ohmmeter-measures resistance

Georg
Simon
Ohm



$$V = I \times R$$

We can use this formula to figure out volts, current and resistance.

Ohm's Law Formula

$$V = I \cdot R$$

Symbol	Name	Unit	Unit Symbol
V	Voltage	Volts	v
I	Current	Amps	A
R	Resistance	Ohms	Ω

Example: Ohm's Law Problem

Calculate the potential different (volts) across a 3 Ω resistior if a 0.5 A current is flowing through it.

g) $R = 3\ \Omega$
$I = 0.5\text{A}$

u) $V = ?$

e) $V = I \cdot R$

s) $V = (0.5\text{A})(3\Omega)$

s) $V = 1.5\text{v}$

Power Formula

<u>Electrical Power</u> = the rate at which energy flows

$$P = I \cdot V$$

Symbol	Name	Unit	Unit Symbol
P	Power	Watts	w
I	Current	Amps	A
V	Voltage	Volts	v

Example: Electrical Power Problem

If a CD player uses 4.5 v with 0.2 amps of current, what is the Power it uses?

g) $V = 4.5v$

$I = 0.2A$

u) $P = ?$

e) $P = I \cdot V$

s) $P = (0.2A)(4.5v)$

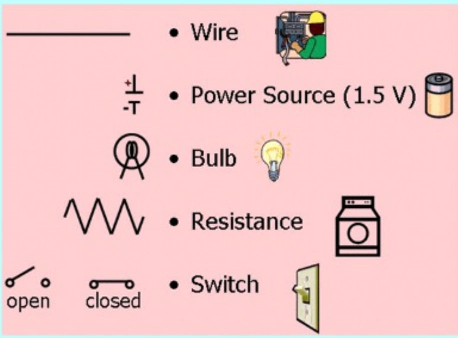
s) $P = 0.9w$

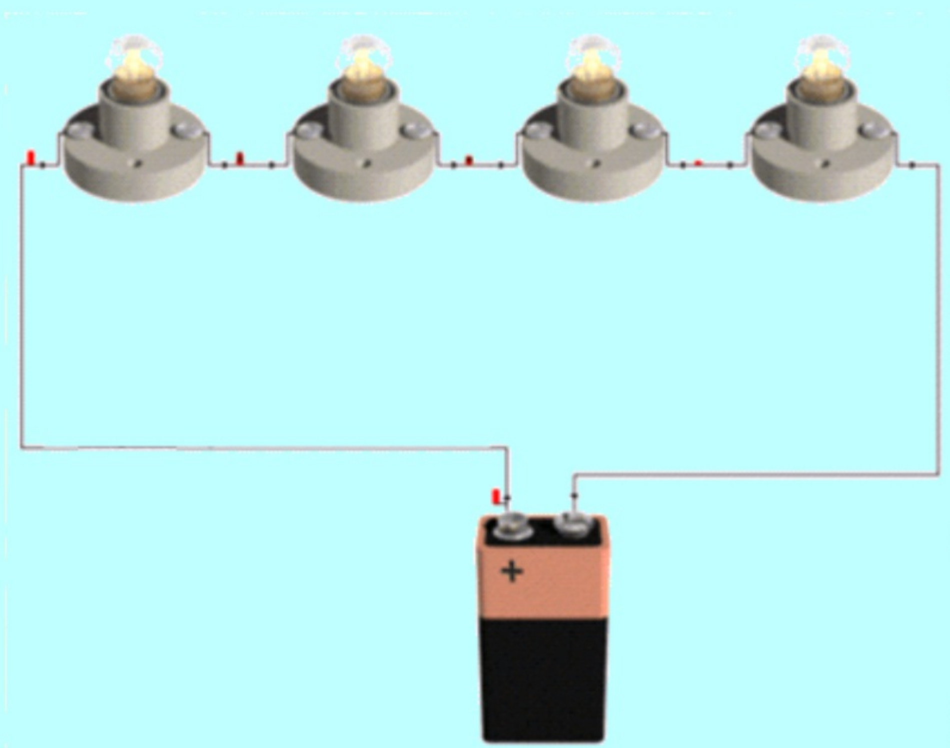
TYPES OF CIRCUITS

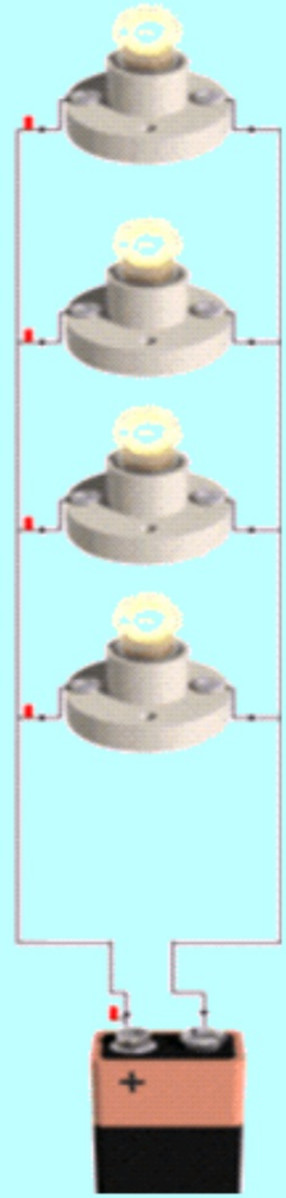
Series Circuits- an electrical circuit with only one path

Parallel Circuit- an electrical circuit with more than one path

Draw circuit diagrams and label these circuits as parallel or series.

