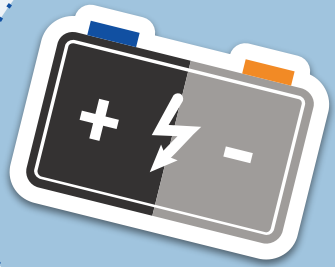


Secondary Science

Building Batteries

RESET Summer Unit: 2024



NGSS Standards (High School)

HS-PS1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

NGSS Standards (Middle School)

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

As you watch...

- Take note of what you **notice** from the video. These should be **facts** that you can see.
- Also take note of what you **wonder**. These should be **questions** that you have after watching the video.



Notice	Wonder



Pause and Talk

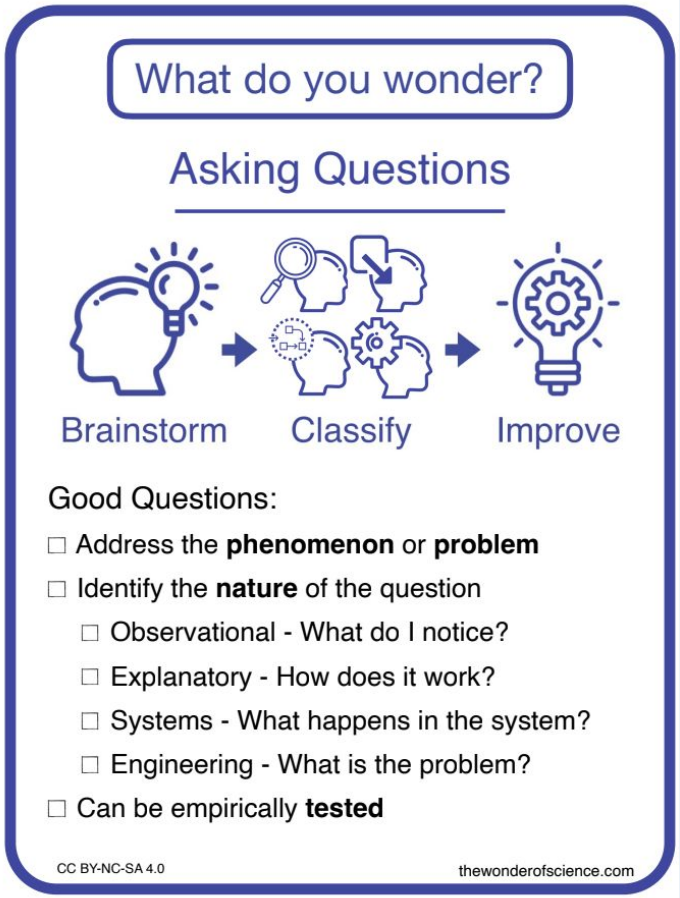




Let's try it!

- **We're going to activate our own heat pack. Before you get started, note as much detail as you can about you heat pack, then, we'll fill in what we see.**

Time (since activated)	Observations
0 sec. (Not started)	
15 seconds	
30 seconds	
1 minute	
3 minutes	
5 minutes	



How does this work?!

- In the space below your data table, note the things that you **wonder** about for this heat pack.
  - **What are you want to know?**
  - **NO GOOGLING. We want to experience the *wonder*.**

Driving Question Board



Hot Packs Explained



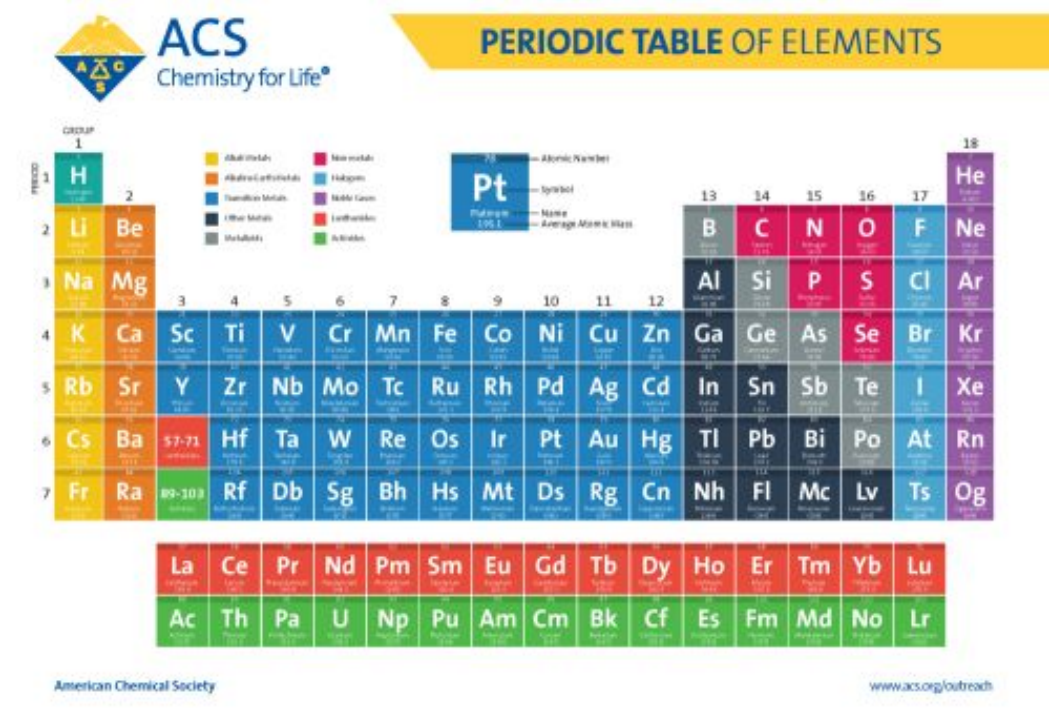
How can we predict which elements and compounds will have certain properties?

- When do we need specific properties?
  - When we need energy to be released from a reaction.
  - When we need two elements/compounds to not react with each other.
  - When we need compounds to be at a specific temperature.

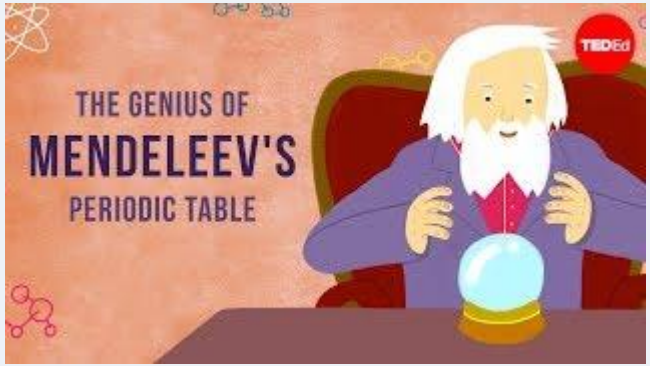




How can we predict which elements and compounds will have certain properties?



History of the Periodic Table



- **Dmitri Mendeleev**
  - Russian Chemist
  - Late 1800s- decided to organize the elements
  - Put in order of increasing **atomic masses-** saw a pattern

History of the Periodic Table



- **Henry Moseley**
  - British chemist and physicist
  - Arranged elements not by atomic mass, but by **atomic number.**
  - Why is this change important?
    - Ex: the atomic mass of cobalt is slightly larger than that of nickel, which would have placed them in backwards order if they had been placed in the Periodic Table blindly according to atomic mass.

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII		IB	IIB	IIIA	IVA	VA	VIA	VIIA	
1 H 1.00797																2 He 4.0026
3 Li 6.939	4 Be 9.0122										5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312										13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	‡89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

*

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97

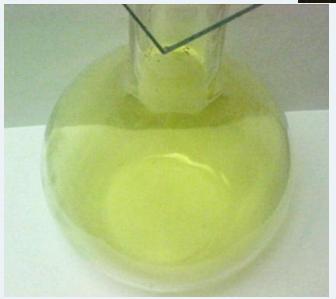
‡

90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)

The Non-Metals

- Located in the upper right corner of the table
- Many are gases or brittle solids
- Poor conductors
- Diatomic molecules





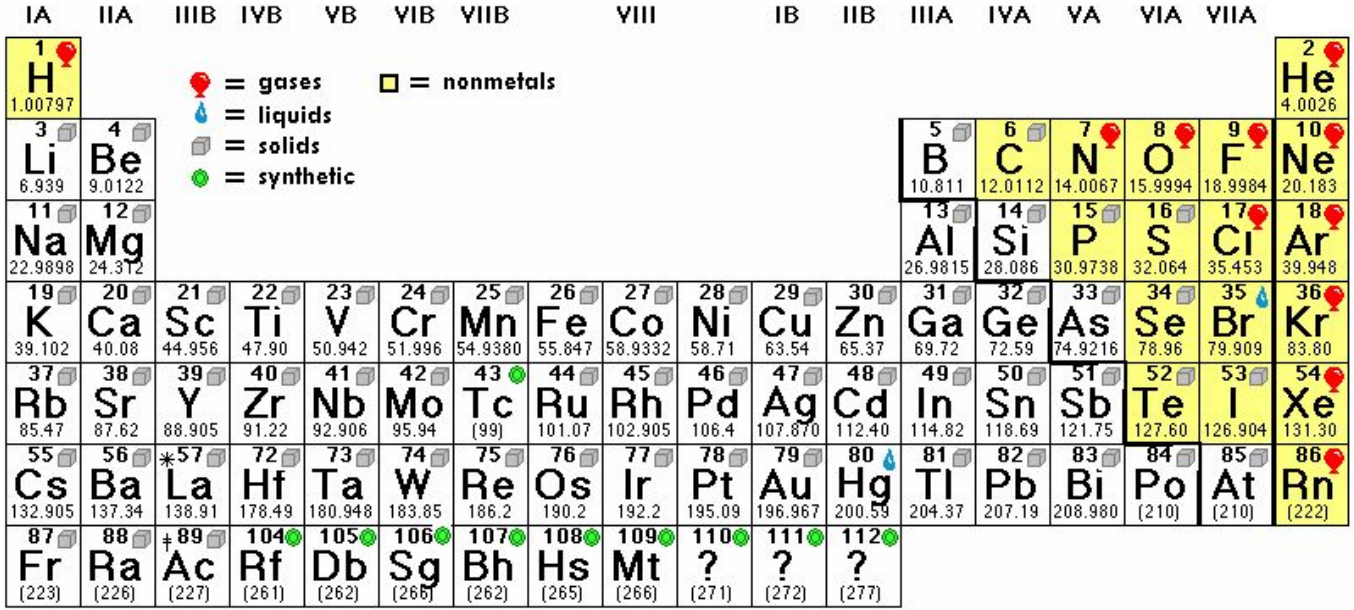


Non Metals

- poor conductors
- dull (not shiny)
- most = gases at room temp
- can be liquid or a brittle solid



PERIODIC CHART OF THE ELEMENTS



Numbers in parenthesis are mass numbers of most stable or most common isotope.

