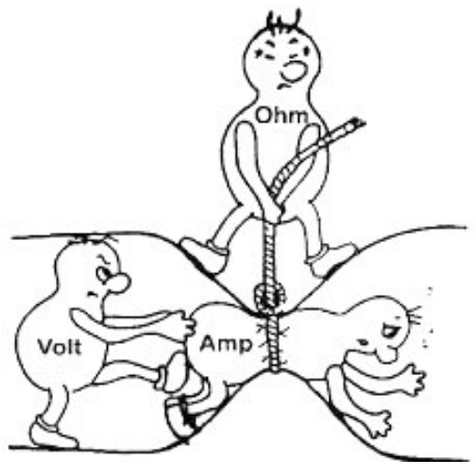
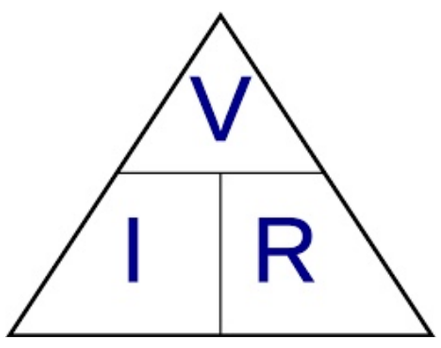
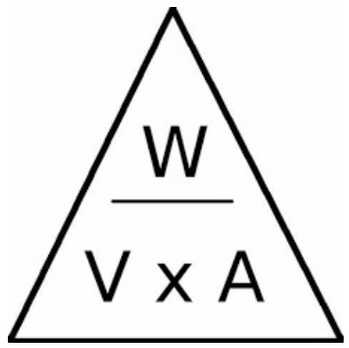


Electricity Basics

Class 2 for Gallup Solar Team 7



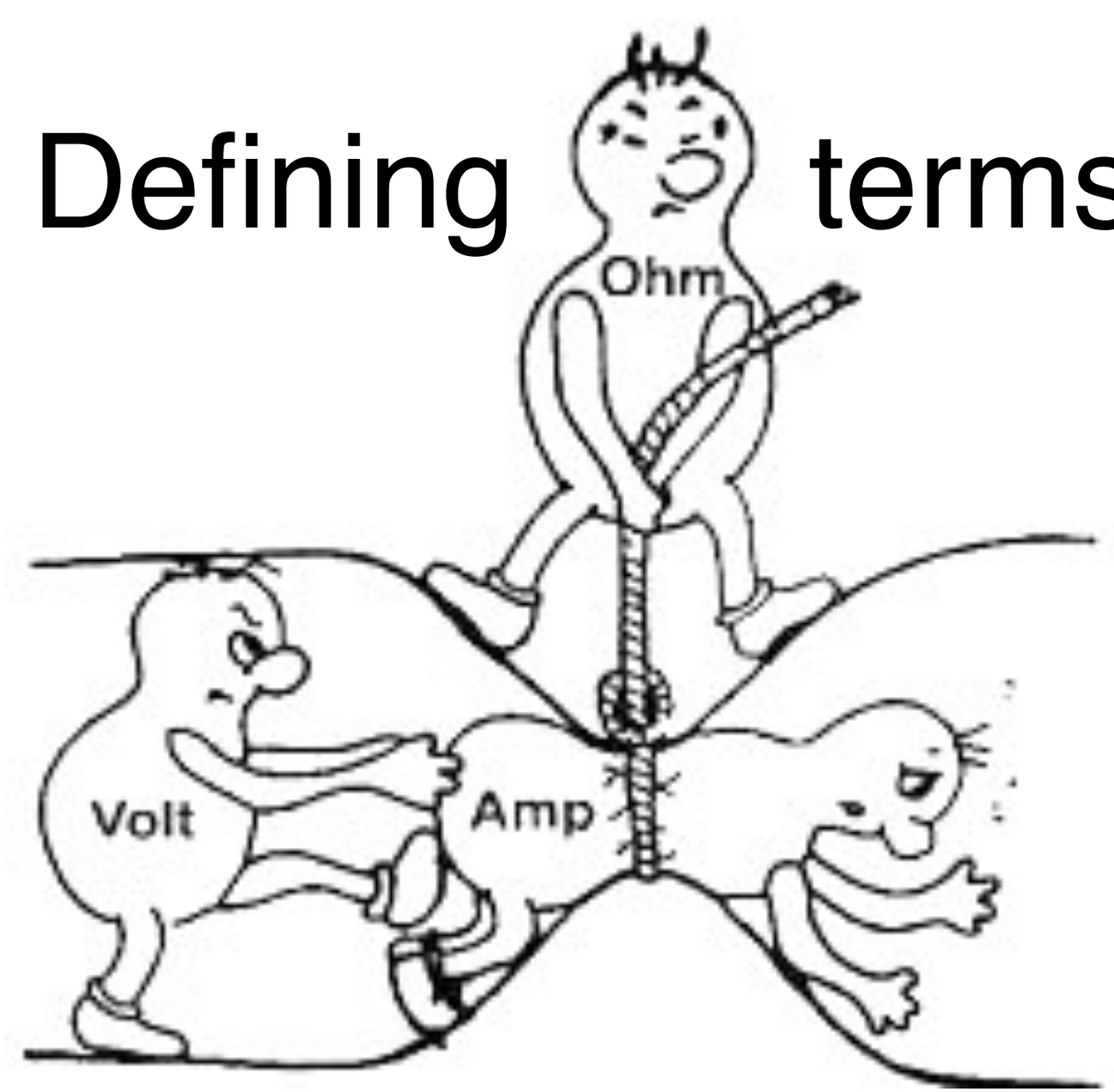


Electricity is the movement of electrons.

Moving electrons create charge to run your fridge, TV, turn on lights and charge devices.

The movement of electrons can be defined in terms that make it possible to manage electricity.

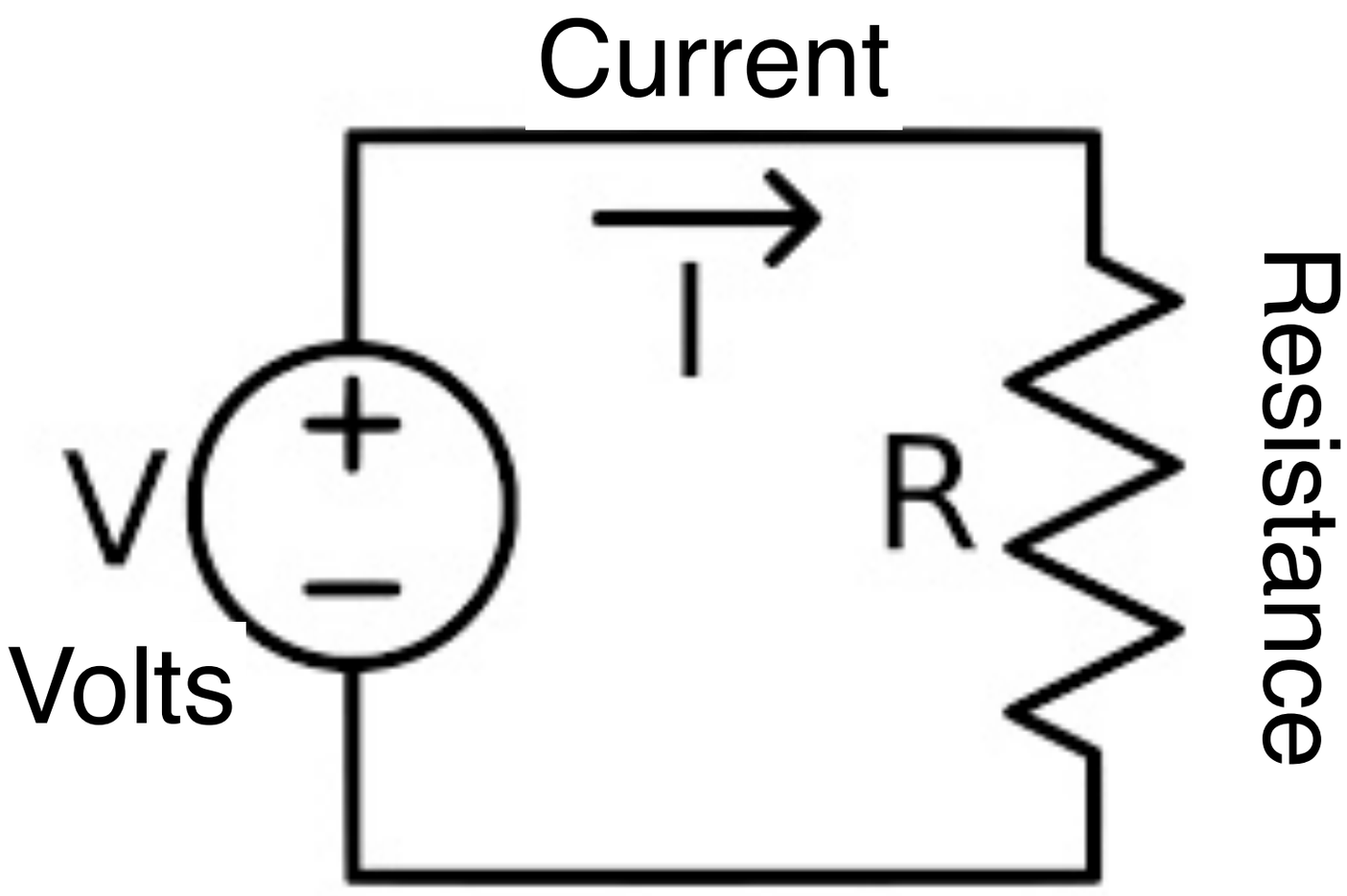
Defining terms



Volts Amps Ohms

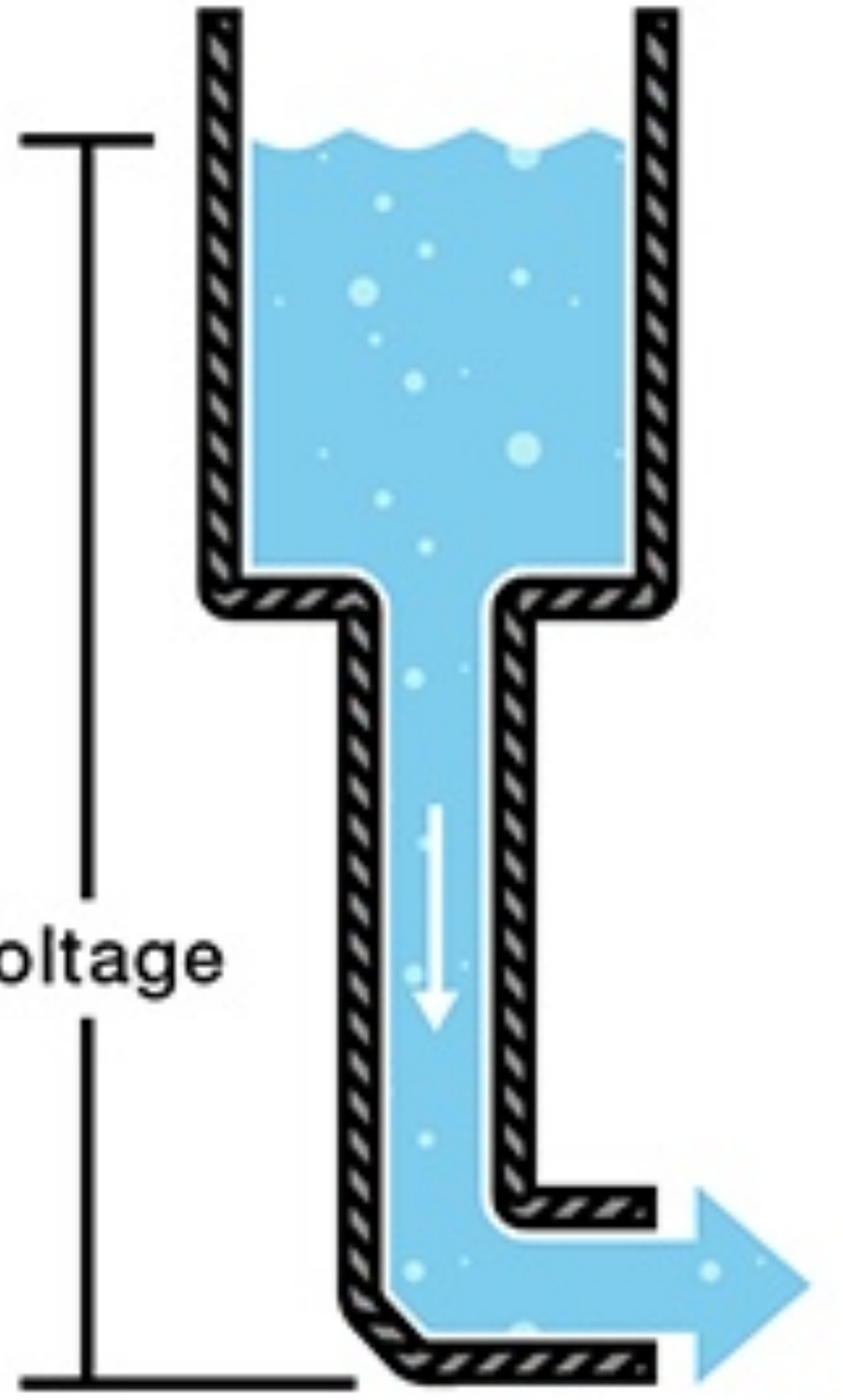
Remember forever: Amps A are the same as Current I and Ohms Ω are the same as Resistance R