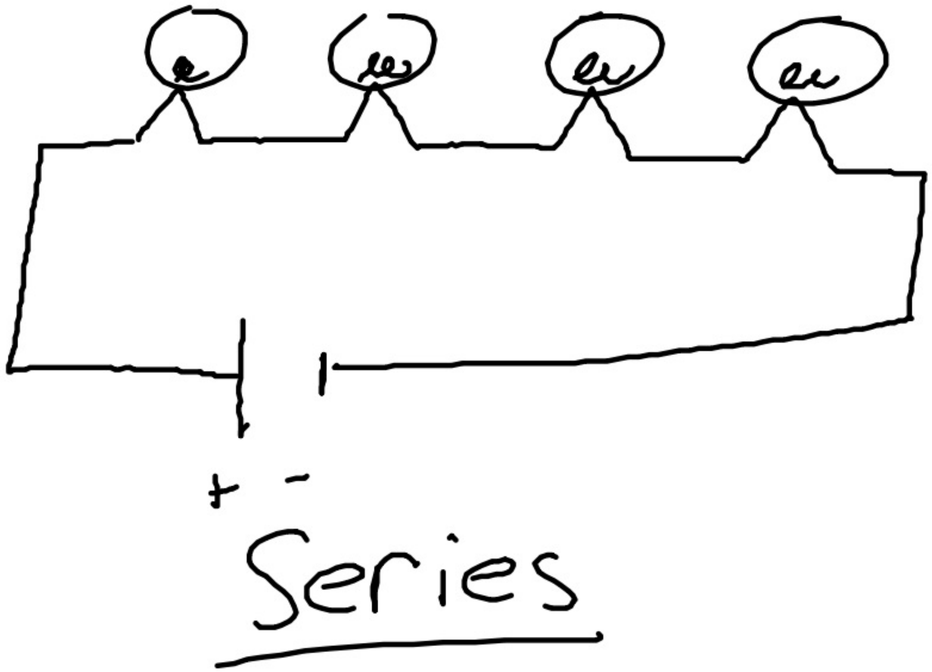


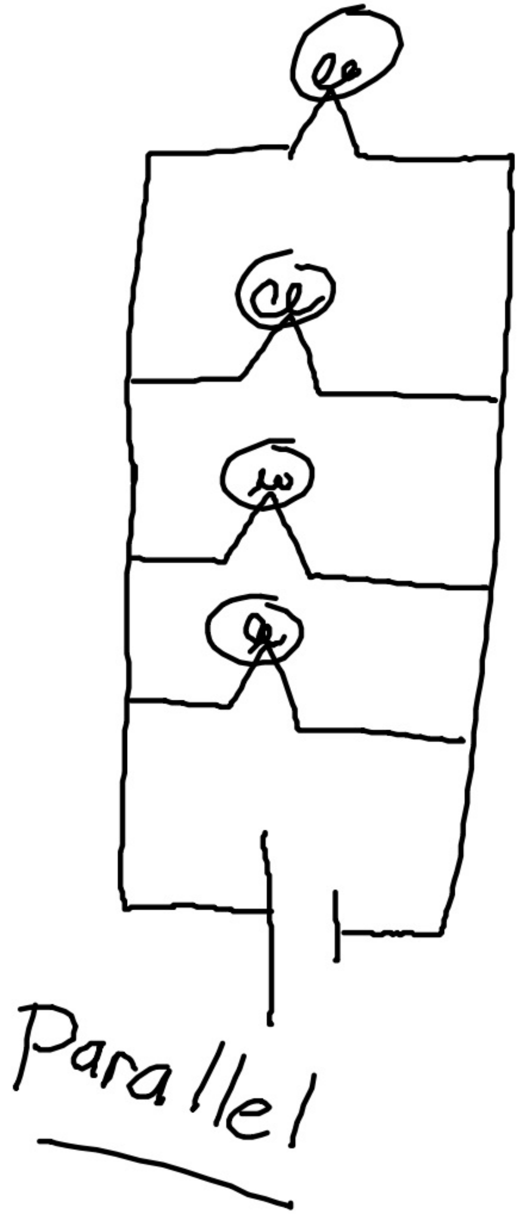




What do you notice about the lights?