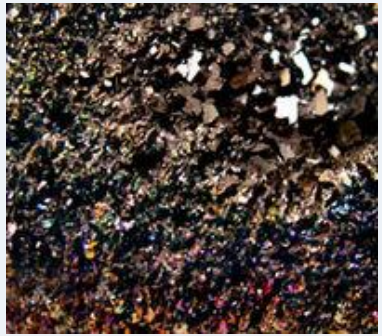
Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

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The Metalloids

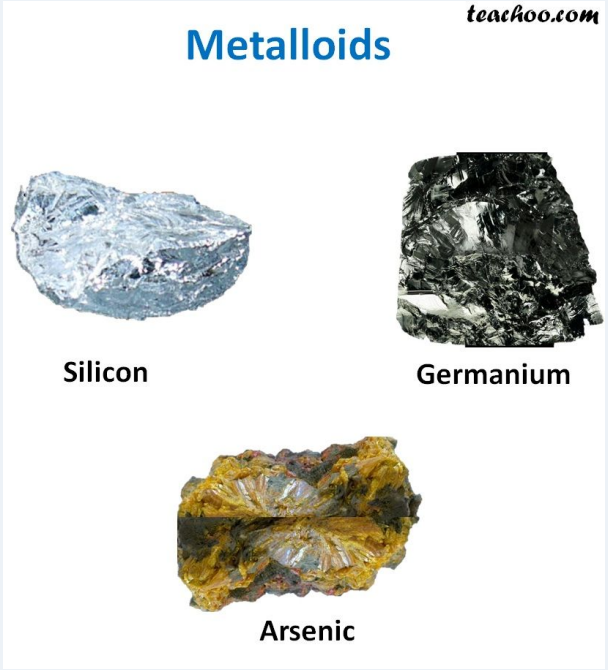
- Separate the metals from the non-metals
- Are found along the “zigzag”
- Have properties of both metals and nonmetals
- Example: semiconductors

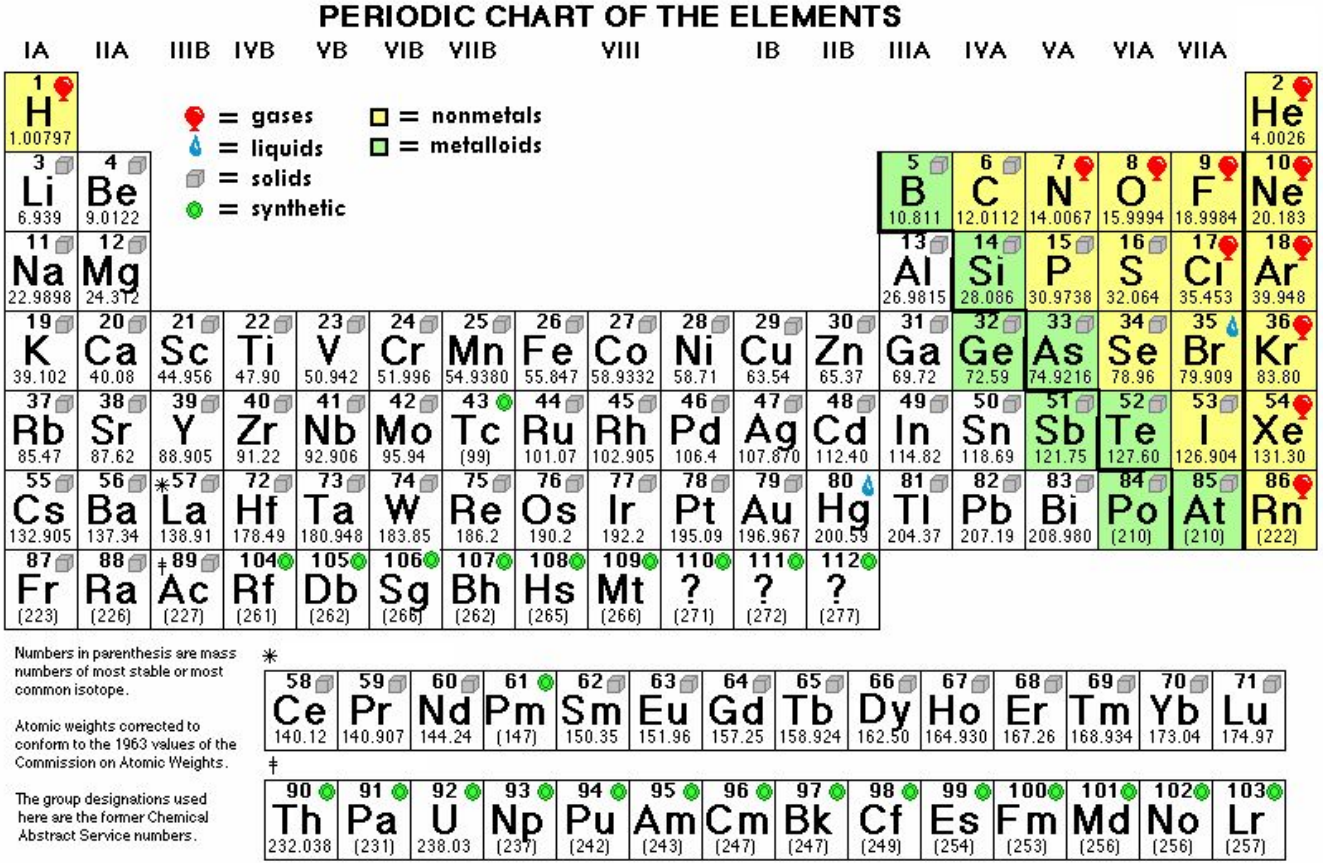




Metalloids

- properties of both metals and nonmetals
- shiny or dull
- most are solids
- ductile
- semiconductors
  - (important in computers and other electronic devices)




PERIODIC CHART OF THE ELEMENTS
IA IIA IIIB IVB VB VIB VIIB VIII IB IIB IIIA IVA VA VIA VIIA
= gases
= liquids
= solids
= synthetic
= nonmetals
= metalloids
1 H 1.00797
2 He 4.0026
3 Li 6.939
4 Be 9.0122
5 B 10.811
6 C 12.0112
7 N 14.0067
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11 Na 22.9898
12 Mg 24.312
13 Al 26.9815
14 Si 28.086
15 P 30.9738
16 S 32.064
17 Cl 35.453
18 Ar 39.948
19 K 39.102
20 Ca 40.08
21 Sc 44.956
22 Ti 47.90
23 V 50.942
24 Cr 51.996
25 Mn 54.9380
26 Fe 55.847
27 Co 58.9332
28 Ni 58.71
29 Cu 63.54
30 Zn 65.37
31 Ga 69.72
32 Ge 72.59
33 As 74.9216
34 Se 78.96
35 Br 79.909
36 Kr 83.80
37 Rb 85.47
38 Sr 87.62
39 Y 88.905
40 Zr 91.22
41 Nb 92.906
42 Mo 95.94
43 Tc (99)
44 Ru 101.07
45 Rh 102.905
46 Pd 106.4
47 Ag 107.870
48 Cd 112.40
49 In 114.82
50 Sn 118.69
51 Sb 121.75
52 Te 127.60
53 I 126.904
54 Xe 131.30
55 Cs 132.905
56 Ba 137.34
*57 La 138.91
72 Hf 178.49
73 Ta 180.948
74 W 183.85
75 Re 186.2
76 Os 190.2
77 Ir 192.2
78 Pt 195.09
79 Au 196.967
80 Hg 200.59
81 Tl 204.37
82 Pb 207.19
83 Bi 208.980
84 Po (210)
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95 Am (243)
96 Cm (247)
97 Bk (247)
98 Cf (249)
99 Es (254)
100 Fm (253)
101 Md (256)
102 No (256)
103 Lr (257)

The Metals

- Shiny solids – with one exception!
- Good conductors of heat and electricity
- High melting points
- Usually malleable