Ohm’s Law V=IR

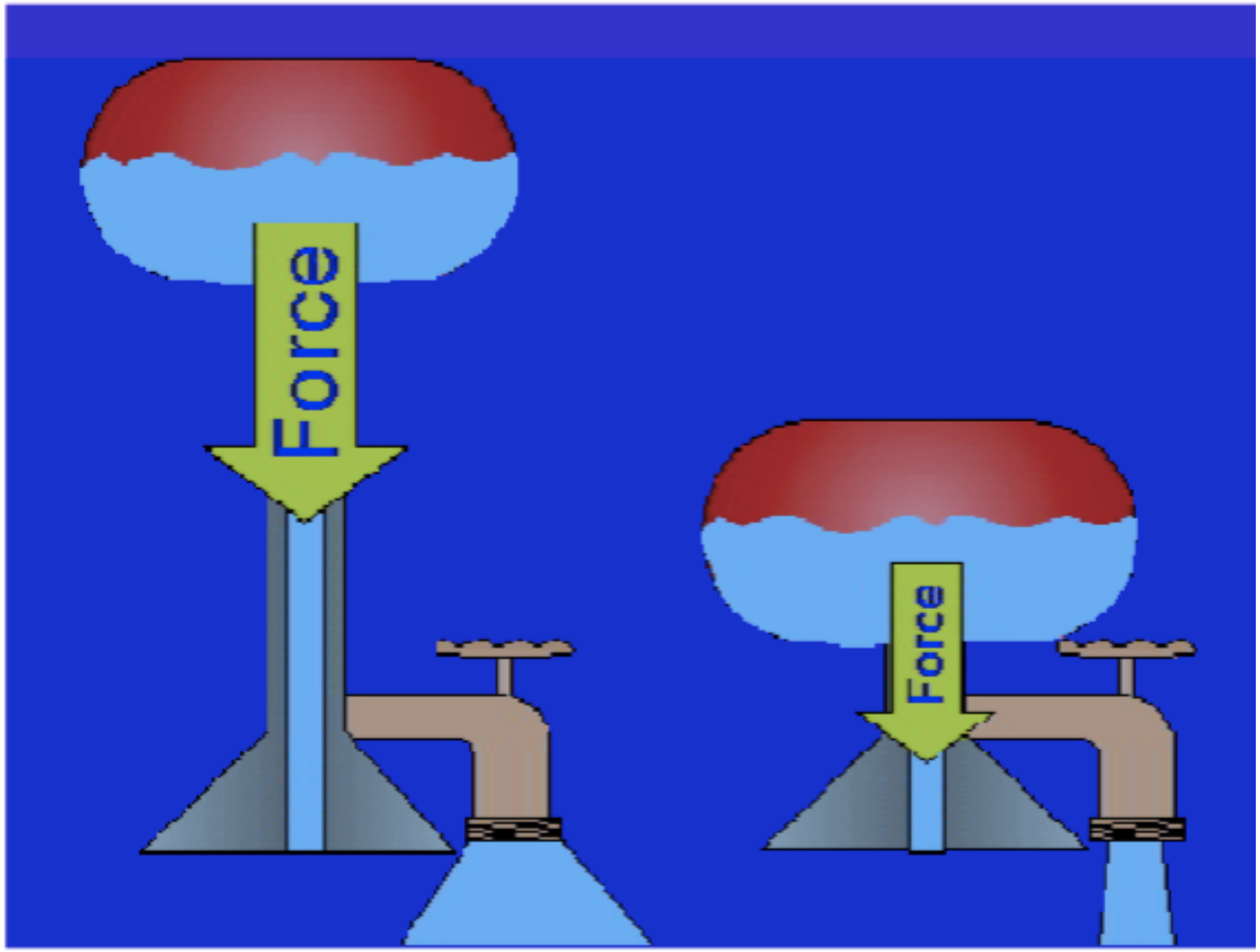


Ohm’s Law defines the relationship and balance of forces between Voltage, Current and Resistance in every electric circuit.

Volts

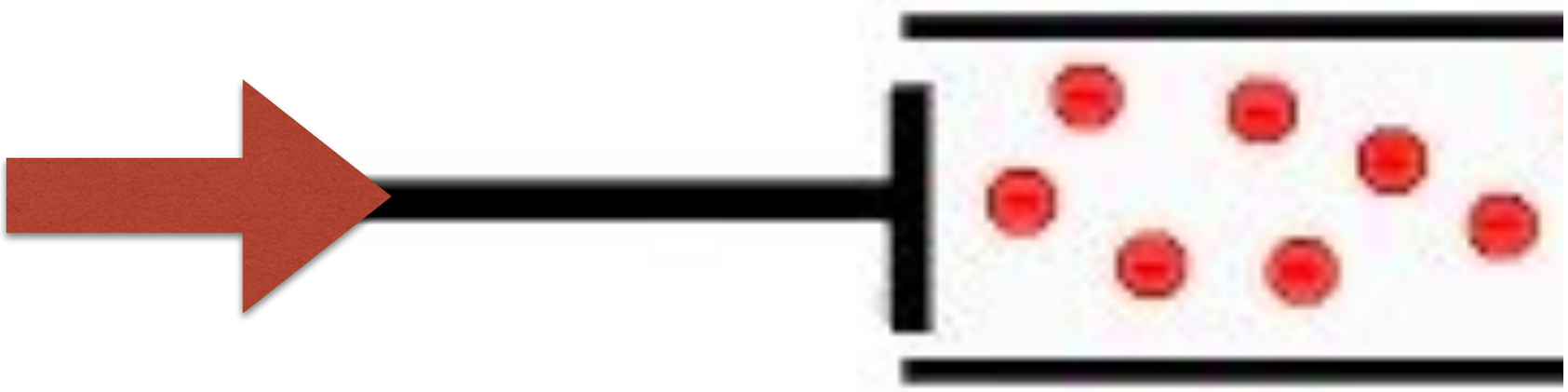


Voltage (V) is the potential charge between two points.



Voltage is often compared to water pressure

Low Voltage = low pressure on electrons

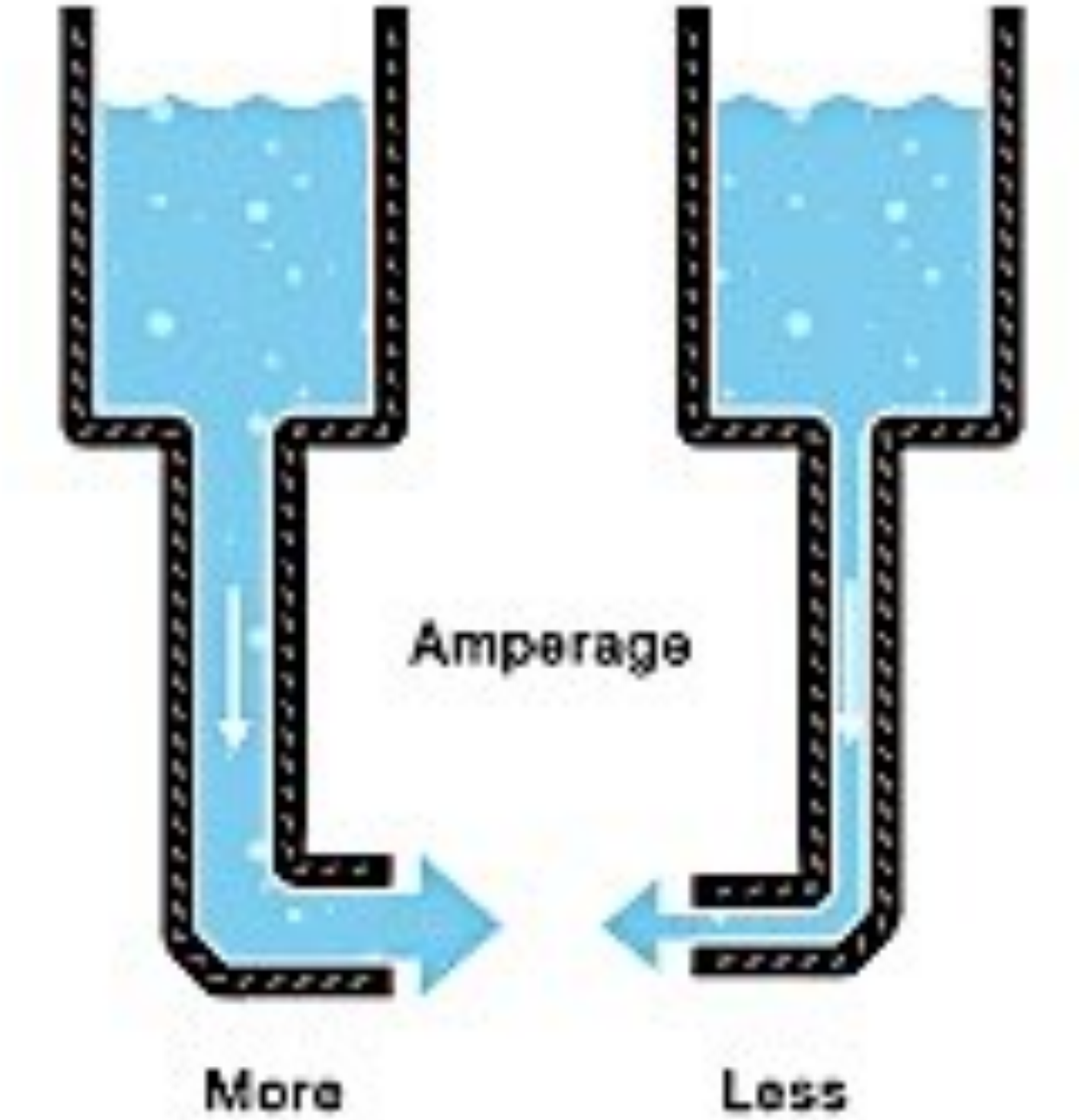


High Voltage = high pressure on electrons

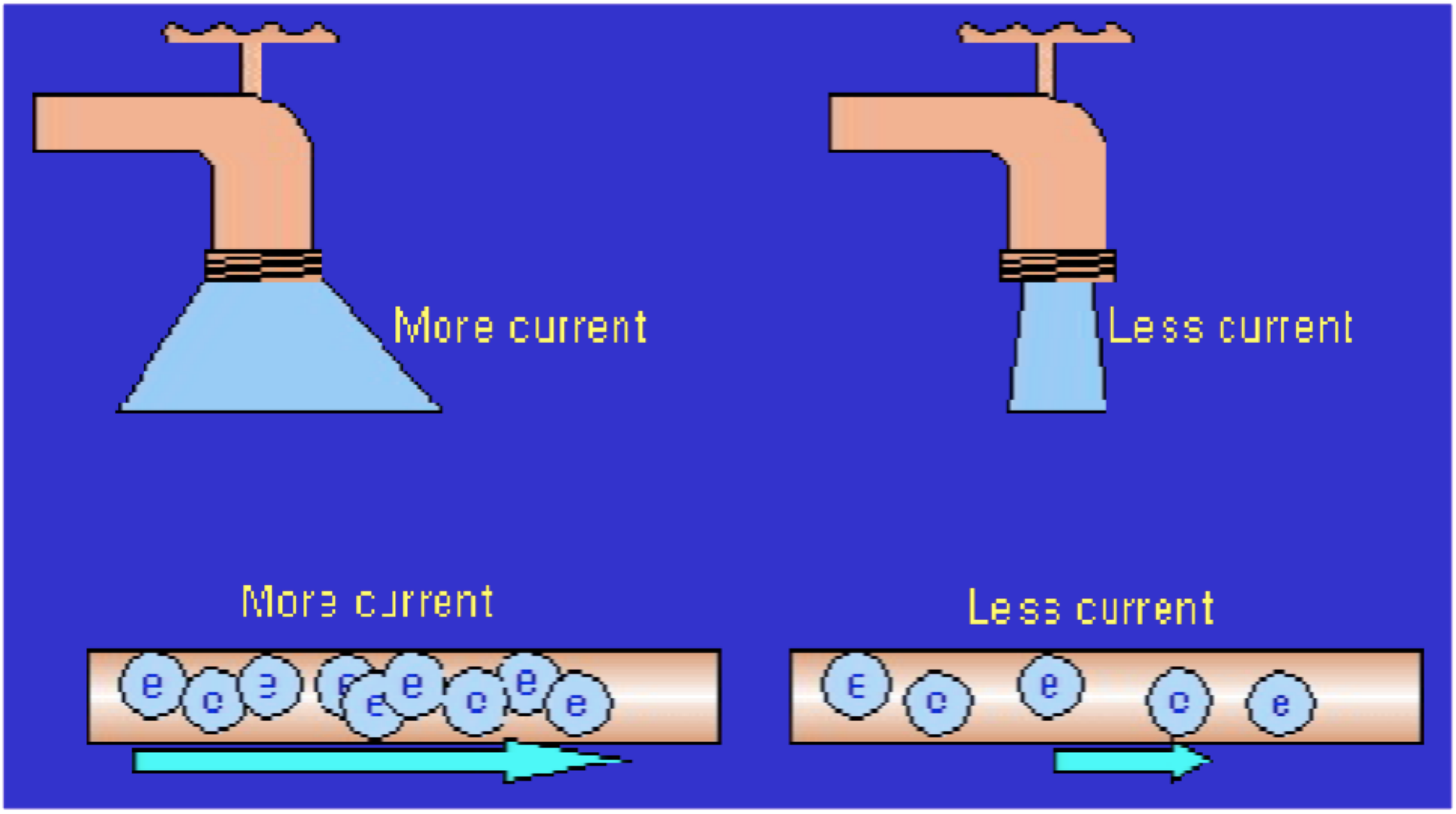
Some Common Voltages

One solar cell any size **.3 -.5V**
Single-cell, rechargeable battery **1.2V**
Single-cell, non-rechargeable battery **1.5V–1.56V**
USB **5V**
Automobile battery **2.1V per cell**
Electric vehicle battery **400V**
Off-Grid Hogan System **12V or 24V**
Household outlet (Japan) **100V**
Household outlet (North America) **120V**
Household outlet (Europe, Asia, Africa, Australia) **230V**
Rapid transit third rail **600V–750V**
High-voltage electric power lines **110,000V**
Lightning **100,000,000V**