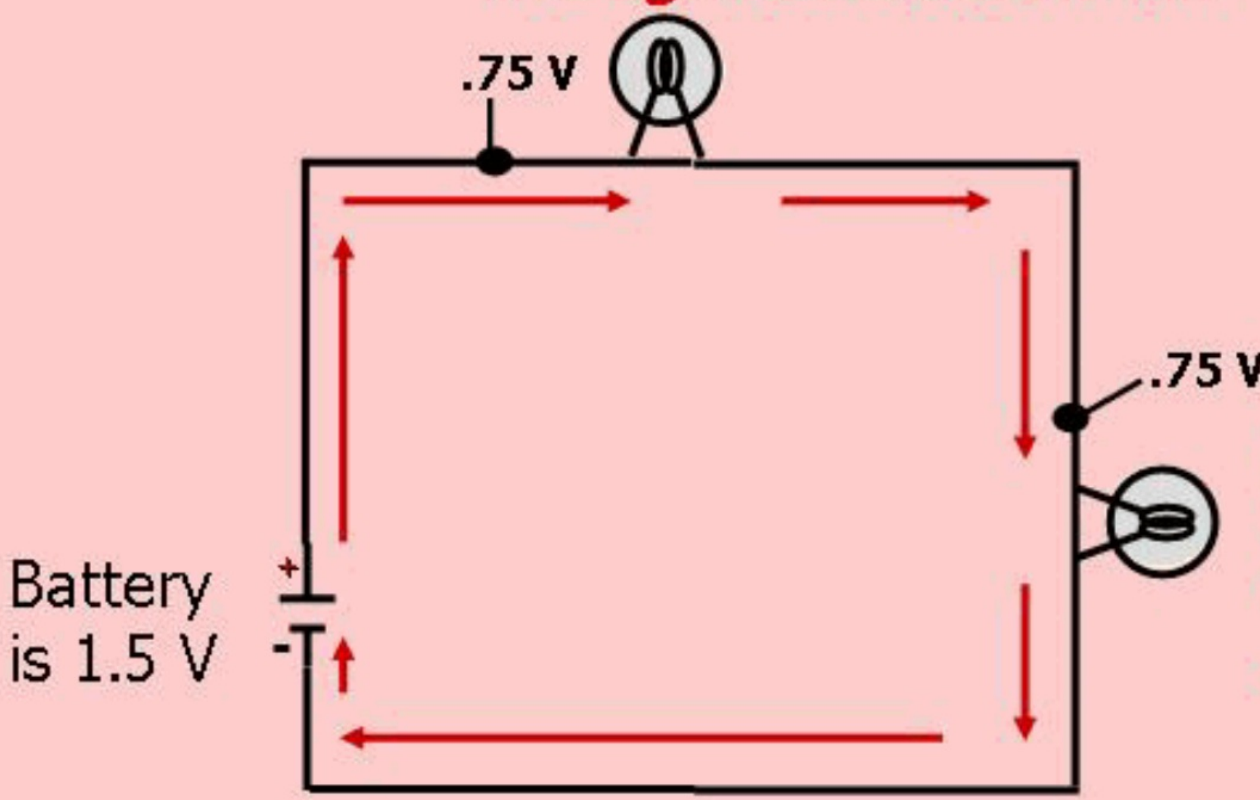
What it should look like





Series Circuits

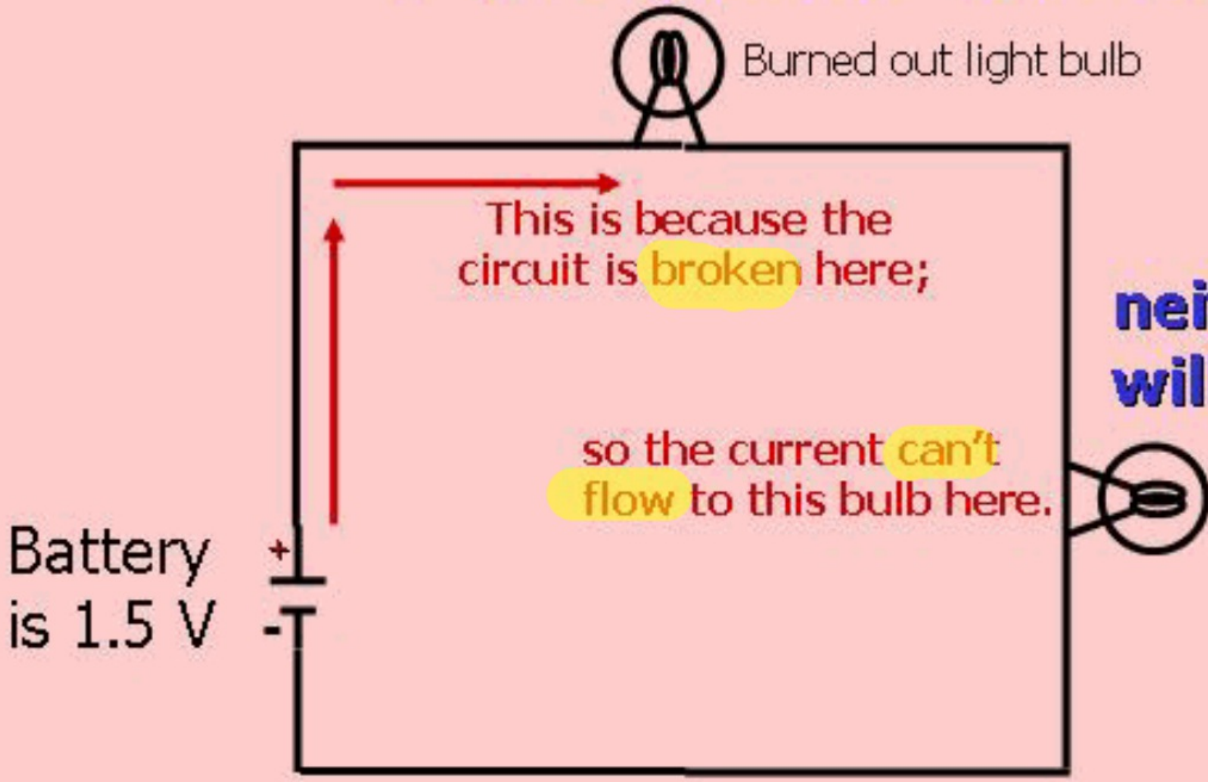
The light bulbs turn on.



However, since the voltage drops, the lights are dimmer.

Series Circuits

If this light bulb does not turn on,



neither light bulb will turn on.

Christmas lights are commonly made this way.