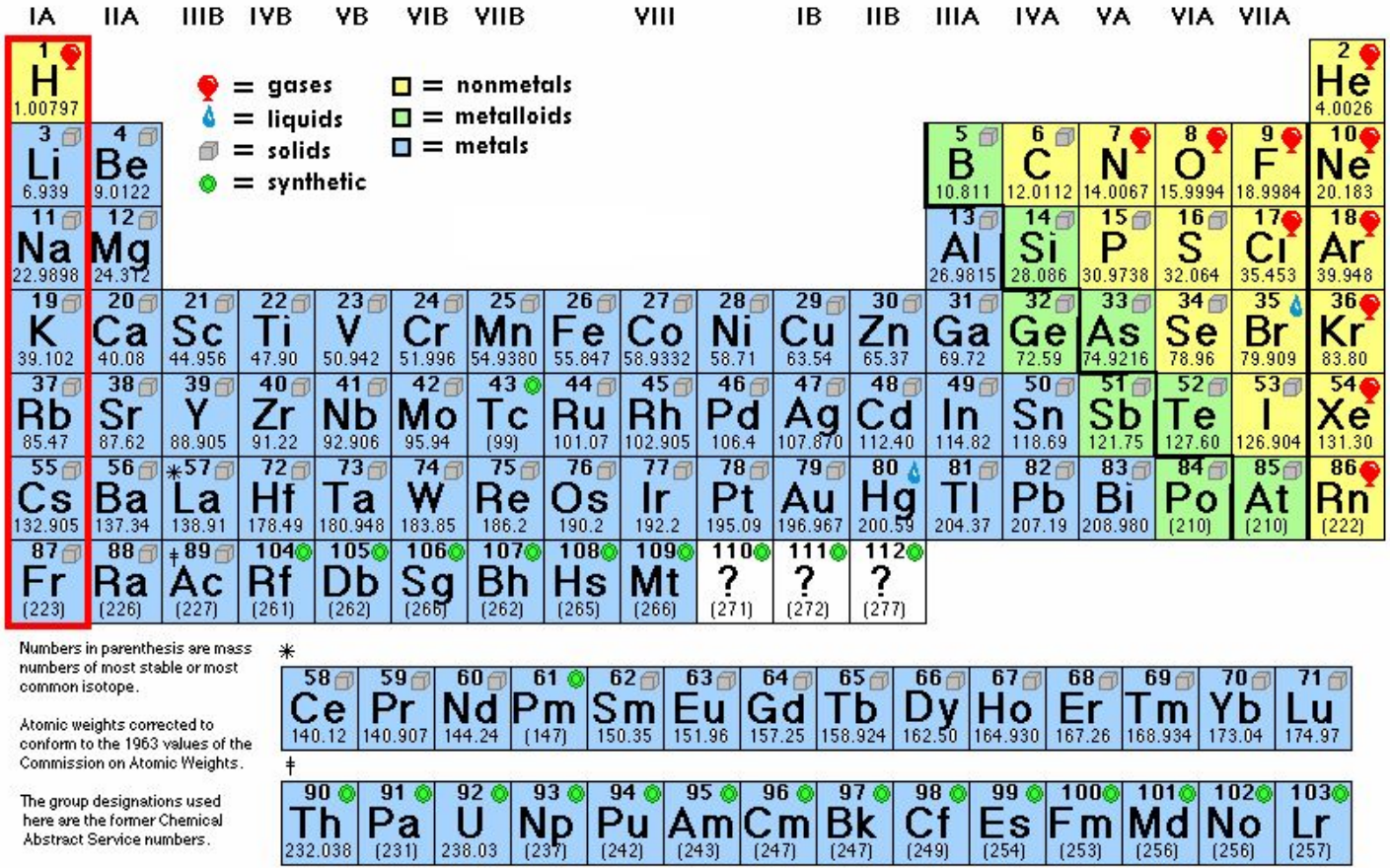


Metals

- good conductors of heat and electricity
- malleable
- ductile
- solids at room temp (except - Hg)
- metallic and shiny



PERIODIC CHART OF THE ELEMENTS

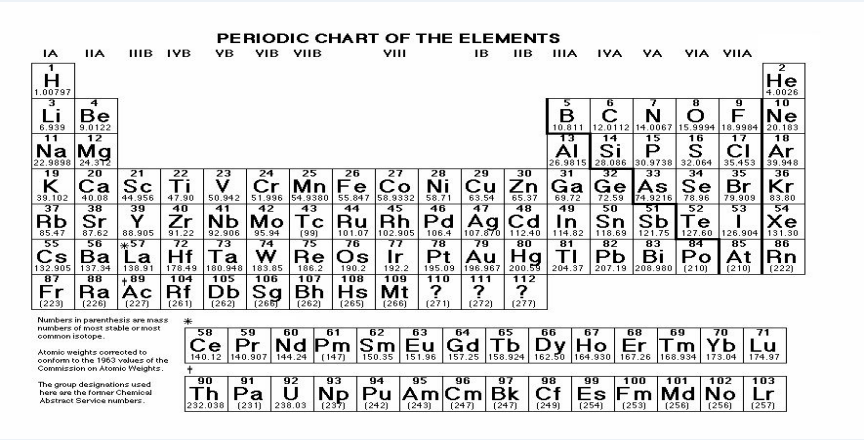


Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

Alkali Metals





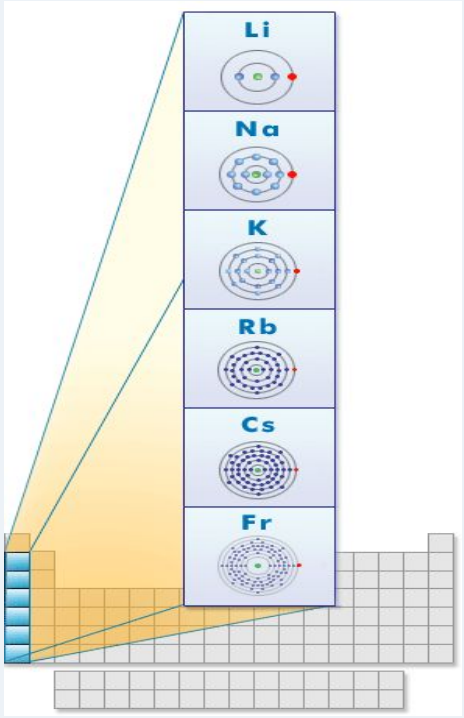
- The Alkali Metals are in group 1
- Properties:
- They have ___ valence electron
- Highly reactive (think explosions)
- Explode in water!
- (K + H_20 = purple fire)

ALKALI METALS

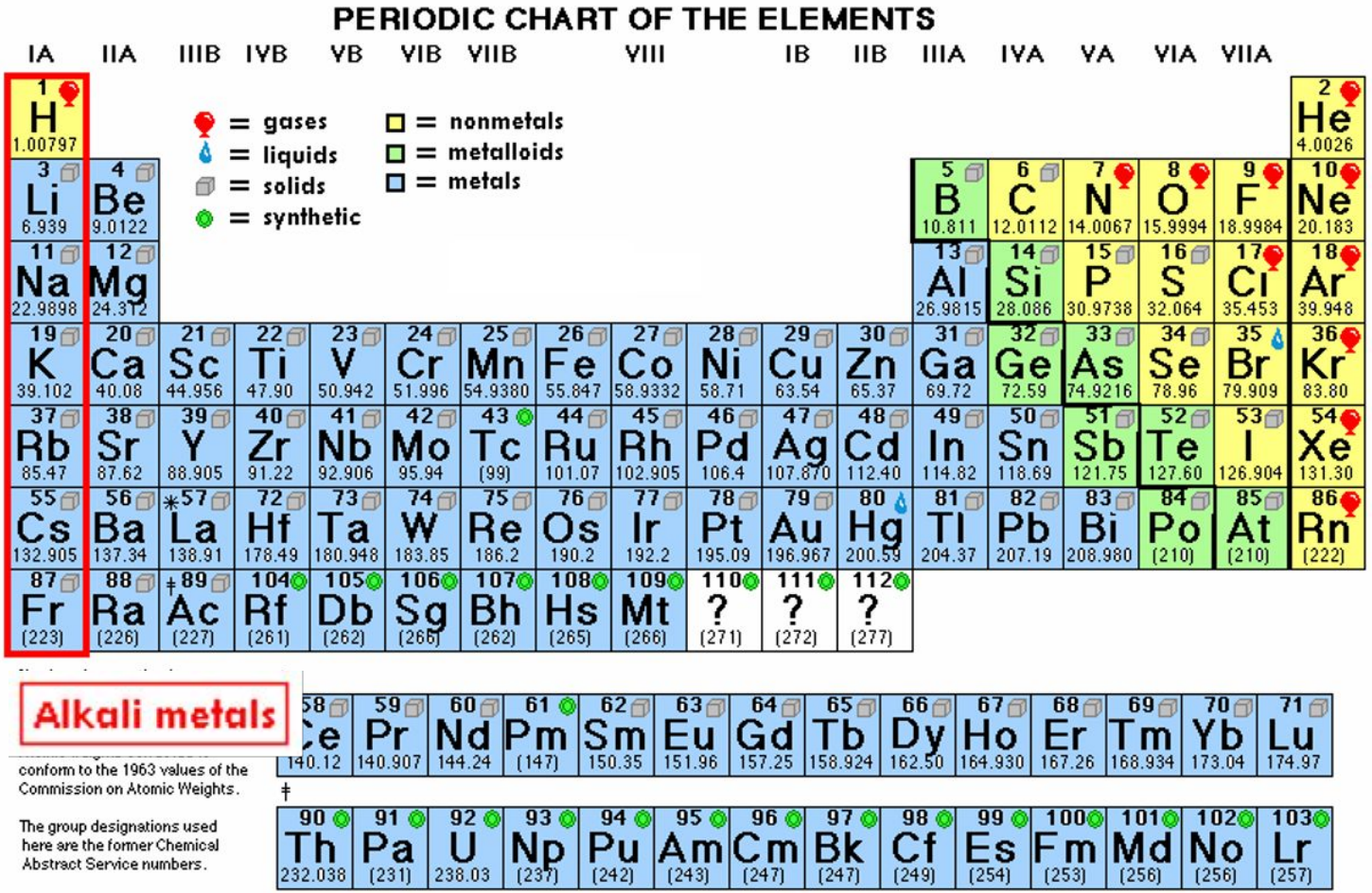
Group 1

Hydrogen is ***not*** a member of this family because it is a **non-metal**

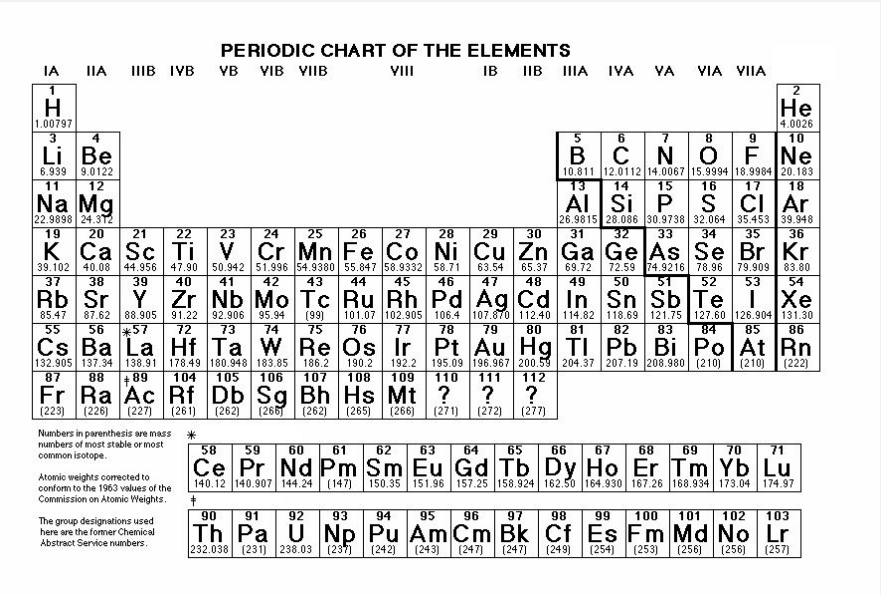
- Valence Electrons = **1**
- Soft metals
- ***Very*** reactive (esp. water)
- Reacts easily with group 17
- Conductive
- METALS






PERIODIC CHART OF THE ELEMENTS
IA IIA IIIB IVB VB VIB VIIB VIII IB IIB IIIA IVA VA VIA VIIA
= gases
= liquids
= solids
= synthetic
= nonmetals
= metalloids
= metals
Alkali metals
conform to the 1963 values of the Commission on Atomic Weights.
The group designations used here are the former Chemical Abstract Service numbers.