Amps
Current

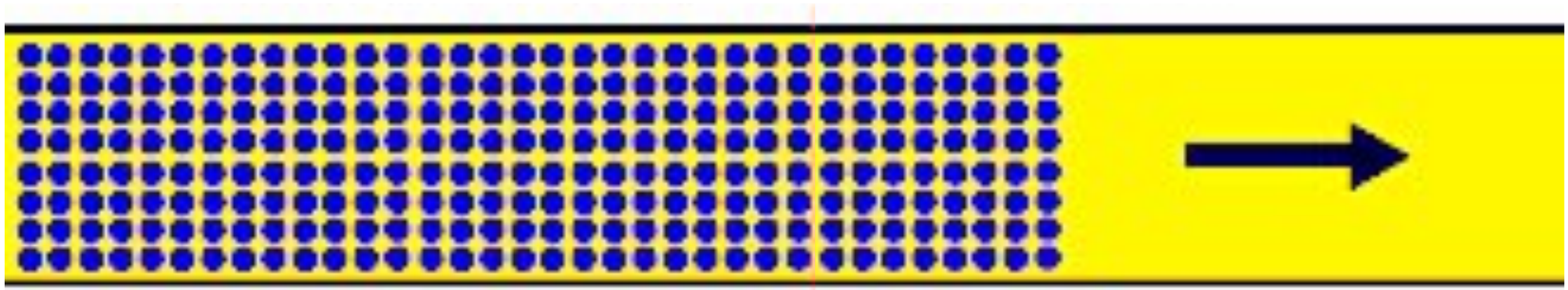


The rate at which charge is flowing.