Series Circuits Info

- The current has only one path it can travel along
- One light goes out all lights out-open circuit
- Imagine if you turned off one light in your house that means that the circuit is broke and everything else goes off. Everything would have to be turned on to keep things running.
- Current is the same at all points
- Voltage is reduced by each resistance (light bulb, motor, heaters)
- **Voltage drop**-each separate resistor causes volts to drop

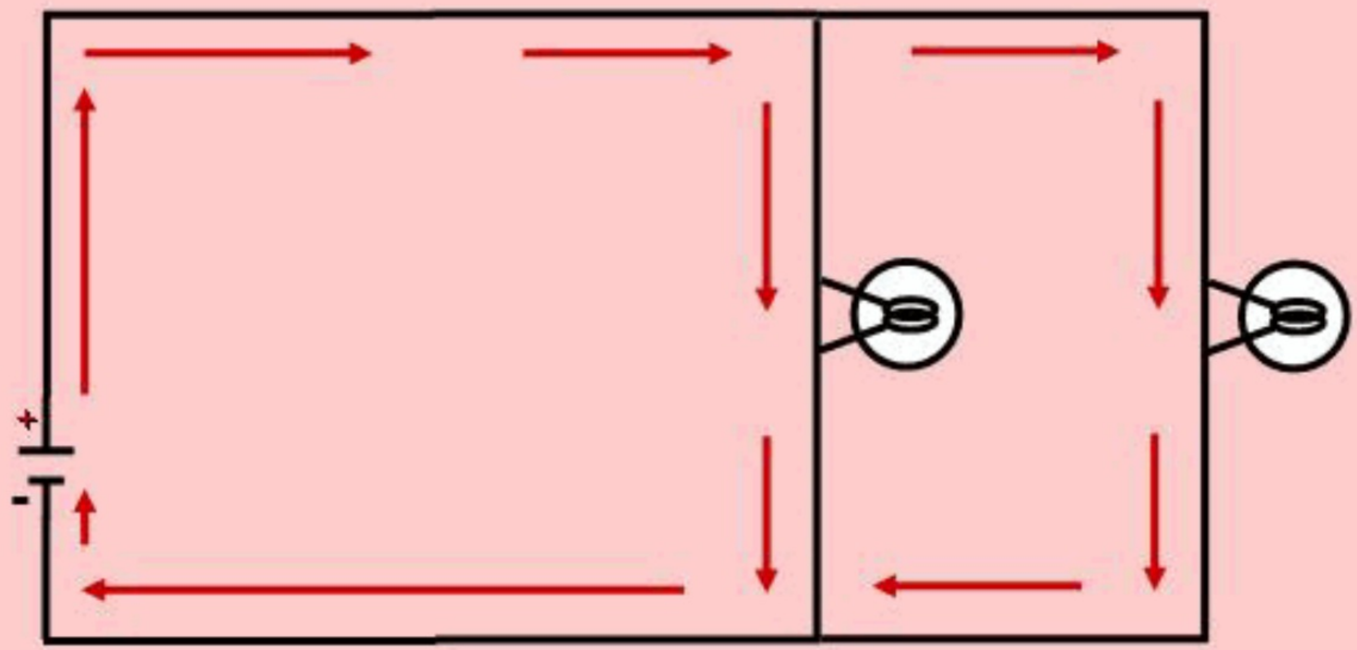
Kirchhoff's Voltage Law

- The total of all voltage drops must add up to the total voltage supplied by the battery (energy in)
- +1.5 V - 0.5V - 0.5 V - 0.5 V = 0