Alkaline Earth Metals

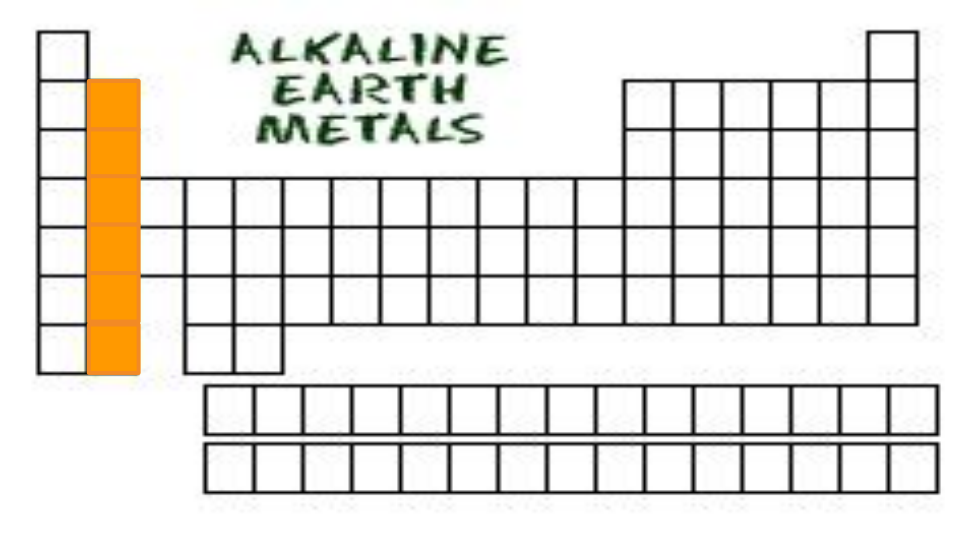


The Alkaline Earth Metals are in group 2

Properties:

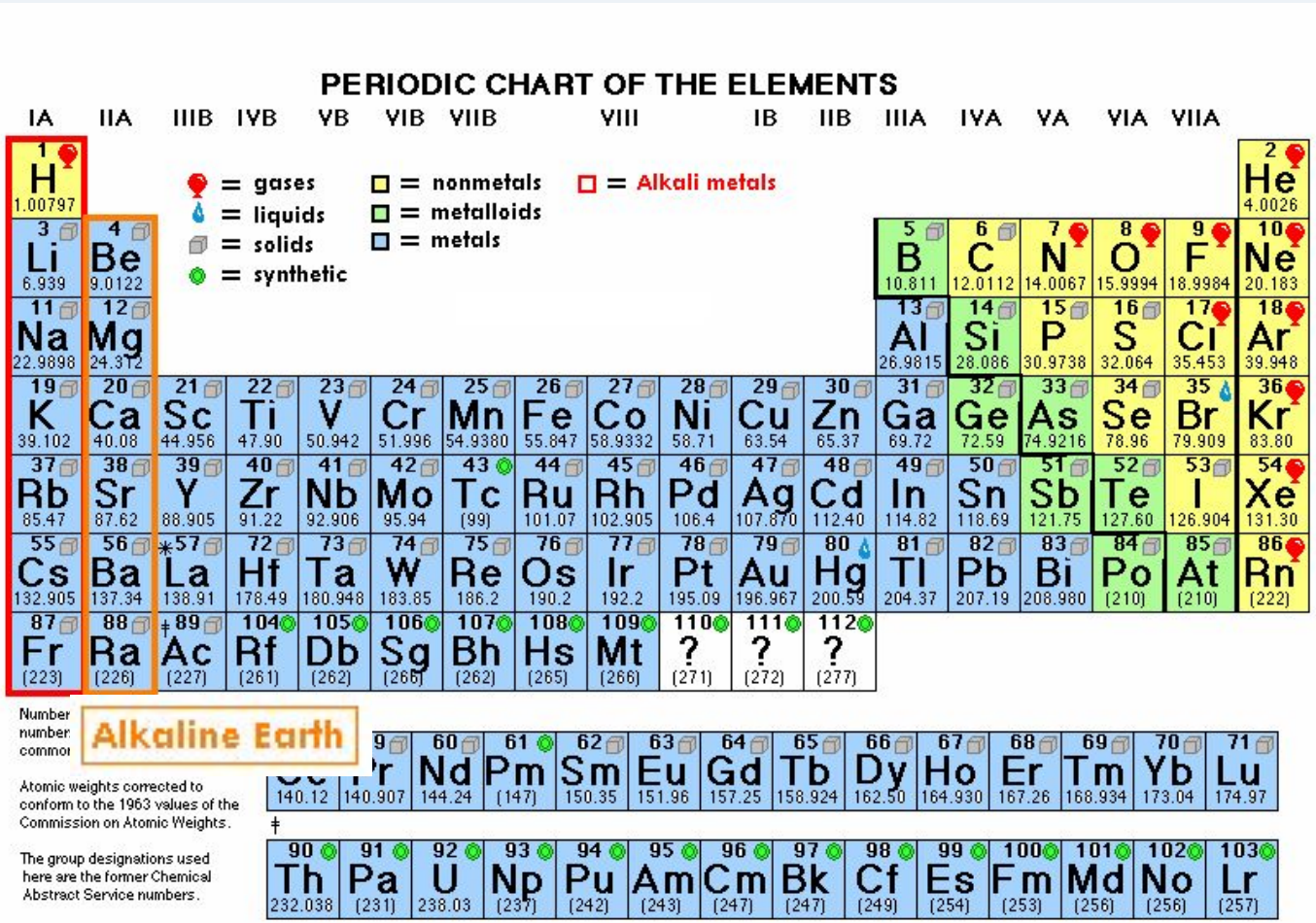
- They have ___ valence electrons
- The are soft, silvery metals
- They react with halogen gases and water

ALKALINE EARTH METALS

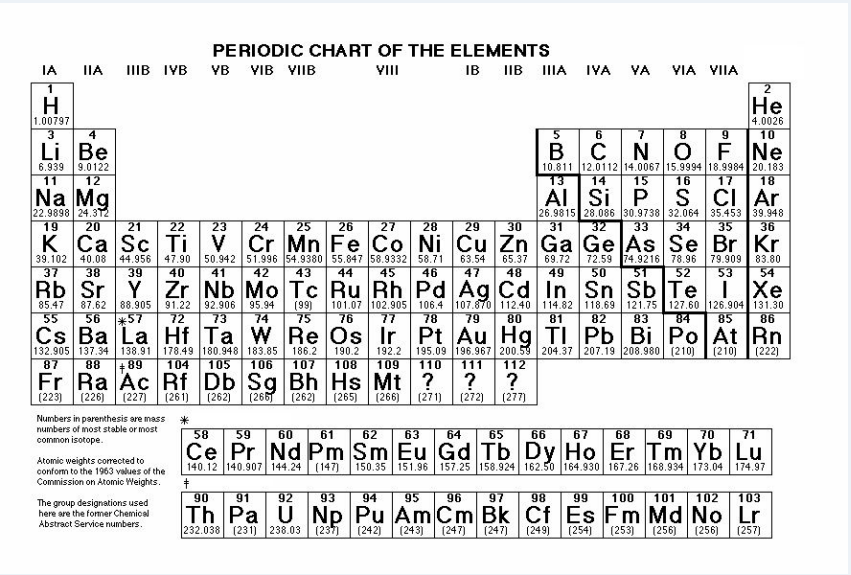


Group 2

- Valence Electrons = **2**
- malleable
- reactive BUT less reactive than group 1
- conductive
- METALS


PERIODIC CHART OF THE ELEMENTS
IA IIA IIIB IVB VB VIB VIIB VIII IB IIB IIIA IVA VA VIA VIIA
= gases
= liquids
= solids
= synthetic
= nonmetals
= metalloids
= metals
= Alkali metals
Alkaline Earth
Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.
The group designations used here are the former Chemical Abstract Service numbers.

Transition Metals



Transition Metals are in groups 3-12 B

Properties:

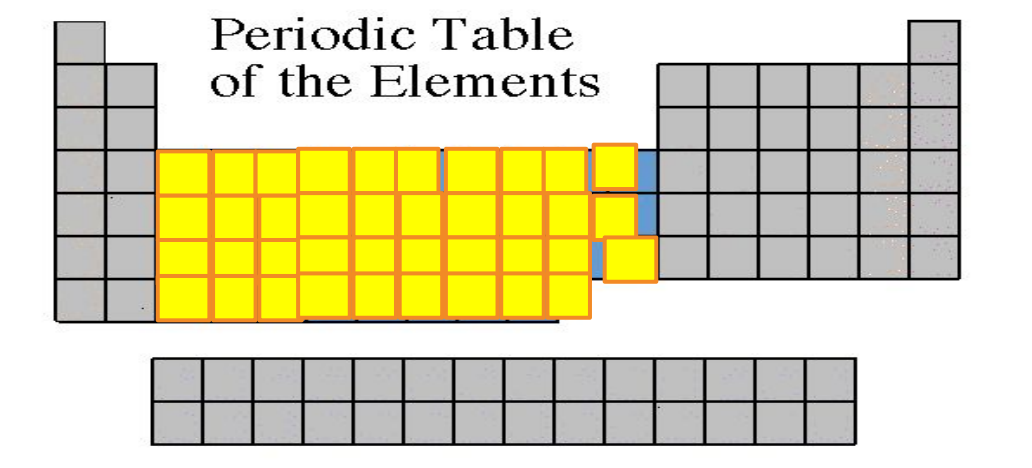
They have varying numbers of valence electrons.