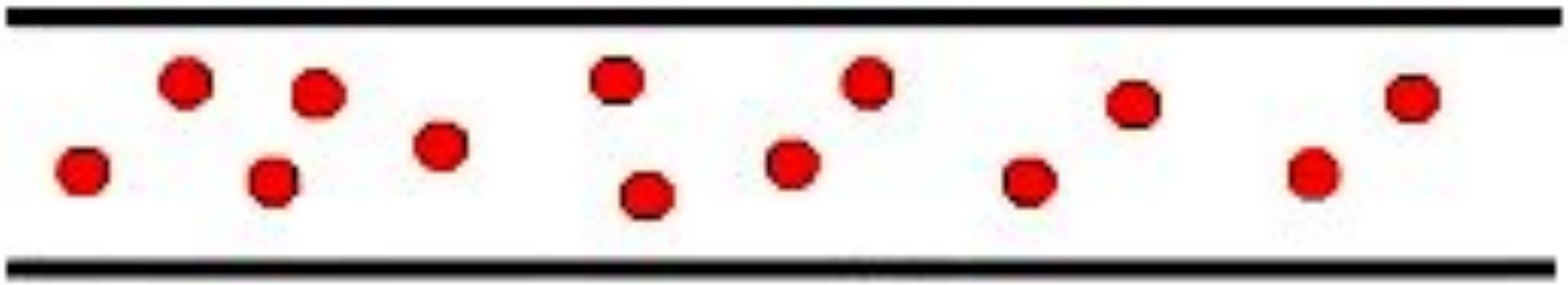


Amperage, Current is often compared to water flow

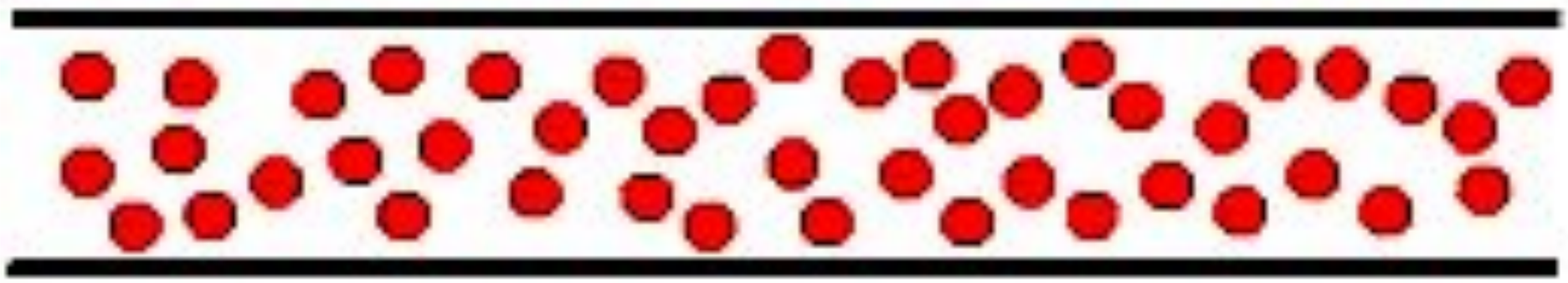
A wire carrying 1 Ampere carries about…



6,241,000,000,000,000,000 electrons across it per second

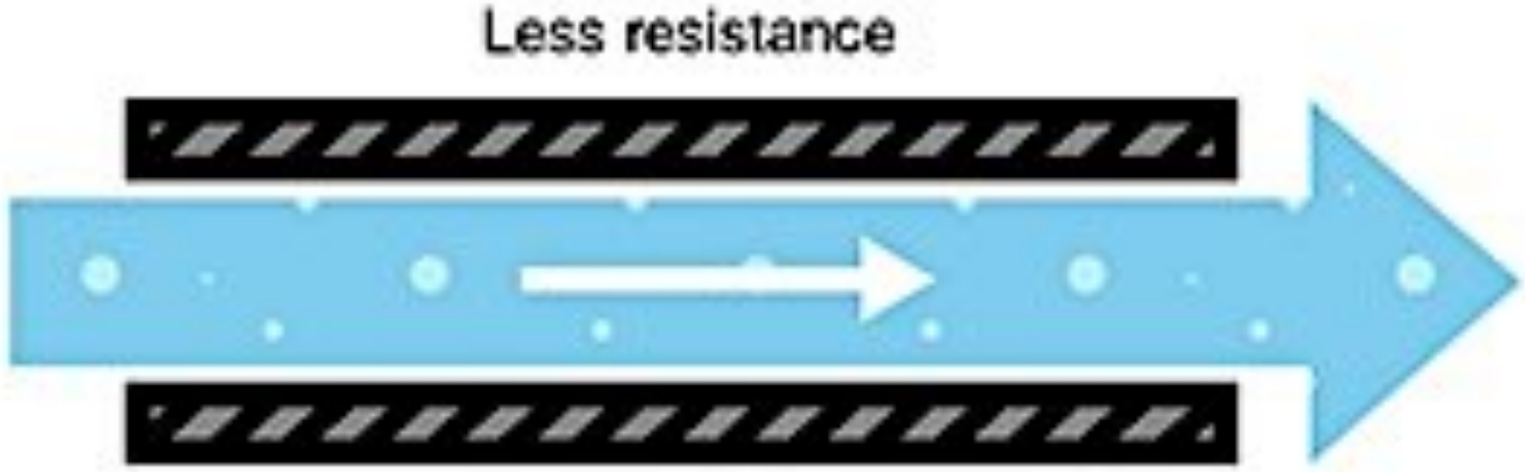


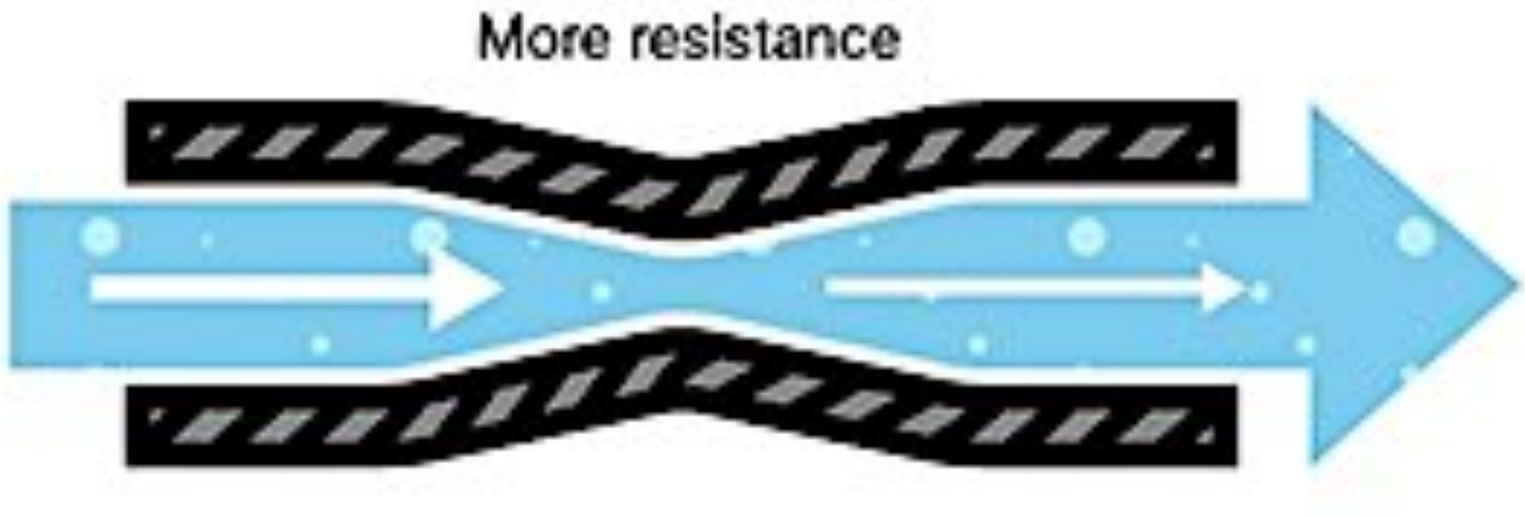
Low Amperage= few electrons flowing



High Amperage= many electrons flowing

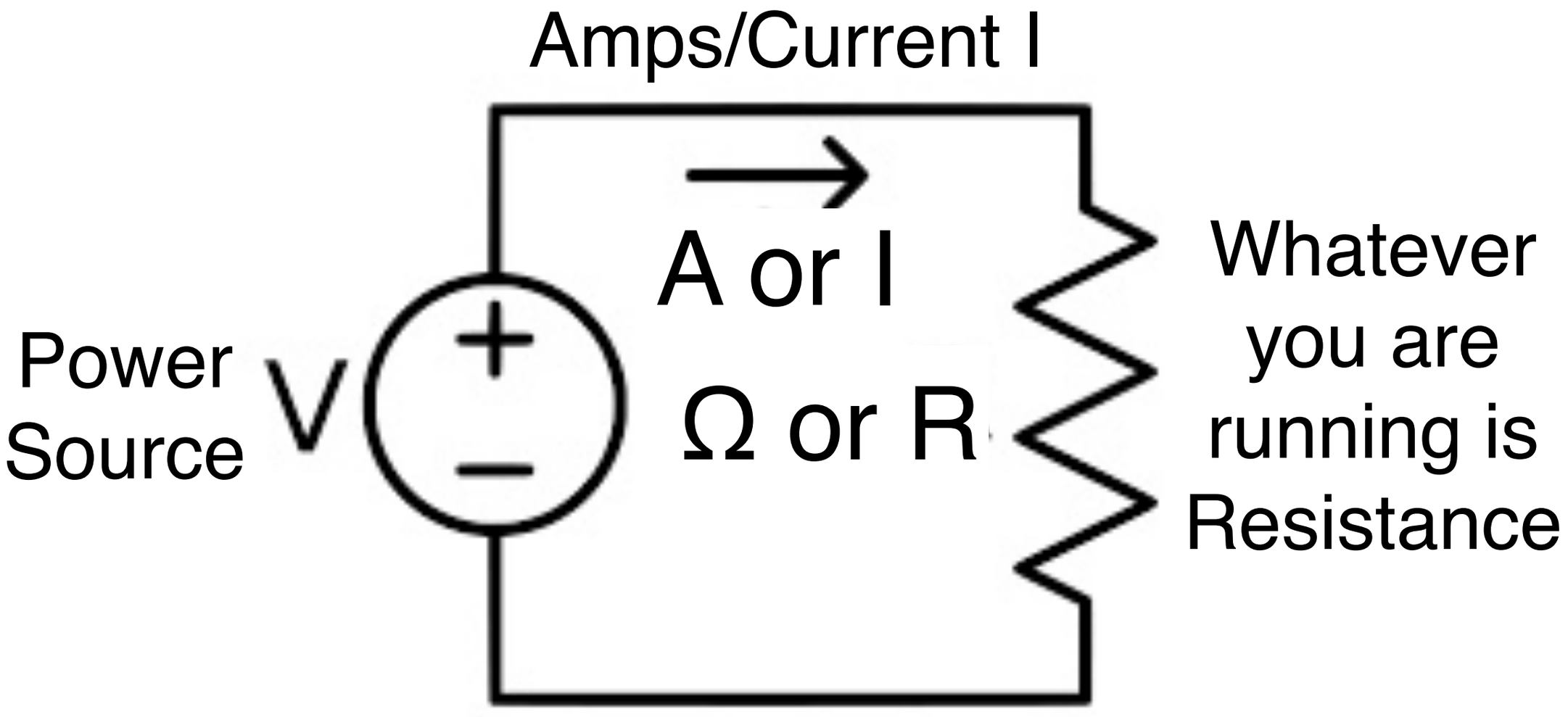
Resistance Ω Ohms

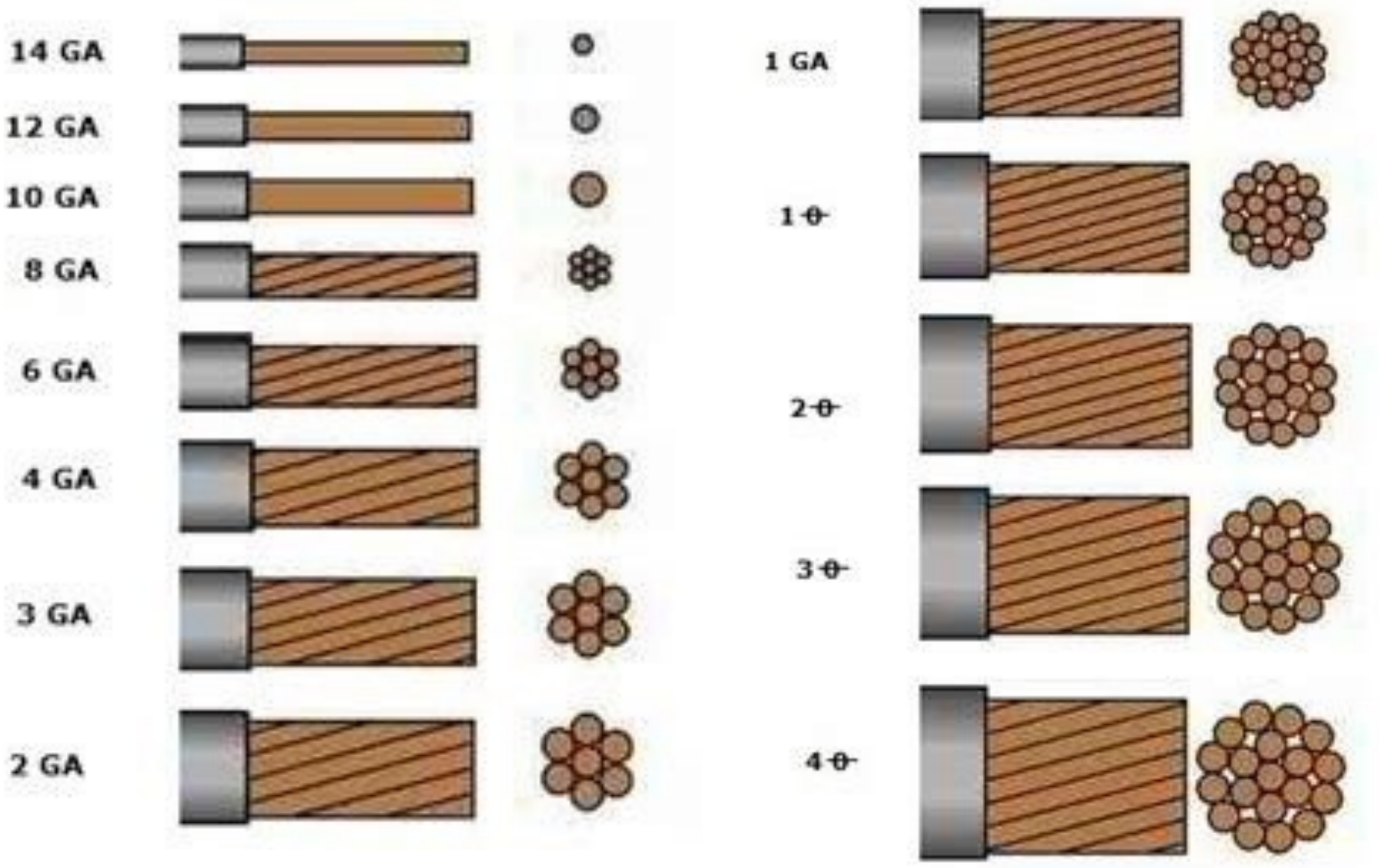




Resistance(R) or Ohms (Ω) is a material's tendency to resist the rate of charge (amperes/current).

Resistance in a Circuit

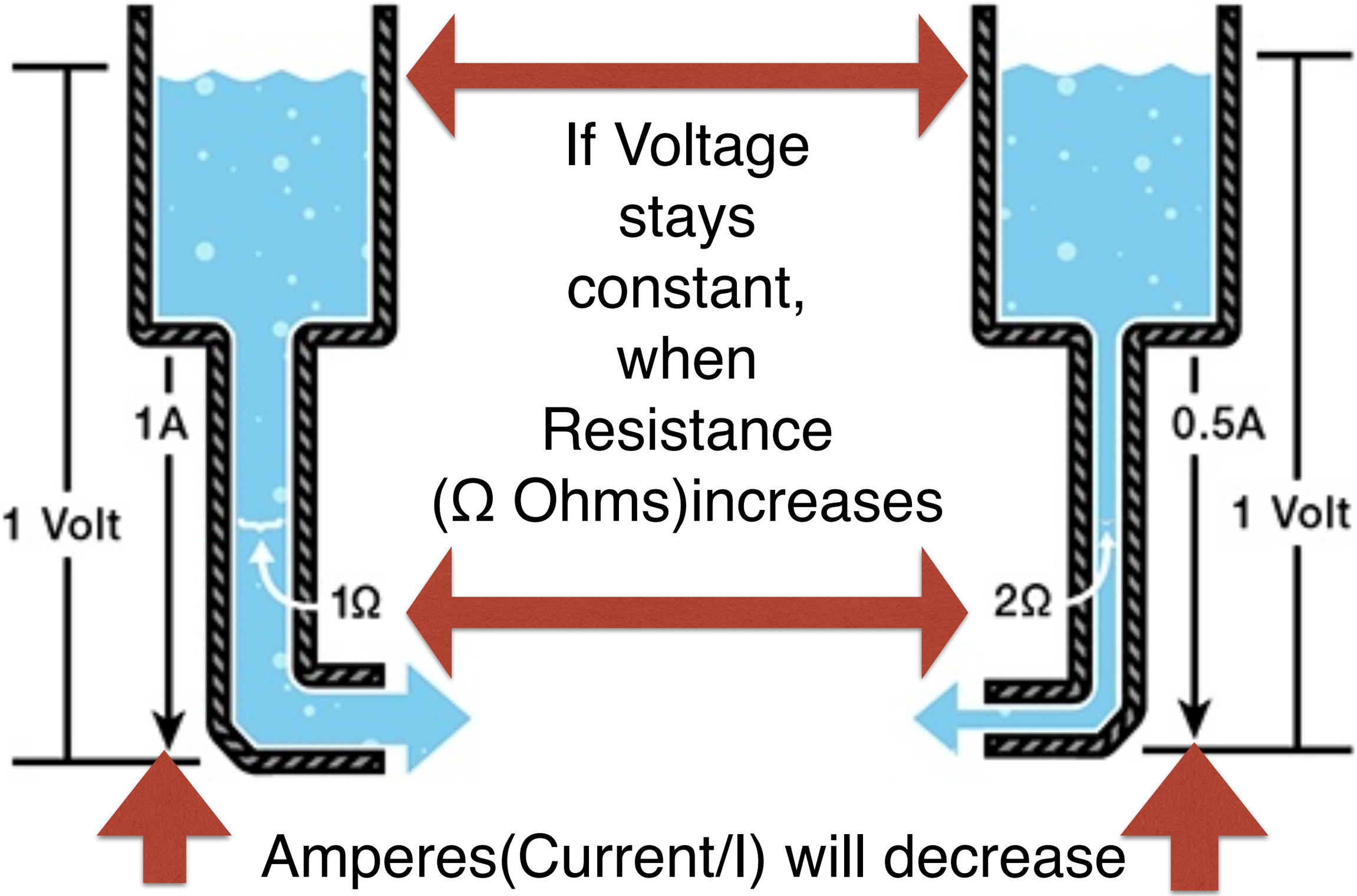




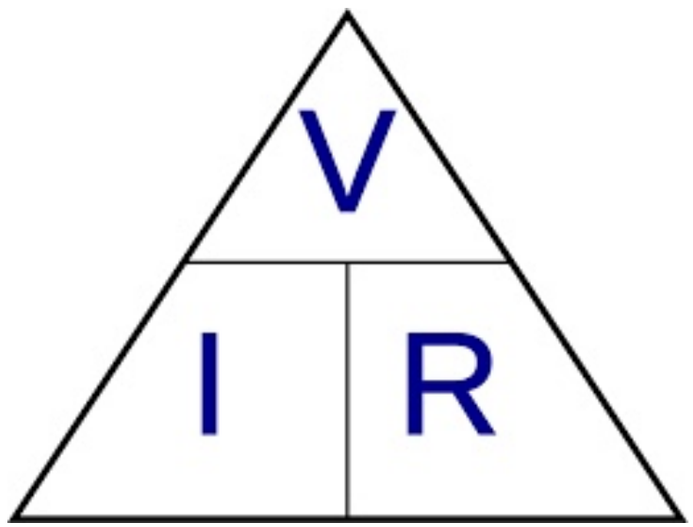
Fatter wires have less Resistance

More available electrons to move

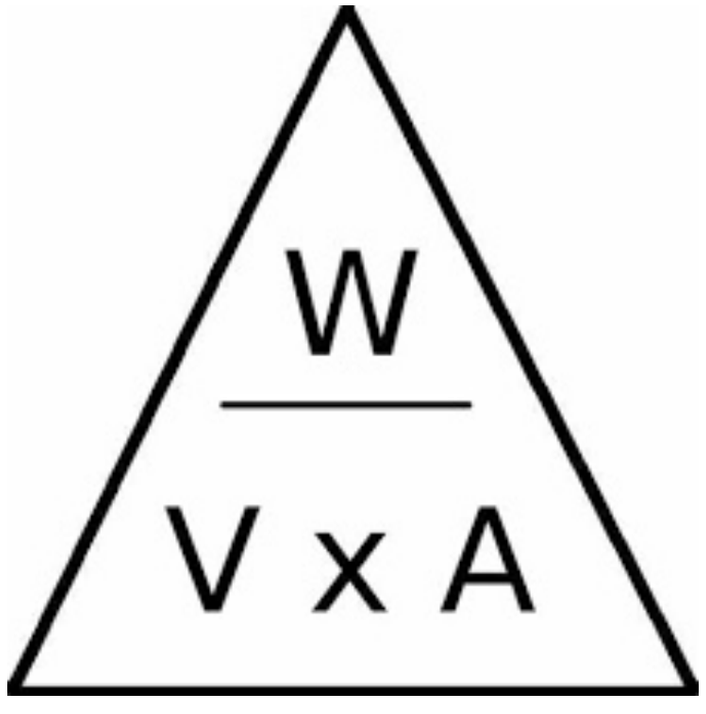
Ohm's Law of Relationships



You got Ohm's Law?

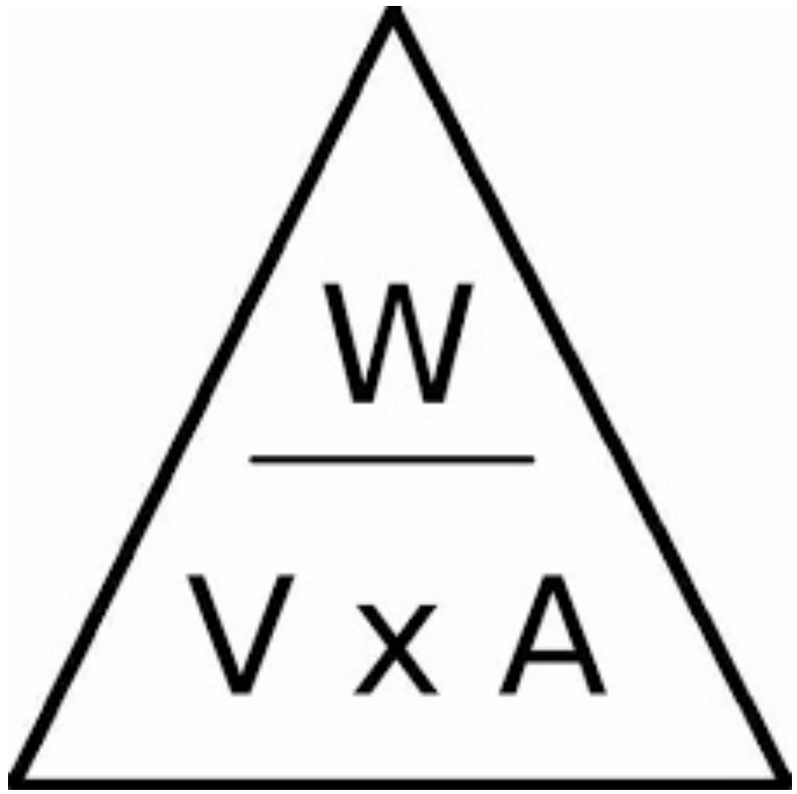


Are you ready for Watt's Law?