  battery bulb bulb bulb

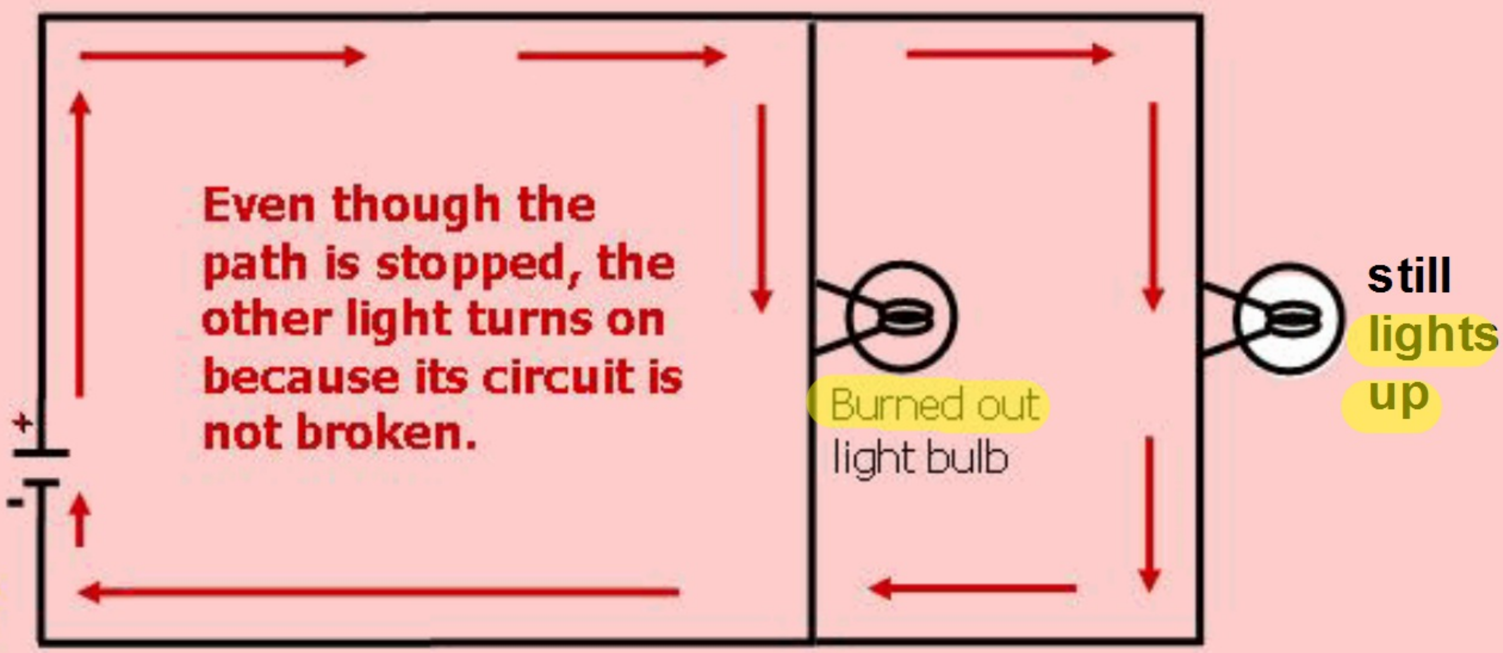
Parallel Circuits

Current divides and has more than one path.



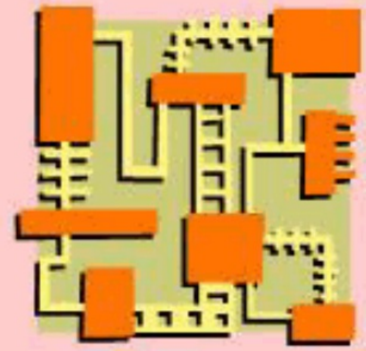
Parallel Circuits

The current divides because it has more than one path to flow.



Your house is wired with parallel circuits.
Why do you think this is so?

Parallel Circuit Info



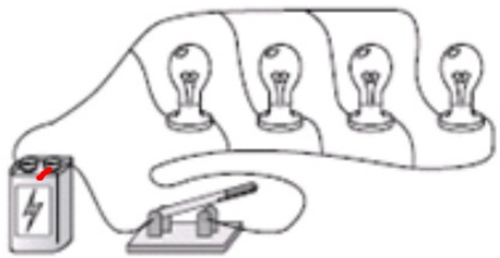
- contains separate branches for current to move through
- potential difference (volts) same at each branch
- one light off, use other branches to transfer current
- voltage is the same across all branch points (think of them as separate series circuits connected to a battery)
- each branch does NOT always have the same current, depends on how much resistance is in each branch, (desk lamp, power saw)

Kirchoff's Current Law

- If current flows into a branching point, the same total current must flow out again.