- solids (except Hg)
- silvery-blue (except Au and Cu)

Lanthanides- used in TVs, movies

Actinides- highly unstable and radioactive

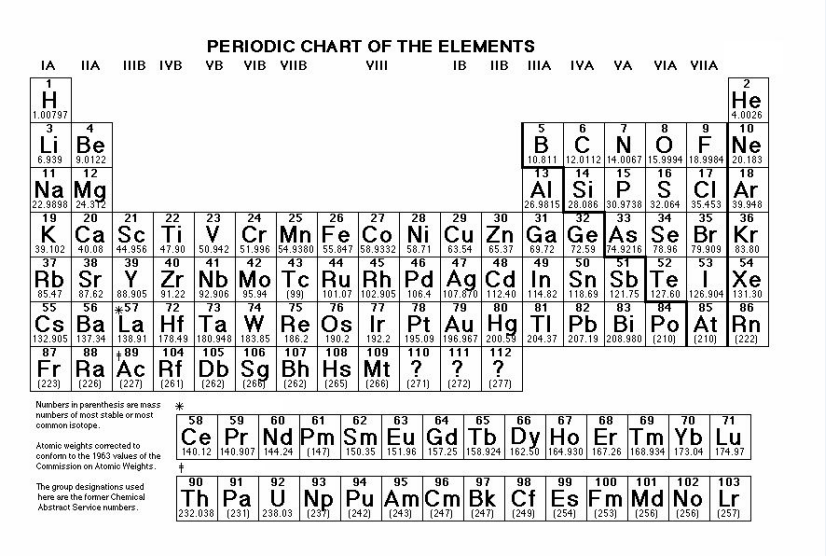
TRANSITION METALS



Groups 3-12

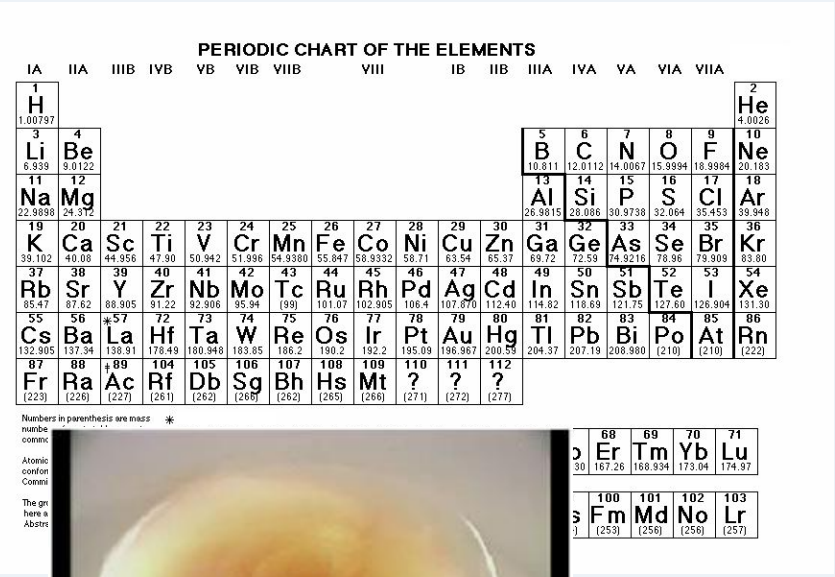
- good conductors
- ductile and malleable
- harder metals
- not very reactive
- METALS

The different families



- The Aluminum, Carbon, Nitrogen, and Oxygen families are in groups IIIA(3A)-VIA(6A) or 13-16.
- How many valence electrons are in each elemental family?

Halogen Gases

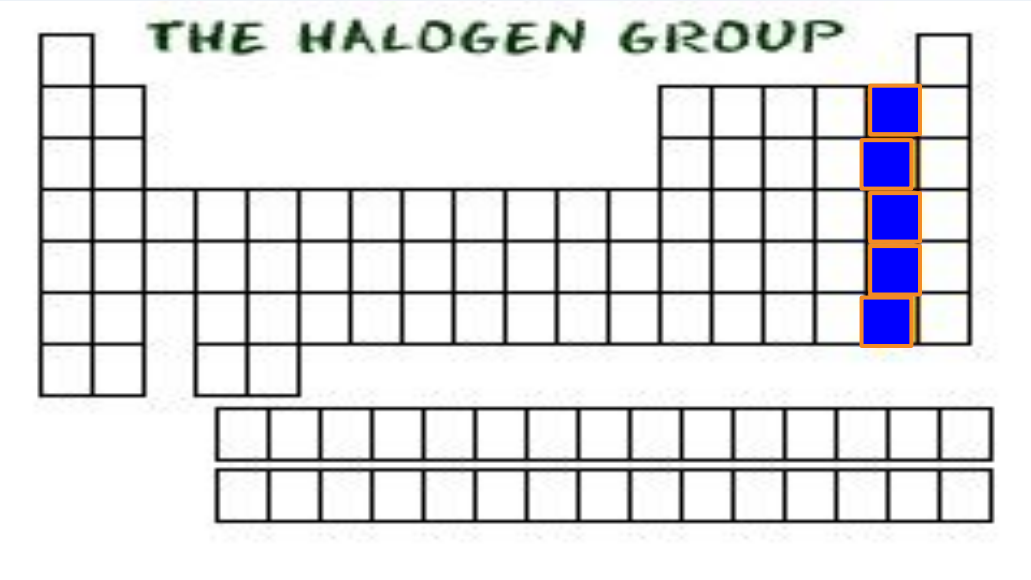


Halogens are in group 7

Properties:

- They have ___ valence electrons
- very reactive!
- they kill stuff! (toxic gases)
- diatomic molecules
- add H? = acid

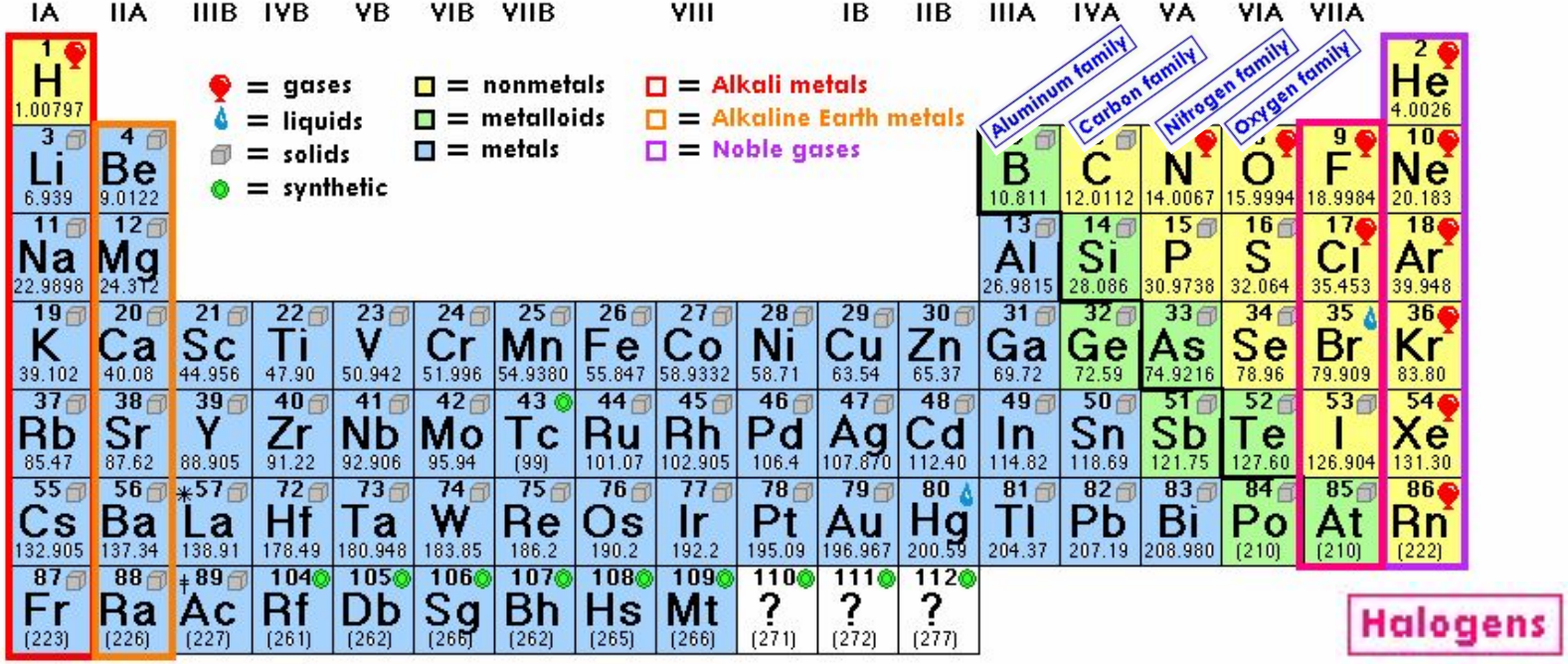
Halogens



Group 17

- Valence Electrons = **7**
- **Very reactive** - often in compounds with group 1
- volatile, diatomic atoms
- NON METALS