What is a Watt?

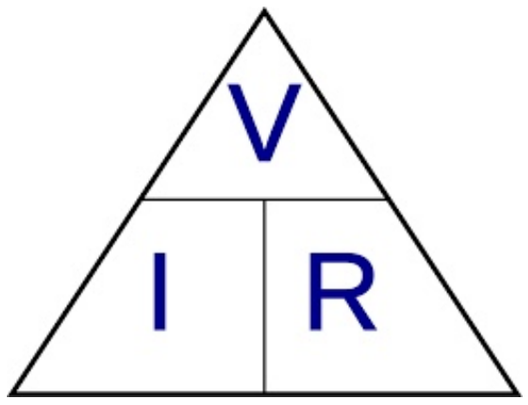
Watts Law



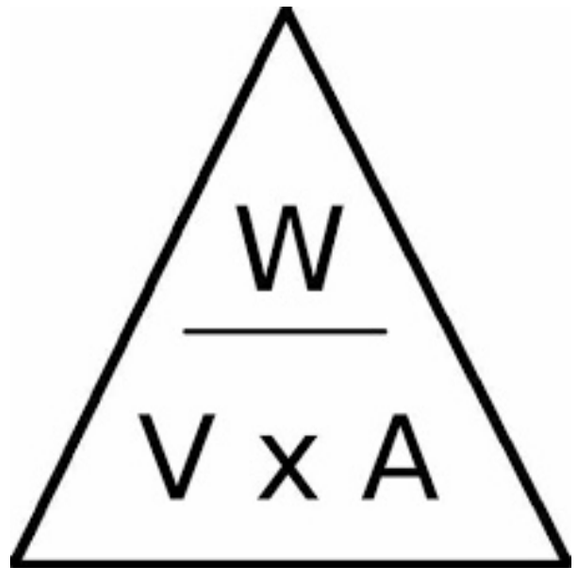
Volts x Amps = Watts

Watts ÷ Amps = Volts

Watts ÷ Volts = Amps

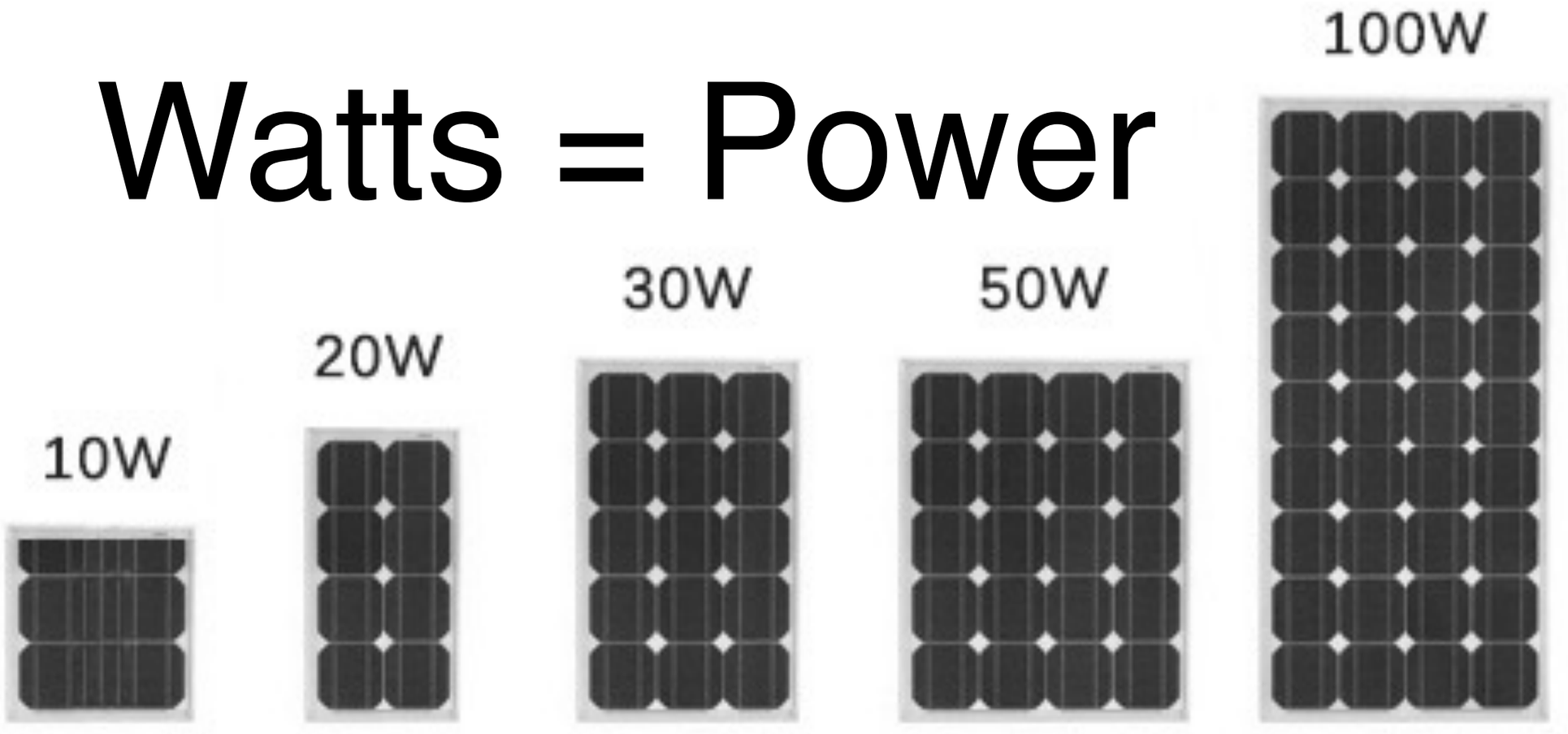


Ohm’s law defines the relationship between resistance, voltage and current in a circuit.



Watt’s law defines the relationship between power, voltage and current.

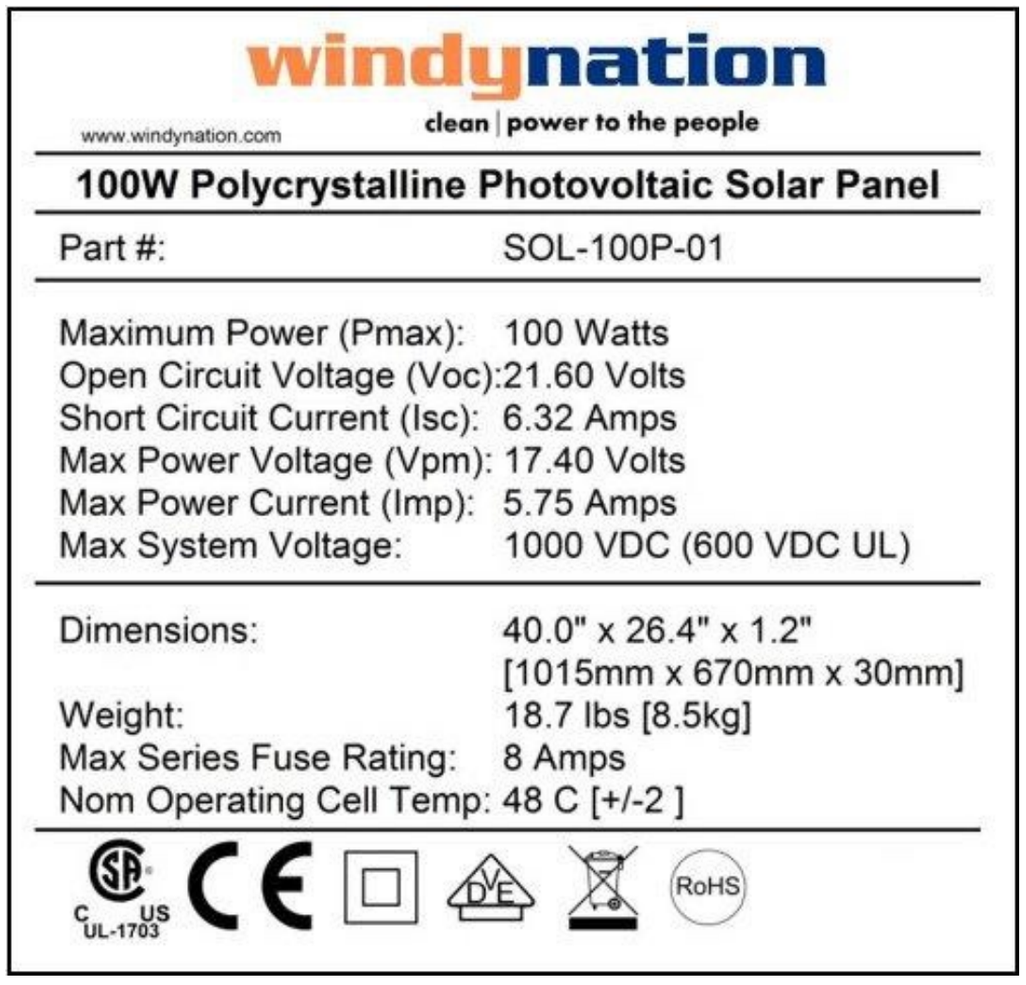
Watts = Power



Solar Panels make watts. Appliances use watts

Volts x Amps = Watts

Power producer
Your solar panel


windynation
www.windynation.com
clean | power to the people

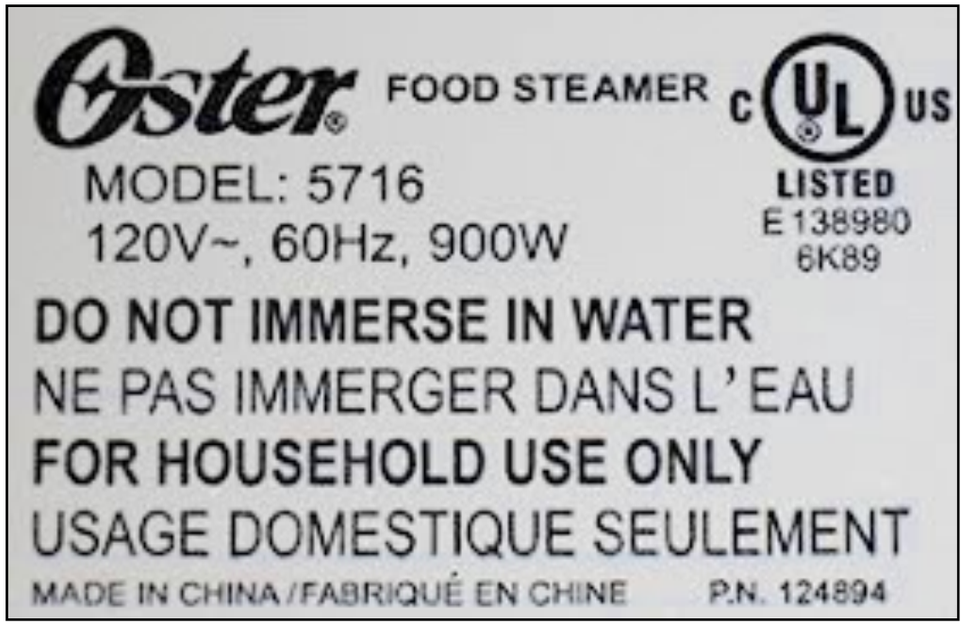
100W Polycrystalline Photovoltaic Solar Panel

Part #:	SOL-100P-01
Maximum Power (Pmax):	100 Watts
Open Circuit Voltage (Voc):	21.60 Volts
Short Circuit Current (Isc):	6.32 Amps
Max Power Voltage (Vpm):	17.40 Volts
Max Power Current (Imp):	5.75 Amps
Max System Voltage:	1000 VDC (600 VDC UL)
Dimensions:	40.0" x 26.4" x 1.2" [1015mm x 670mm x 30mm]
Weight:	18.7 lbs [8.5kg]
Max Series Fuse Rating:	8 Amps
Nom Operating Cell Temp:	48 C [+/-2]

C US UL-1703 CE VDE RoHS

17.40V x 5.75A = 100.05W

Power user
Food Steamer


Oster FOOD STEAMER
c UL us LISTED E138980 6K89
MODEL: 5716
120V~, 60Hz, 900W
DO NOT IMMERSE IN WATER
NE PAS IMMERGER DANS L'EAU
FOR HOUSEHOLD USE ONLY
USAGE DOMESTIQUE SEULEMENT
MADE IN CHINA/FABRIQUÉ EN CHINE P.N. 124894

Here you have to do the math

900W ÷ 120V = 7.5A

Power is measured in
Watt Hours (WH),
the number of watts
produced per hour
or used per hour

DC appliances

Item	Watts	Hours per day	Watt hours
5 Led lights	25	4	100
Phone charger	24	1.5	36
Water pump	40	0.5	20
Speaker system	25	4	100
Fridge	45	4	180
Ceiling fan	25	1	25
		Total Watt hours DC	461

AC appliances

Item	Watts	Hours per day	Watt hours
Laptop charger	50	4	200
Blender	1000	0.03	30
Egg cooker	500	0.16	80
		Total Watt hours AC	310

Total Watt hours per day	771

Managing Electricity

As we said…

The movement of electrons can be defined in terms that make it possible to manage electricity.