Label the series circuit and the parallel circuit

P



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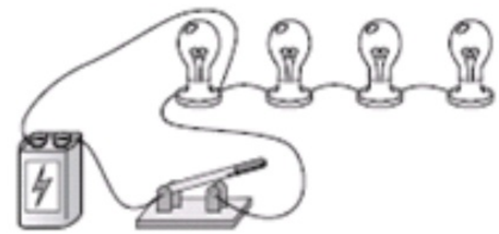

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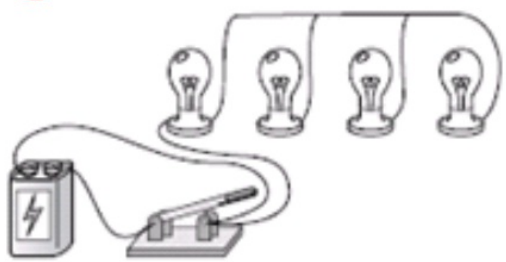

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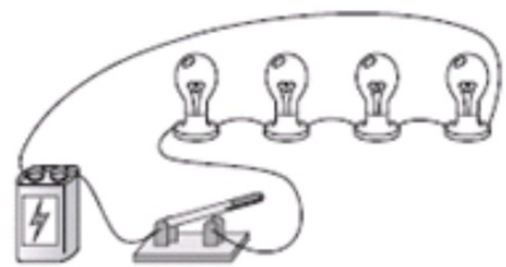
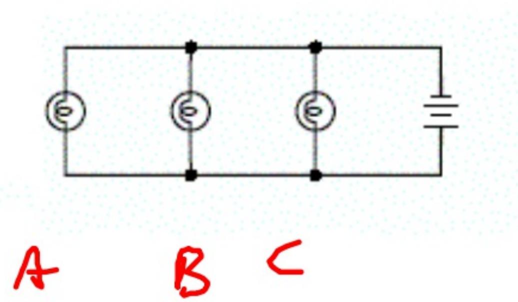
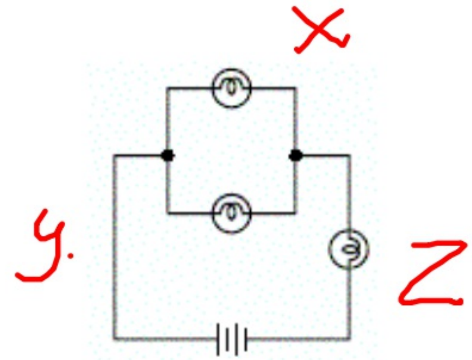