PERIODIC CHART OF THE ELEMENTS



Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

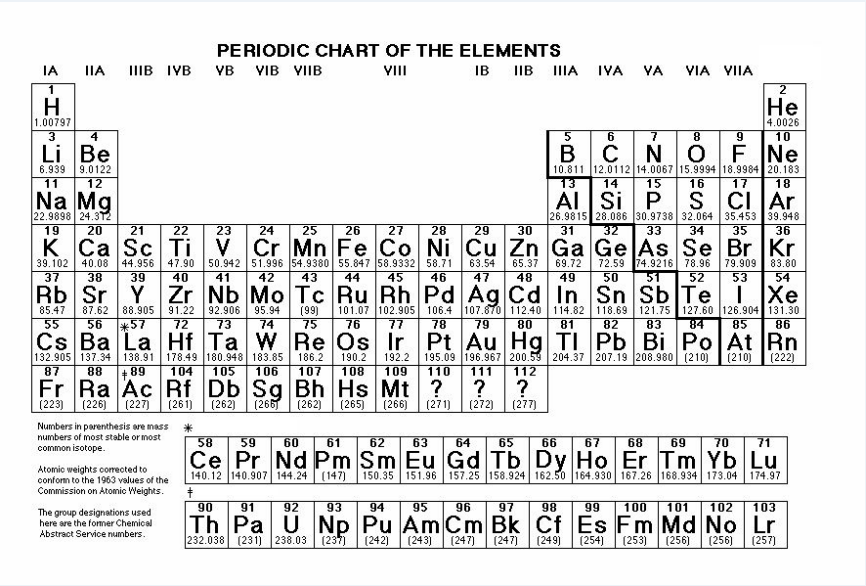
*

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140.12	140.907	144.24	(147)	150.35	151.96	157.25	158.924	162.50	164.930	167.26	168.934	173.04	174.97

‡

90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr
232.038	(231)	238.03	(237)	(242)	(243)	(247)	(247)	(249)	(254)	(253)	(256)	(256)	(257)

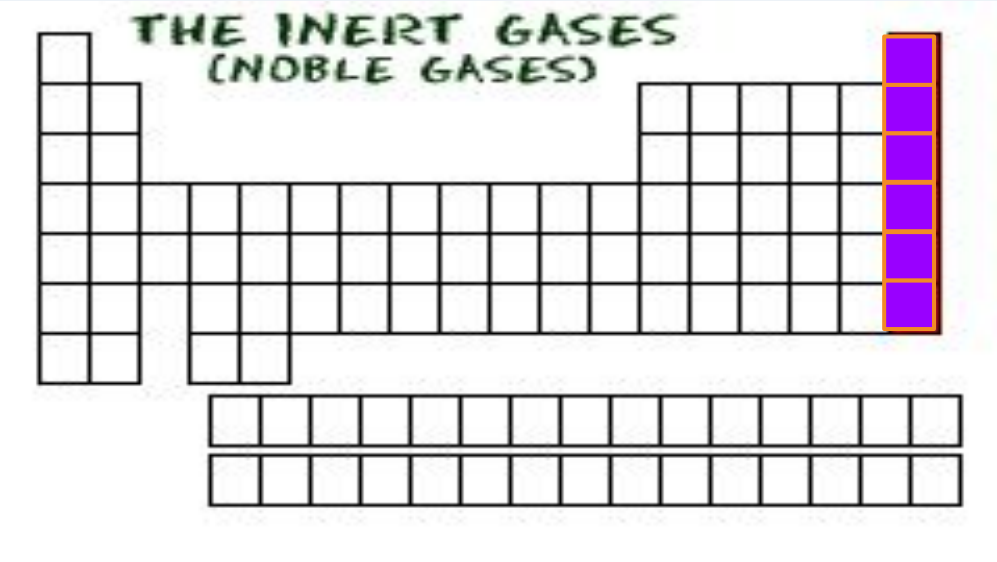
Noble Gases



Noble gases are in group 8
Properties:

- full valence shell- how many electrons??
- previously called “inert gases”

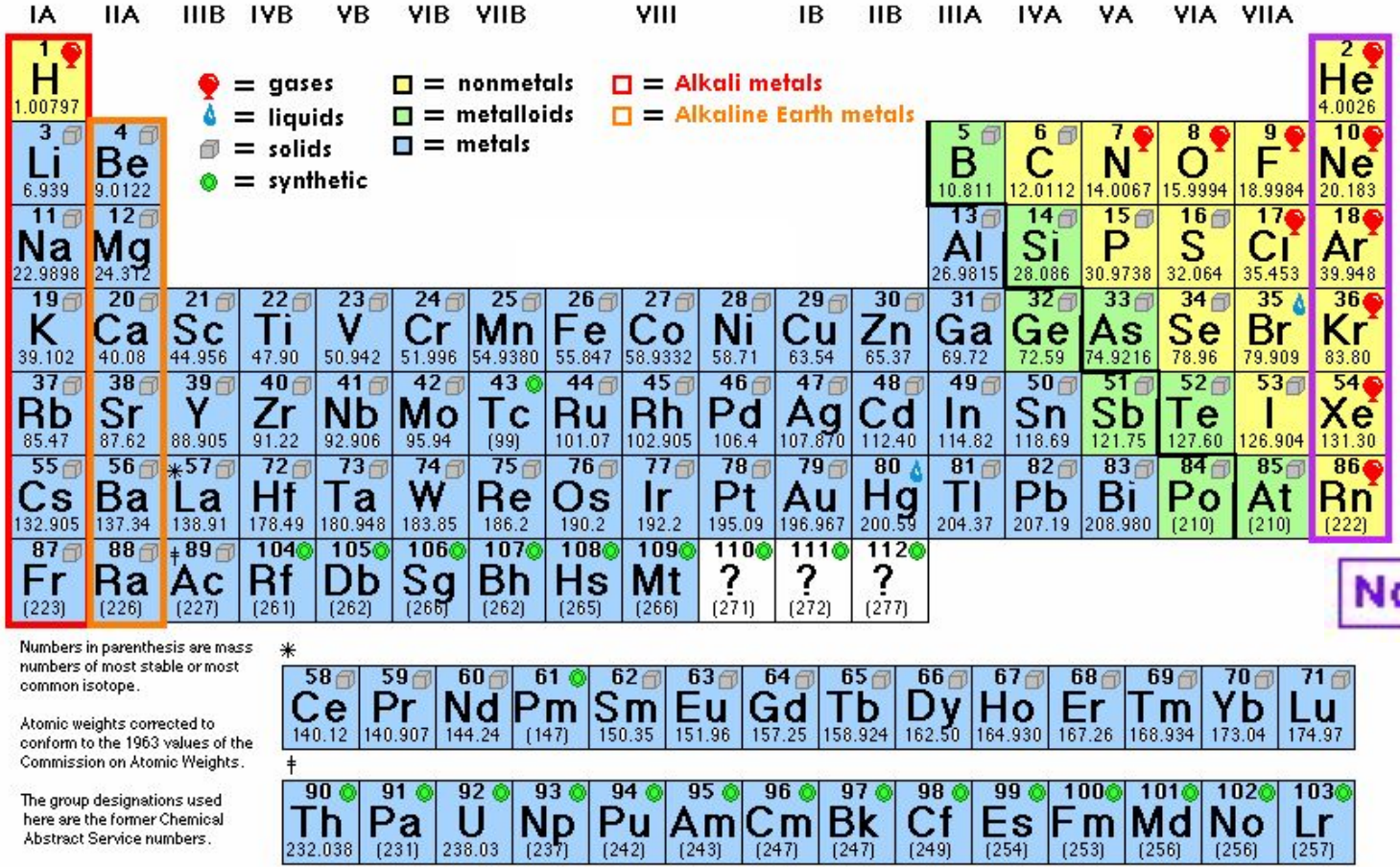
Noble Gases



Group 18

- Valence Electrons - 8 & 2 (He only has 2) - WHY?
- **Not** reactive with other elements
- NON METALS

PERIODIC CHART OF THE ELEMENTS



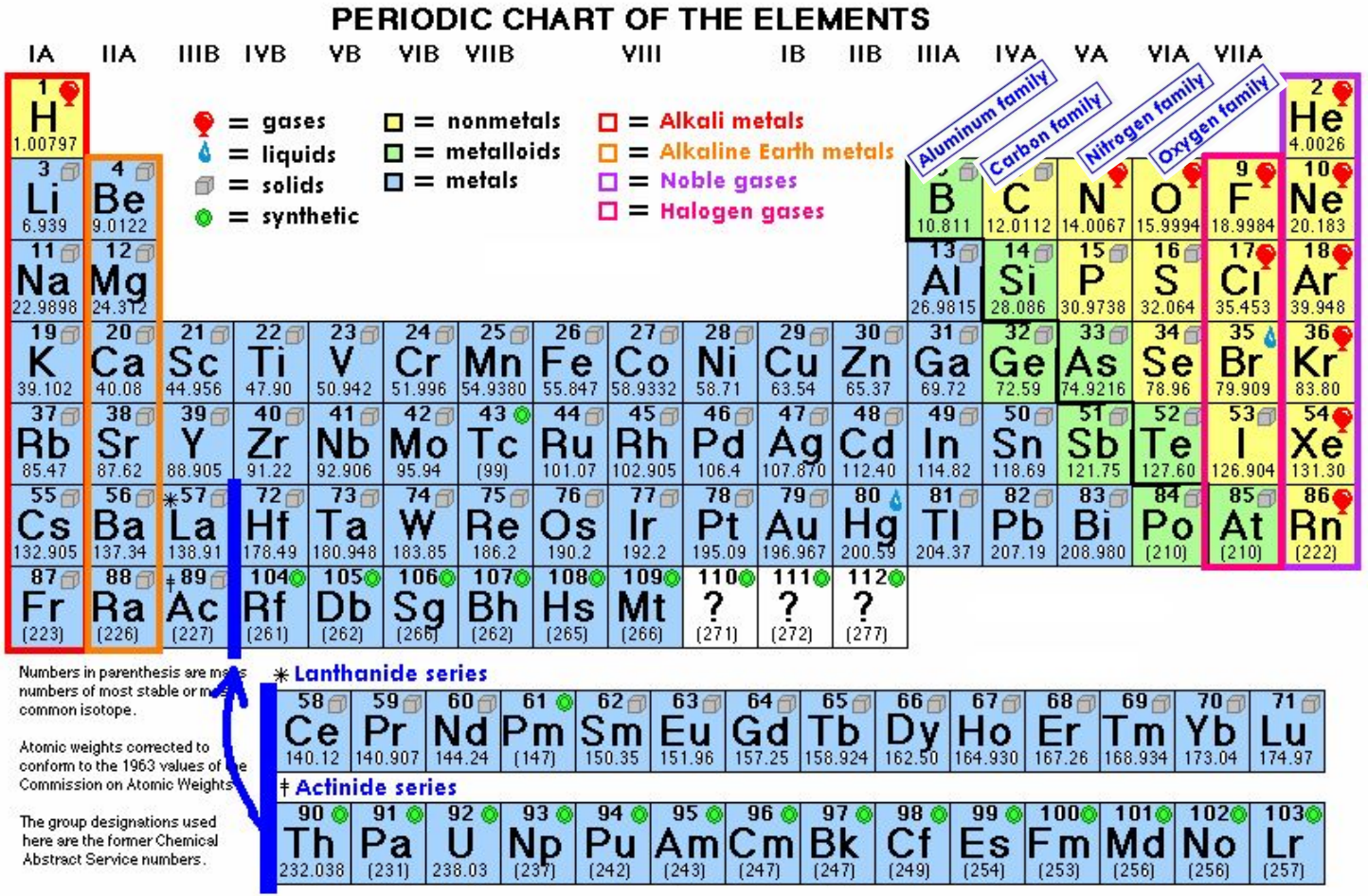
Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

Who are the most reactive???