Series & **Parallel**

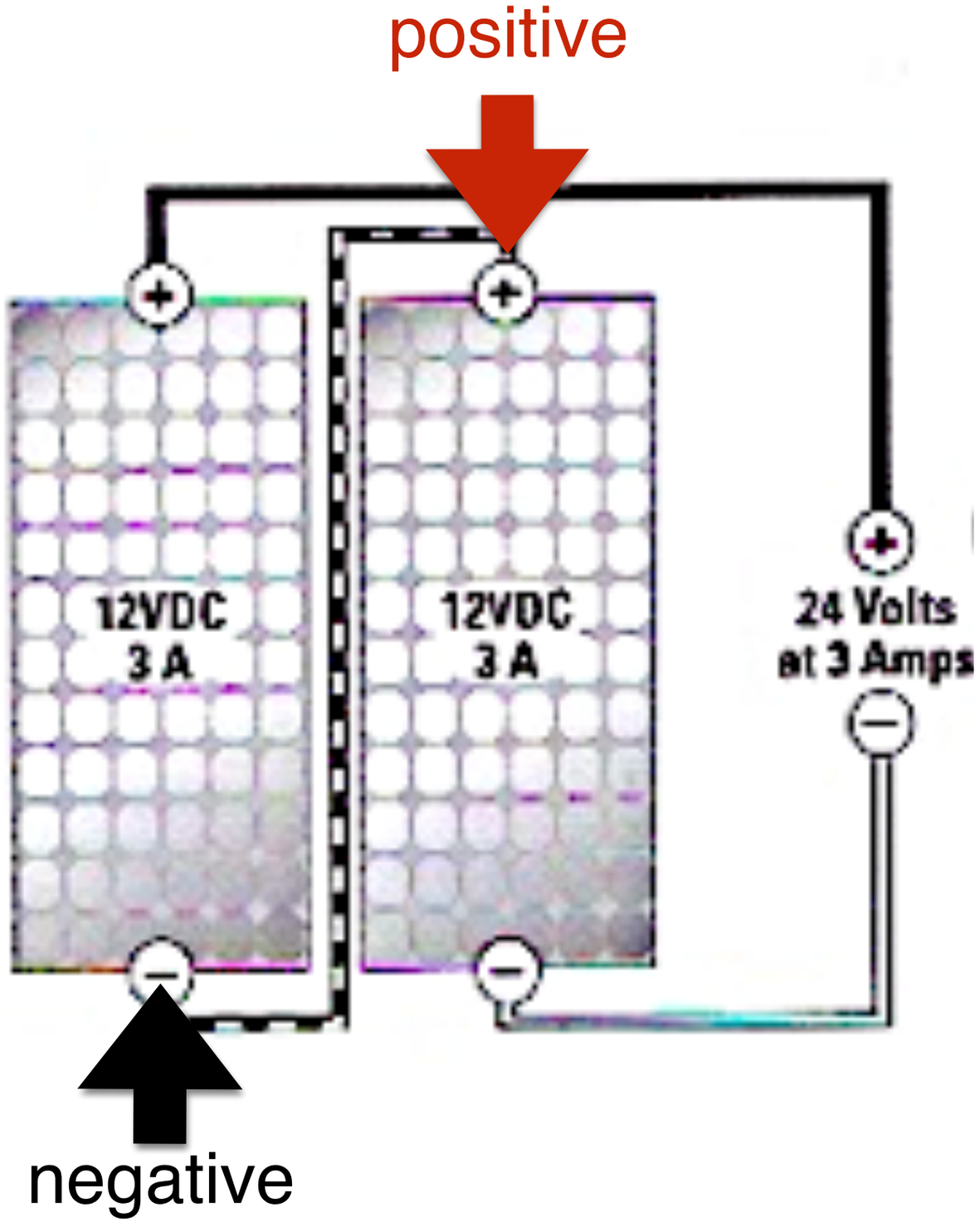
Components can be wired
in **Series** or **Parallel**.

If you want more Volts, wire in series
Amperage stays constant.

If you want more Amps, wire in parallel.
Voltage stays constant.

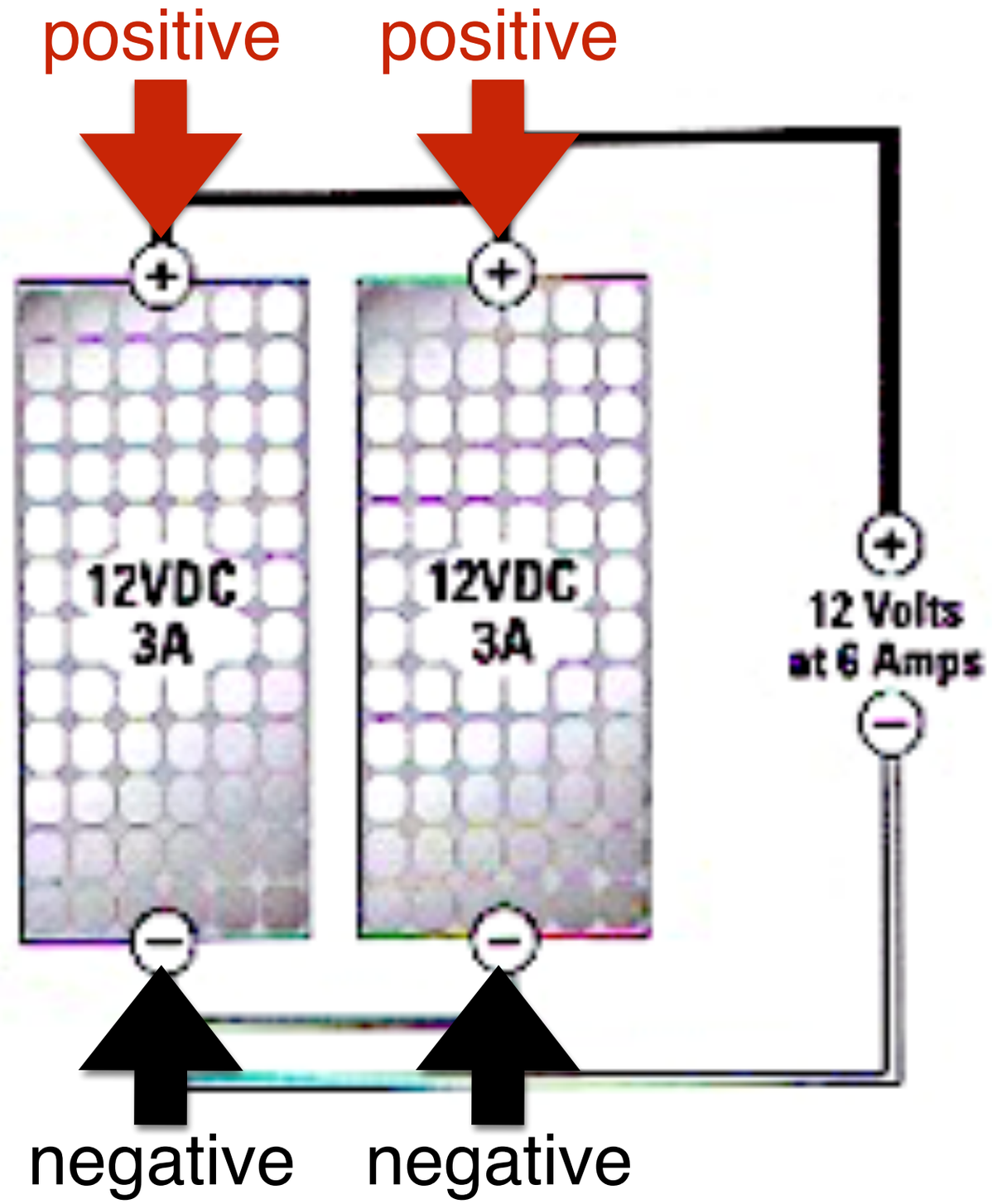
Panels in Series

Two 12VDC
(12 Volt Direct Current)
Solar Panels in series
wired negative (-)
to positive (+)
will produce **24Volts.**
(2 x12V = 24V)
Amperage stays
constant at 3 Amps

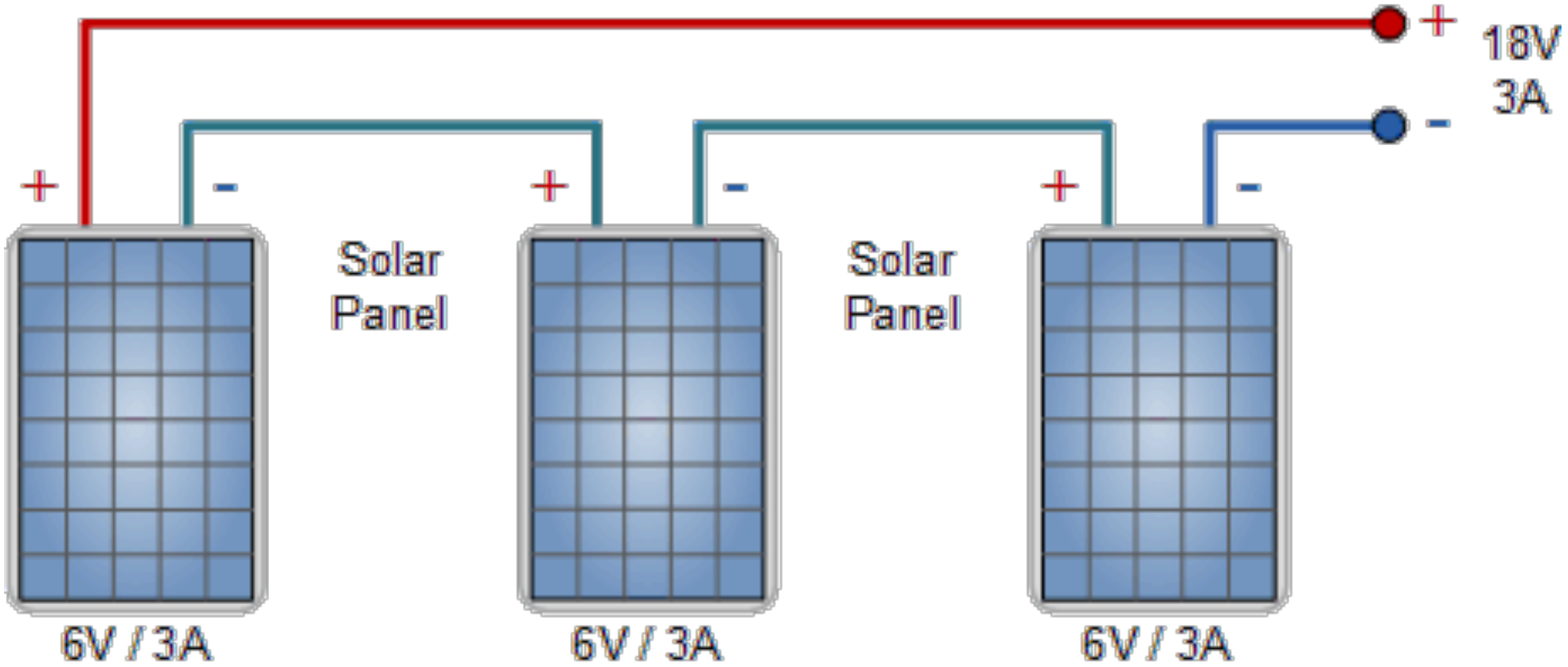


Panels in Parallel

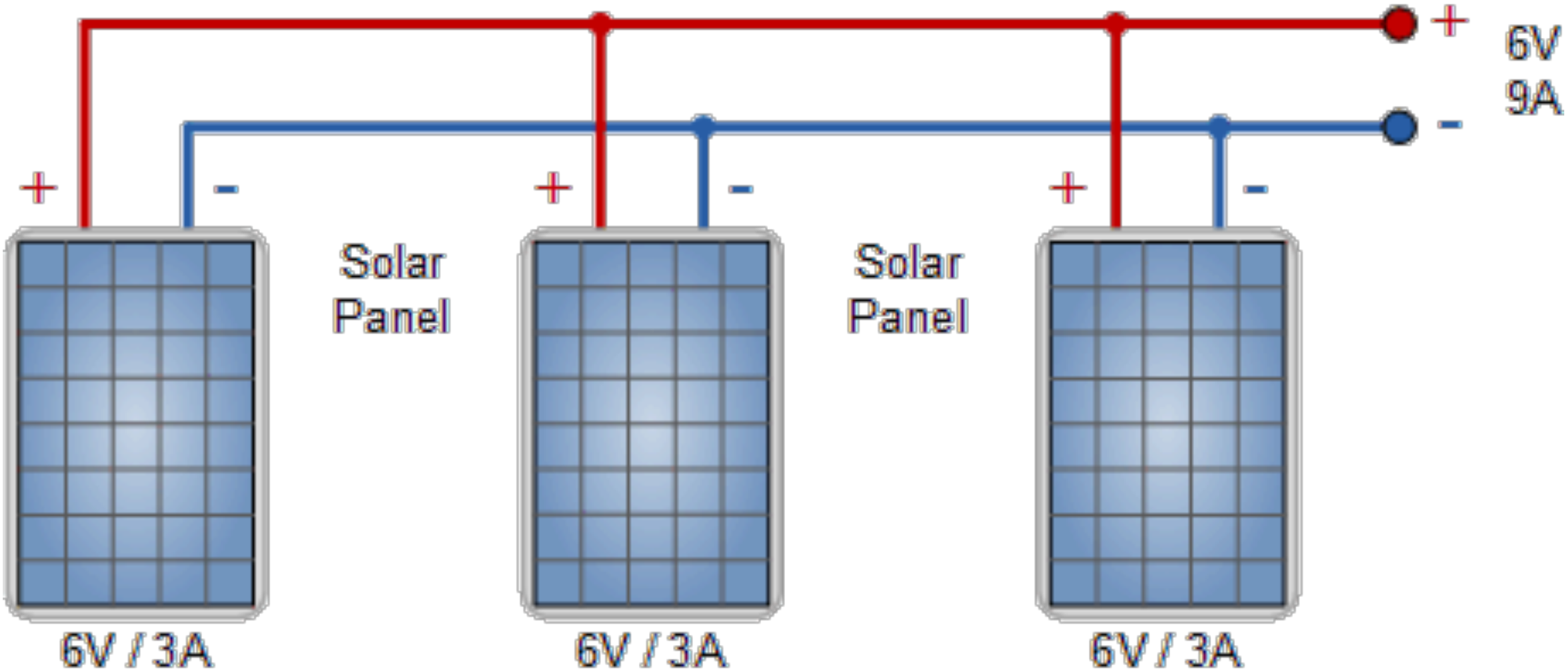
Two 12VDC
(12 Volt Direct Current)
Solar Panels
in parallel wired
negative (-) to negative (-)
positive (+) to positive (+)
will produce **6 Amps.**
(2 x 3A = 6A)
Voltage stays
constant at 12V