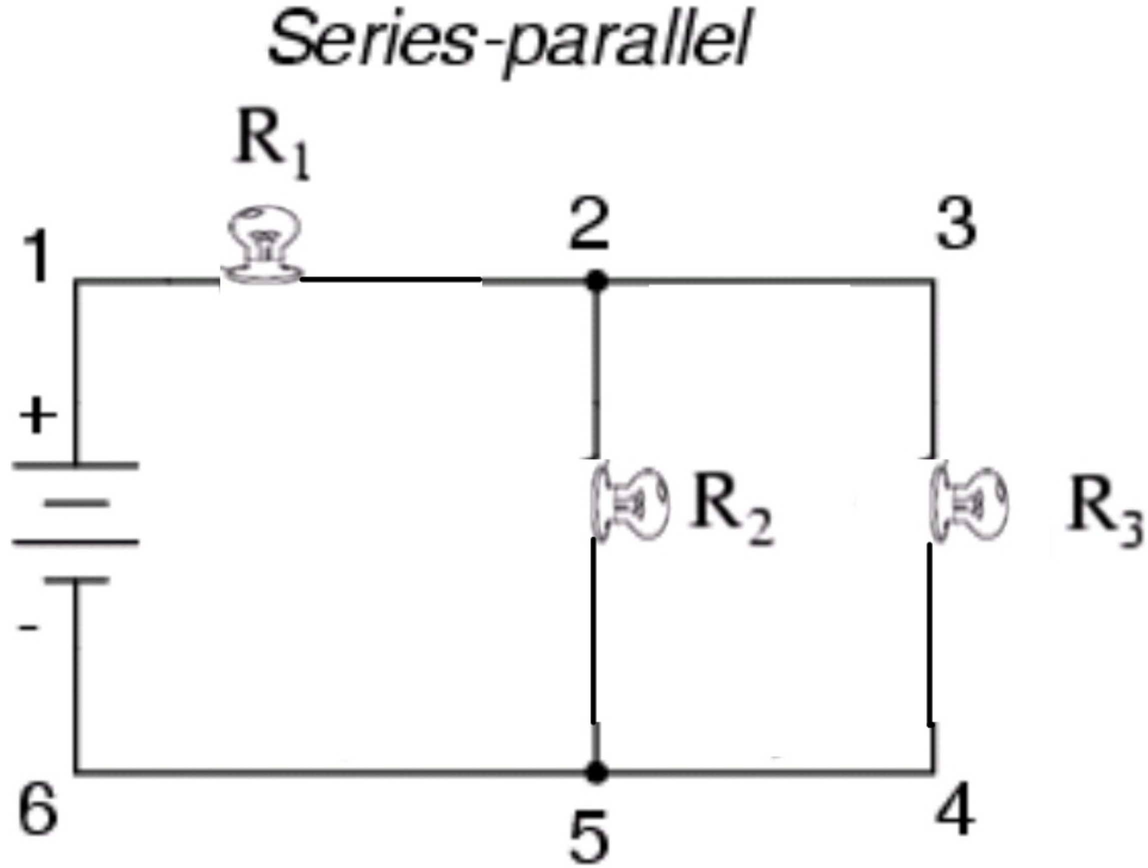
Which circuit will allow the remaining lights to turn on if one bulb is burnt out?

Look at the wiring diagrams shown.





Position and draw a switch in each circuit which would allow you to turn two lights on, and leave one light off.



If the bulb at R_1 is burnt out, would the other bulbs stay lit?

NO

If the wire was cut at point 4, which bulbs would light (if any)?

R_1 & R_2

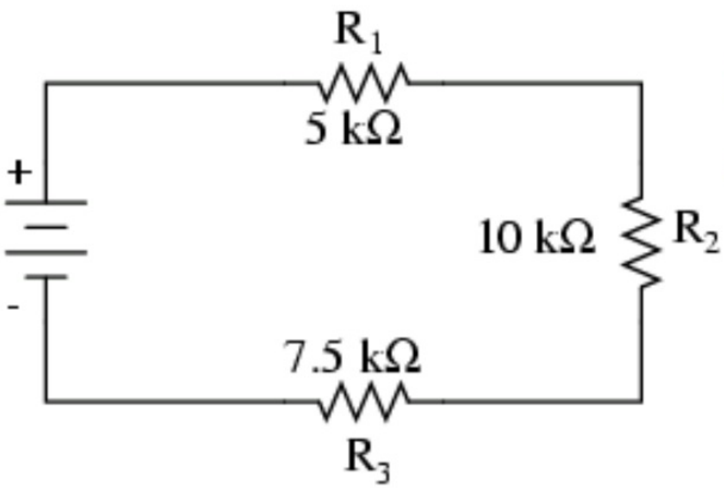
If the bulb at R_2 is missing, would the other two bulbs work?

YES

If an open switch was placed at point 3, which bulbs would light?

R_1 & R_2

The total resistance in a series circuit is the sum of all the individual resistors. $R_t = R_1 + R_2 + R_3...$



What is the total resistance in this circuit?

$R_t = R_1 + R_2 + R_3$

$R_t = 5\ k\Omega + 10\ k\Omega + 7.5\ k\Omega$

$R_t = 22.5\ k\Omega$

If each cell (battery) is 3 V, then what is the total voltage of the circuit? Two Batteries from the diagram above (Big Line/Little Line Combo)

$V = 6v$

What is the current in the above circuit?

g) $V = 6v$

$R = 22.5\ k\Omega$

u) $I = ?$

e) $V = I \cdot R$

s) $\frac{V}{R} = \frac{I \cdot \cancel{R}}{\cancel{R}}$

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

s) $I = \frac{6\ v}{22.5\ k\Omega}$

$I = 0.2667\ A$