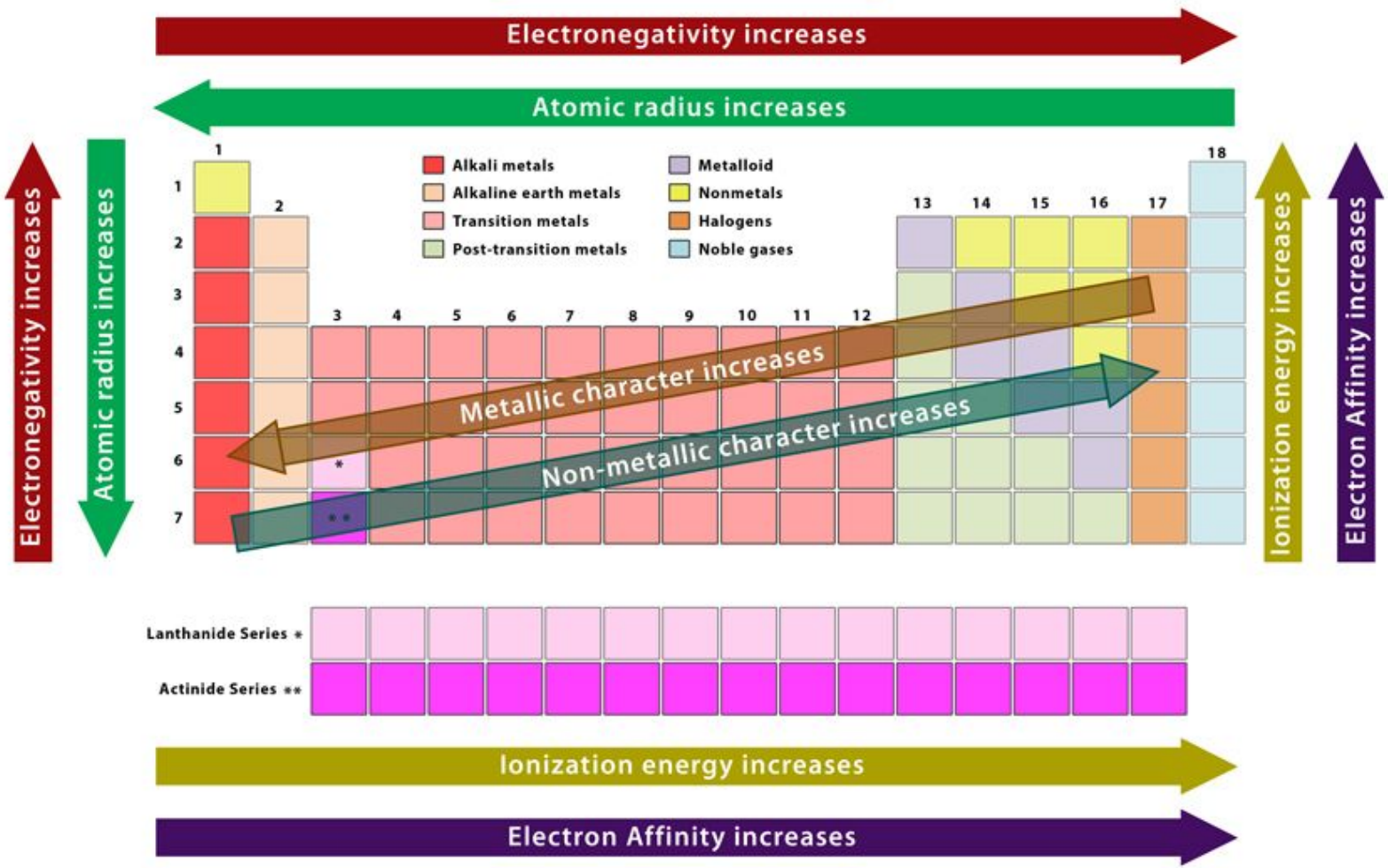
- Which groups on the periodic table were the most reactive?
- Hint: think explosions.


PERIODIC CHART OF THE ELEMENTS
IA IIA IIIB IVB VB VIB VIIB VIII IB IIB IIIA IVA VA VIA VIIA
= gases
= liquids
= solids
= synthetic
= nonmetals
= metalloids
= metals
= Alkali metals
= Alkaline Earth metals
= Noble gases
= Halogen gases
Aluminum family
Carbon family
Nitrogen family
Oxygen family
Numbers in parenthesis are mass numbers of most stable or most common isotope.
Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.
The group designations used here are the former Chemical Abstract Service numbers.
* Lanthanide series
† Actinide series

Trends on the Periodic Table

- Electron affinity – how much an element wants to trap electrons
- Electronegativity- how much an element wants to pull electrons into a covalent bond
- Atomic radius- the size of the atom's radius
    - Ionic radius
- First ionization energy- the energy required (kJ/mol) to remove the LAST electron from an element's valence shell

Periodic Trends





End of Part 1





Notice	Wonder



Make observations about what is happening in the video.

- What do you see?
- What do you wonder?