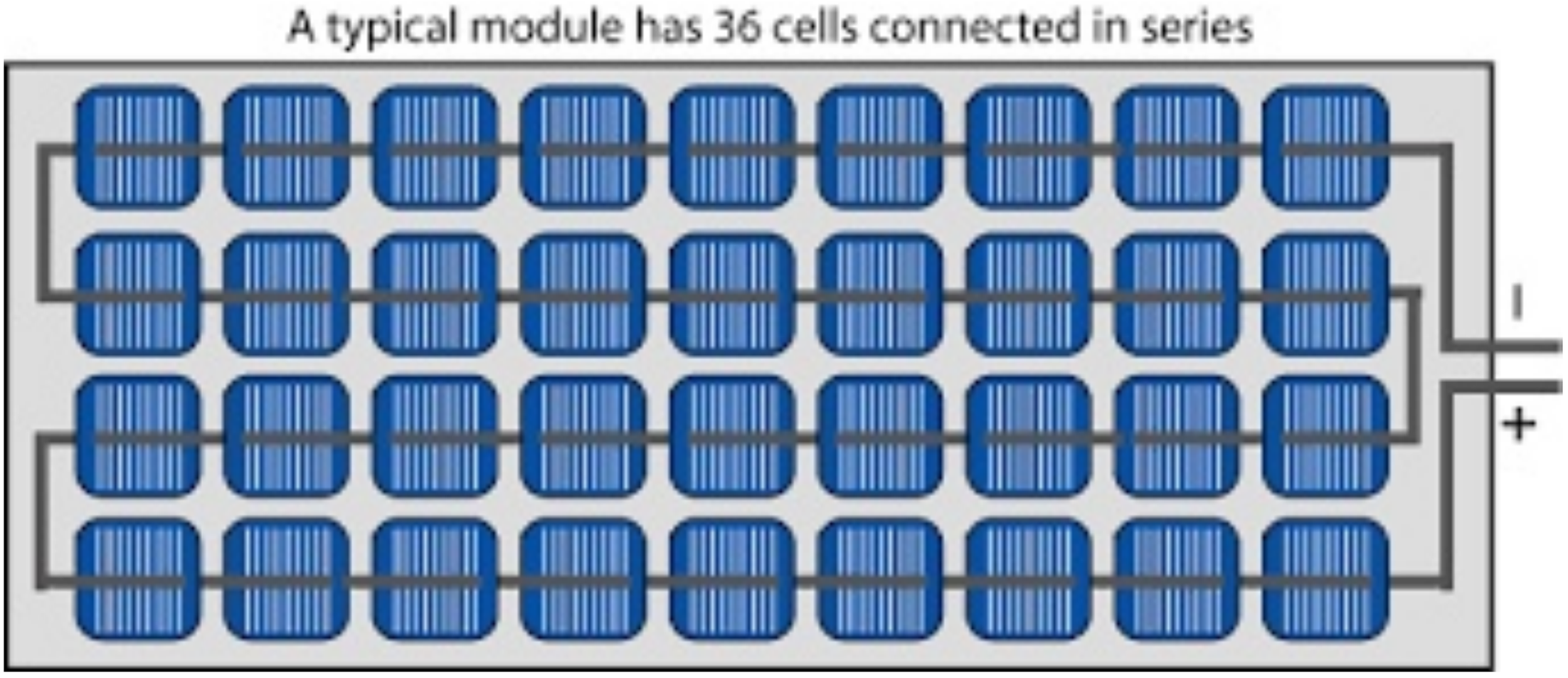
Series



Parallel



The internal wiring of a solar panel



One solar cell equals about half a volt (slide #9)
so what is the voltage of this panel?

Batteries can also be wired in

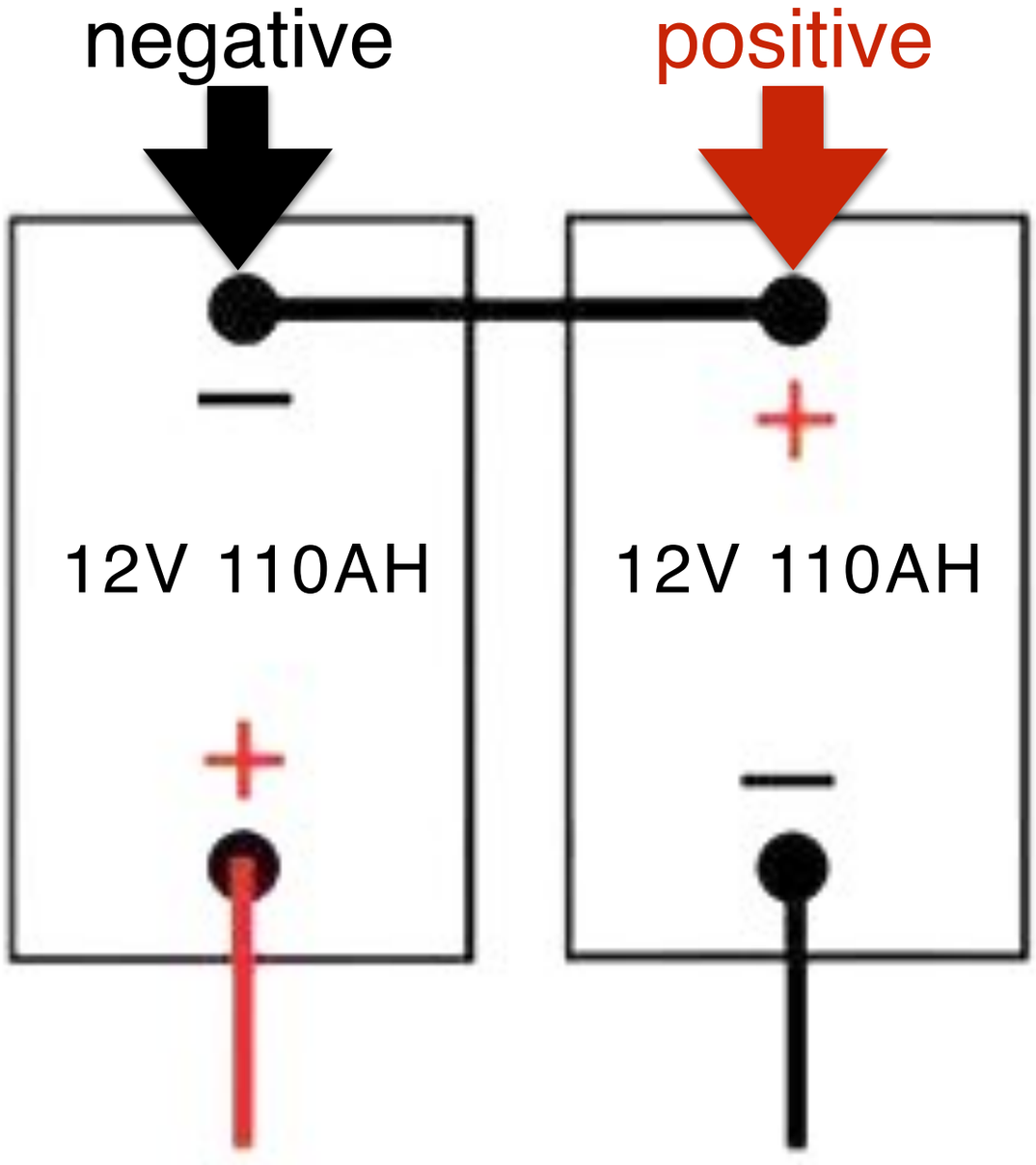
Series and **Parallel**

to boost

Voltage or **Amperage**

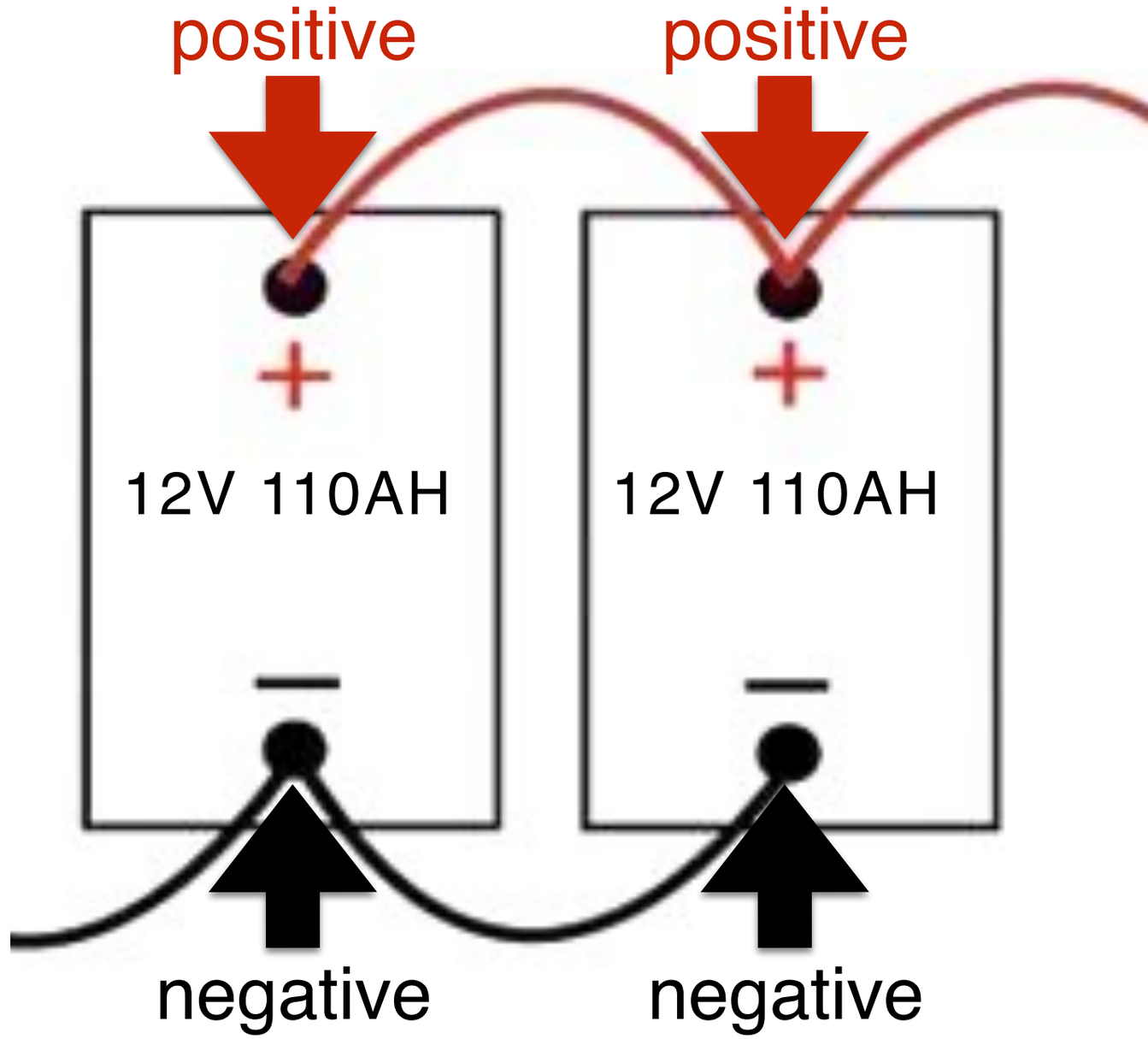
Batteries in Series

Two 12V 110AH (12 Volt 110 Amp Hour Batteries) in series wired negative (-) to positive (+) will produce **110AH at 24Volts.** Same amperage **twice** the voltage.



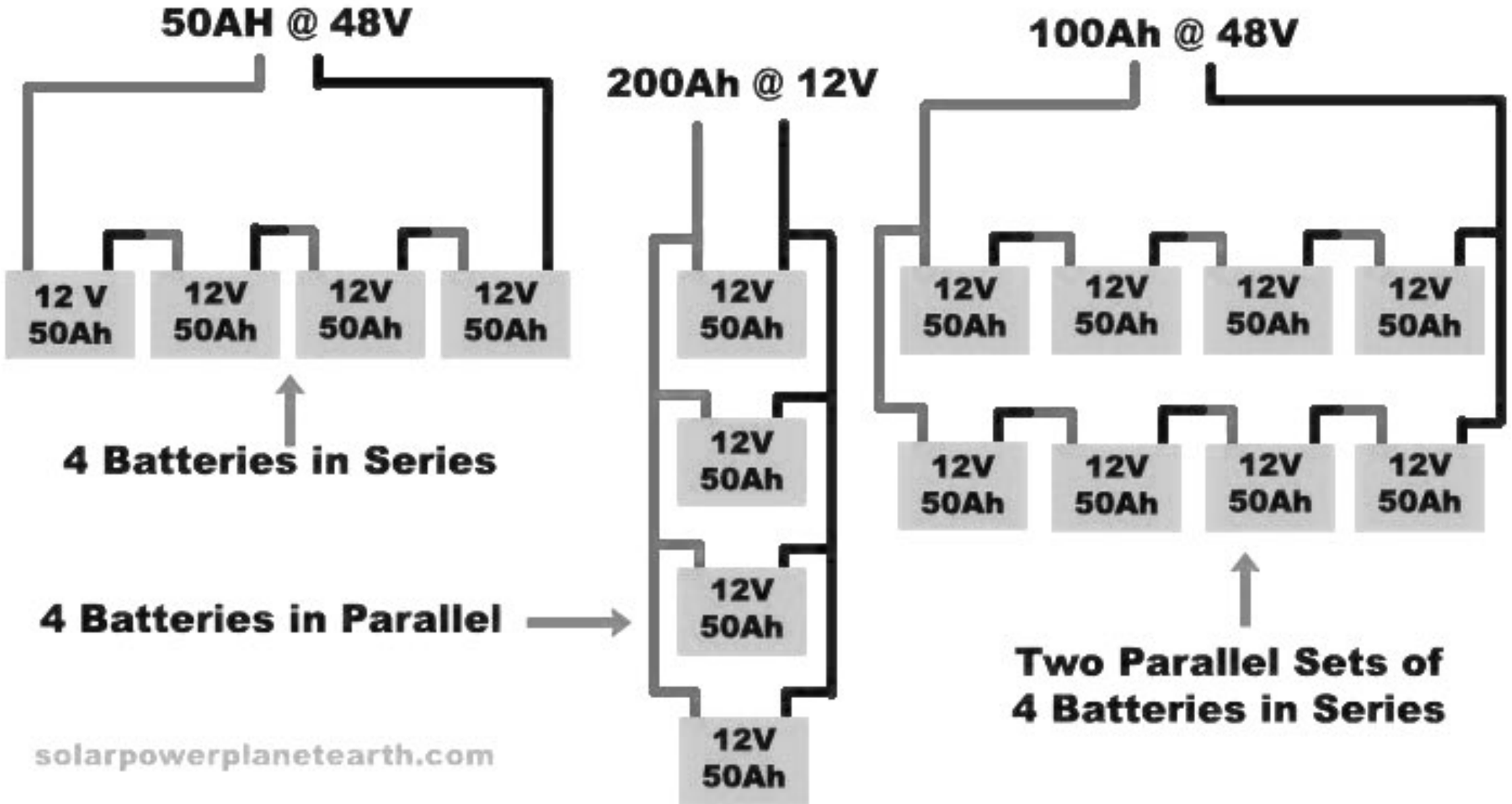
Batteries in Parallel

Two 12V 110AH
(12 Volt 110 Amp
Hour Batteries)
in parallel wired
positive (+) to positive (+)
negative (-) to negative (-)
will produce
220AH at 12V.
Same voltage
twice the amperage.

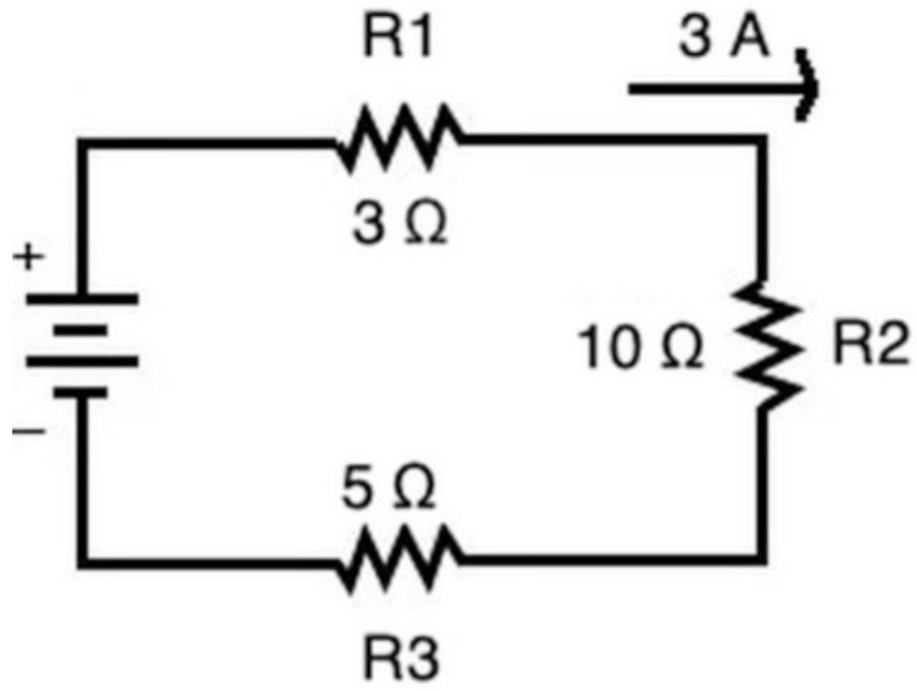


Combining
Series and **Parallel**

This is a mind bender



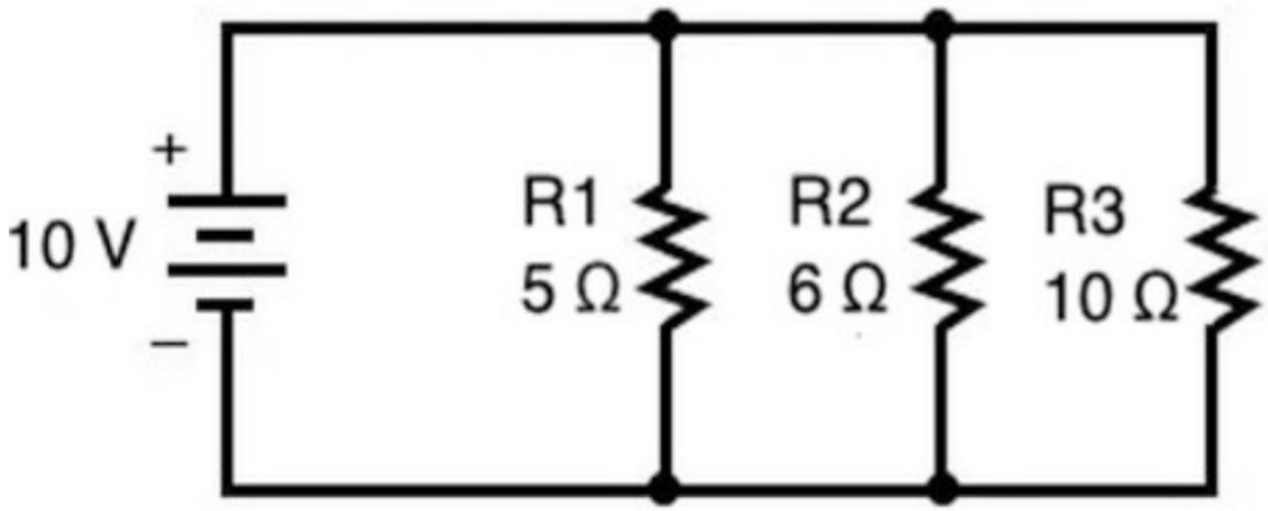
Series Circuits



In a series circuit there is only one path for the current to flow. This means current remains constant throughout.

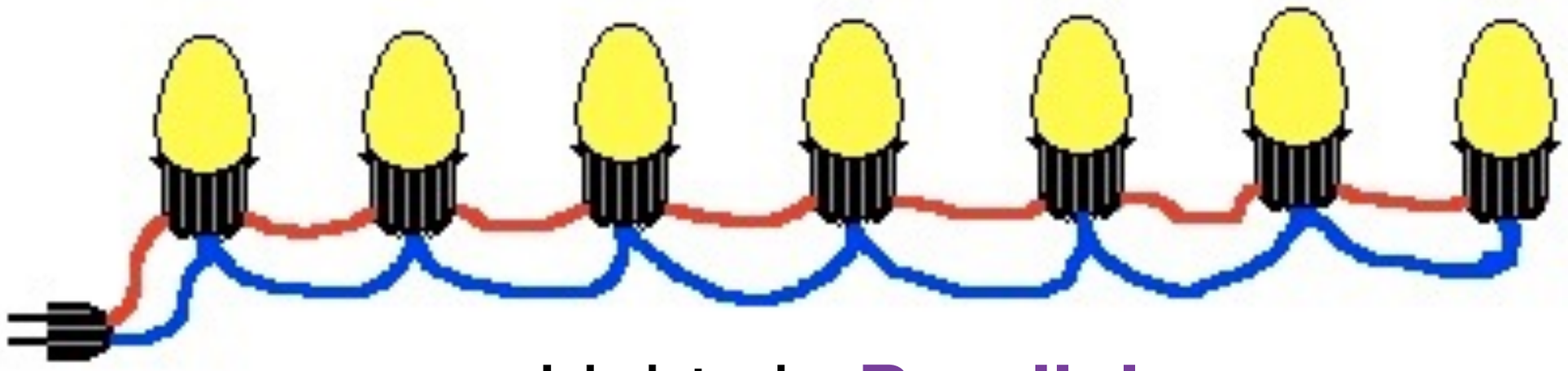
The voltage drops across each resistor according to Ohm's Law V = IR.

Parallel Circuits

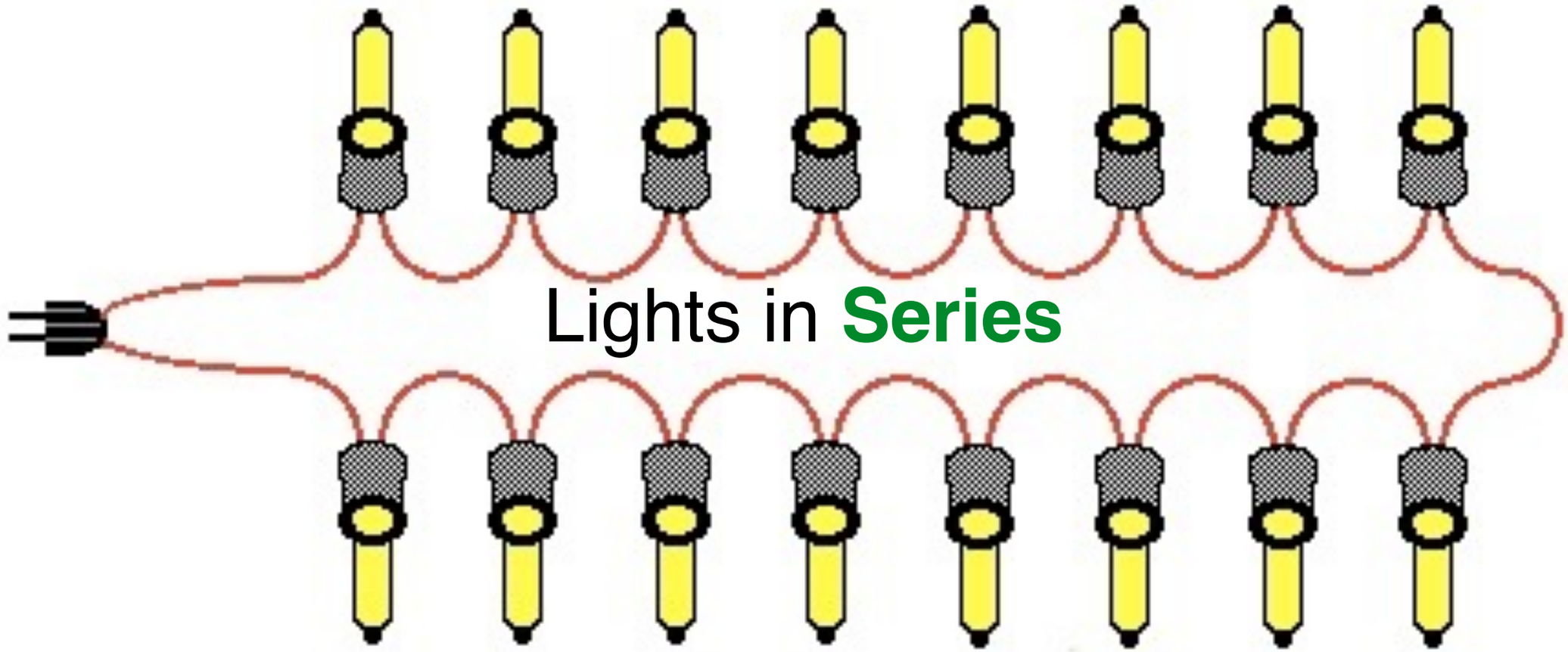


Parallel circuits allow charge to flow through two or more paths. Voltage is the same throughout but amperage varies across the branches with the size of resistor according to Ohms Law, V=IR.

Multiple devices are independent of one another so that, if one were to stop working, the others would continue working.



Lights in **Parallel**



Lights in **Series**

if one light goes out they all go out

Terms for discussion

Electricity
Electrons
Volts
Amps
Current
Ohms
Resistance
Circuit

Charge
Intensité
Ampere
Battery
Amp Hours
Watt Hours
Parallel Wiring
Series Wiring