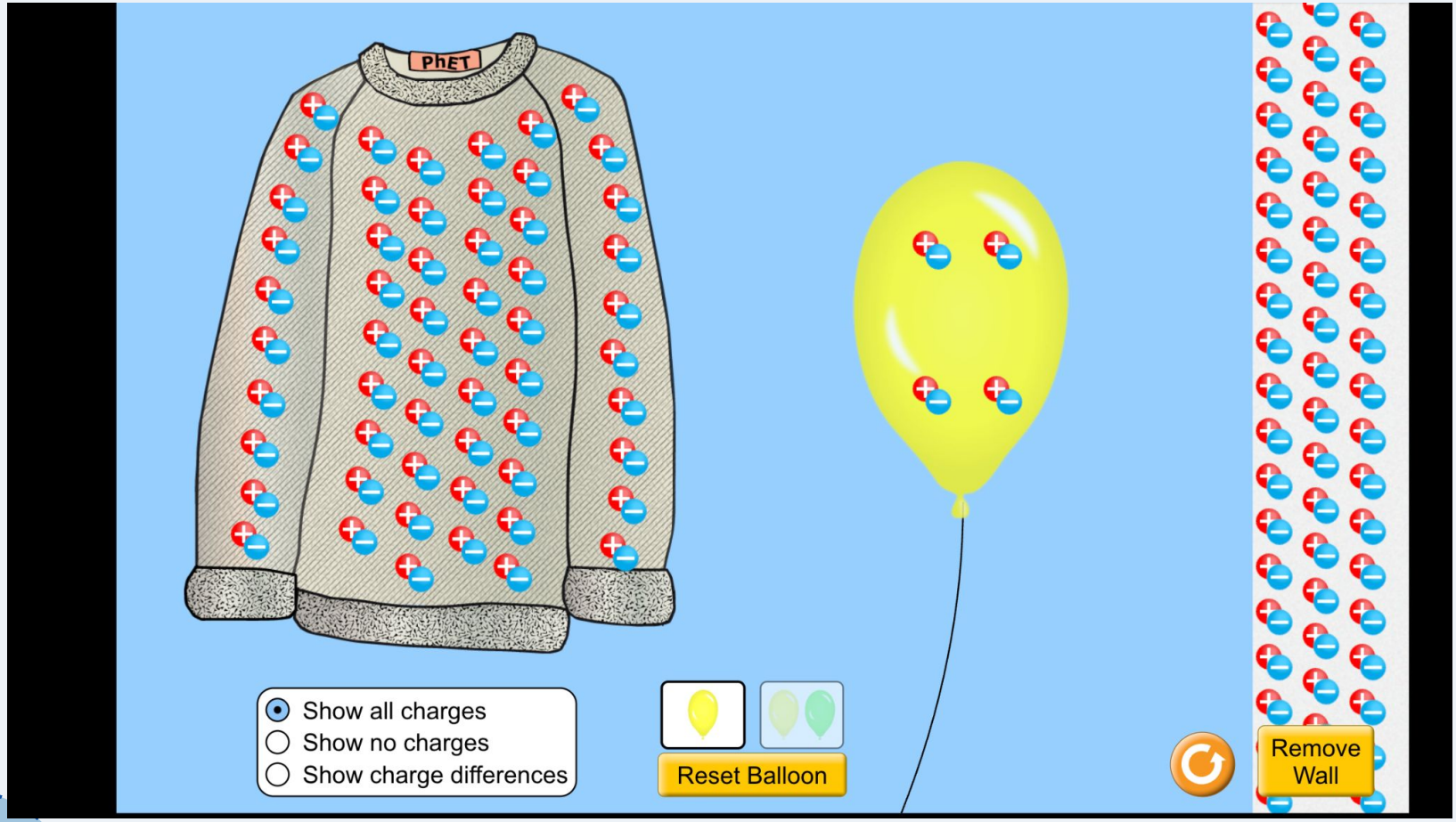
Pause and Talk

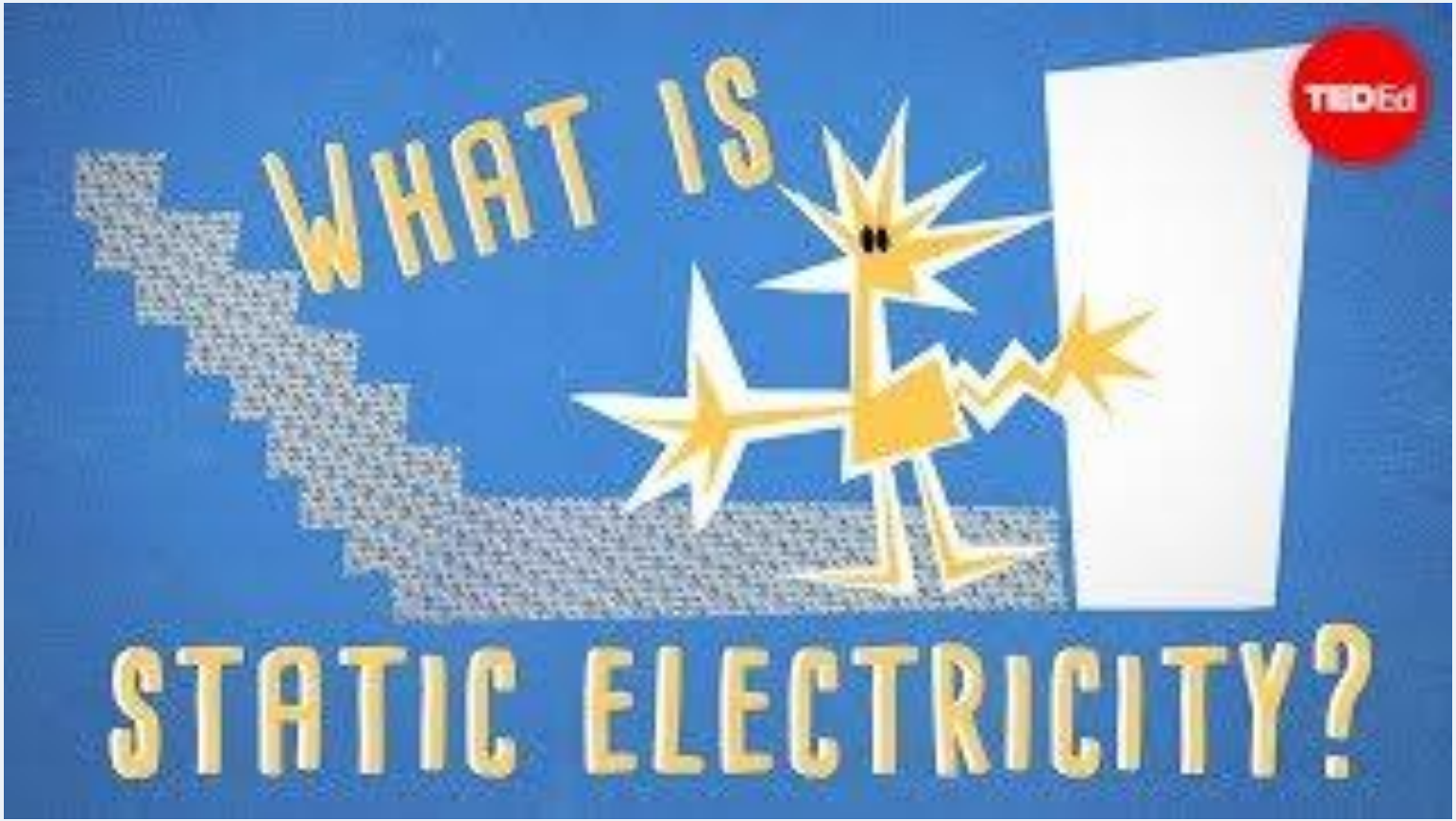




Let’s try it!

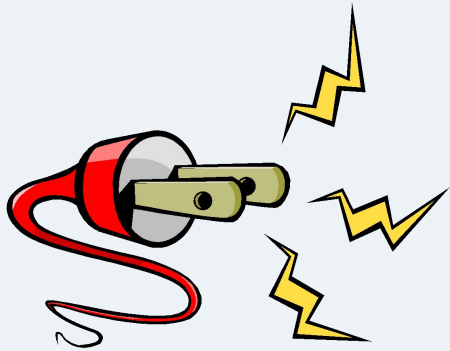


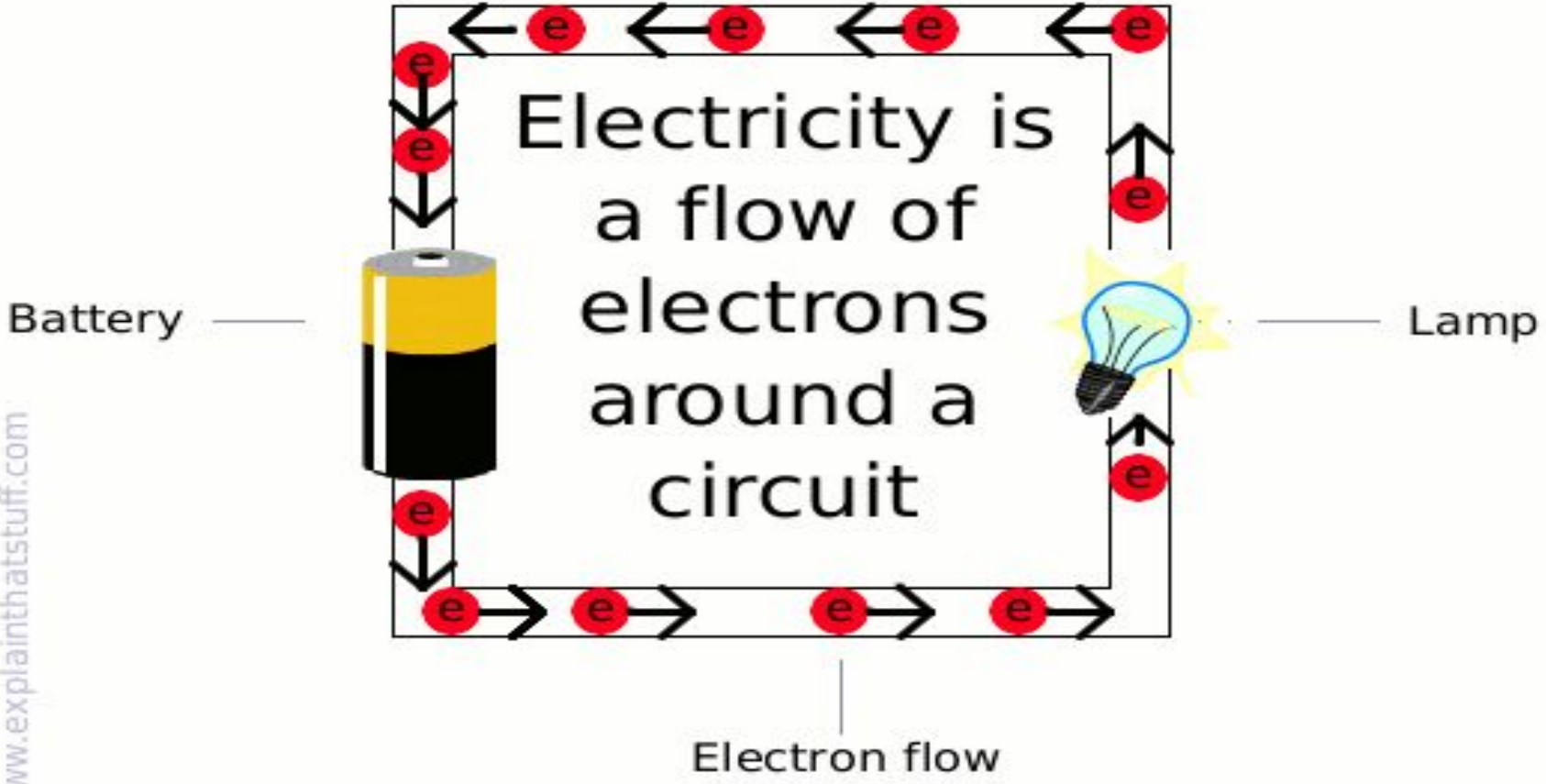

PhET
Show all charges
Show no charges
Show charge differences
Reset Balloon
Remove Wall


WHAT IS
TEDEd
STATIC ELECTRICITY?

Electric Charge: Objects become positively charged when they lose electrons and negatively charged when they gain electrons; objects with like charges repel and objects with opposite charges attract

Electricity: the presence and/or flow of electric charges

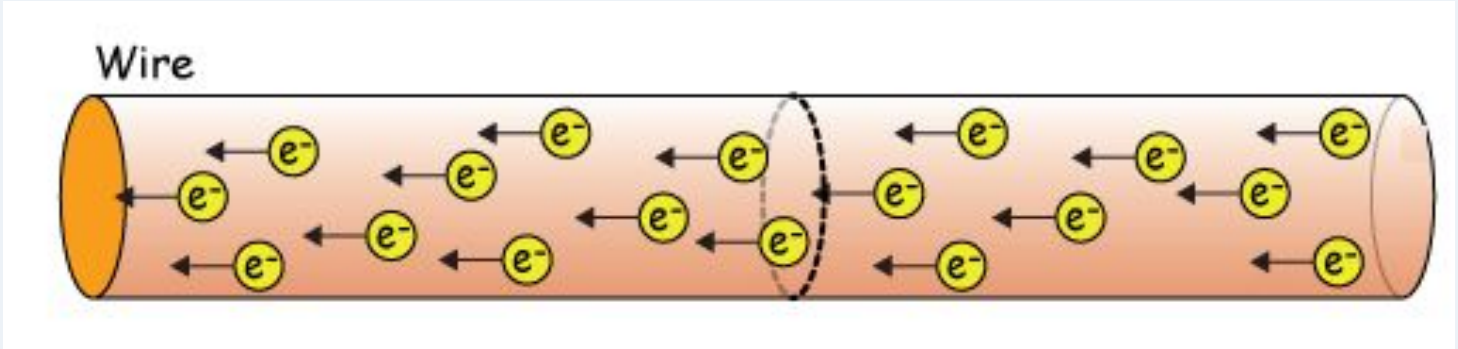




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All matter is composed of positive and negative particles.

The flow of charged particles is an electric current.



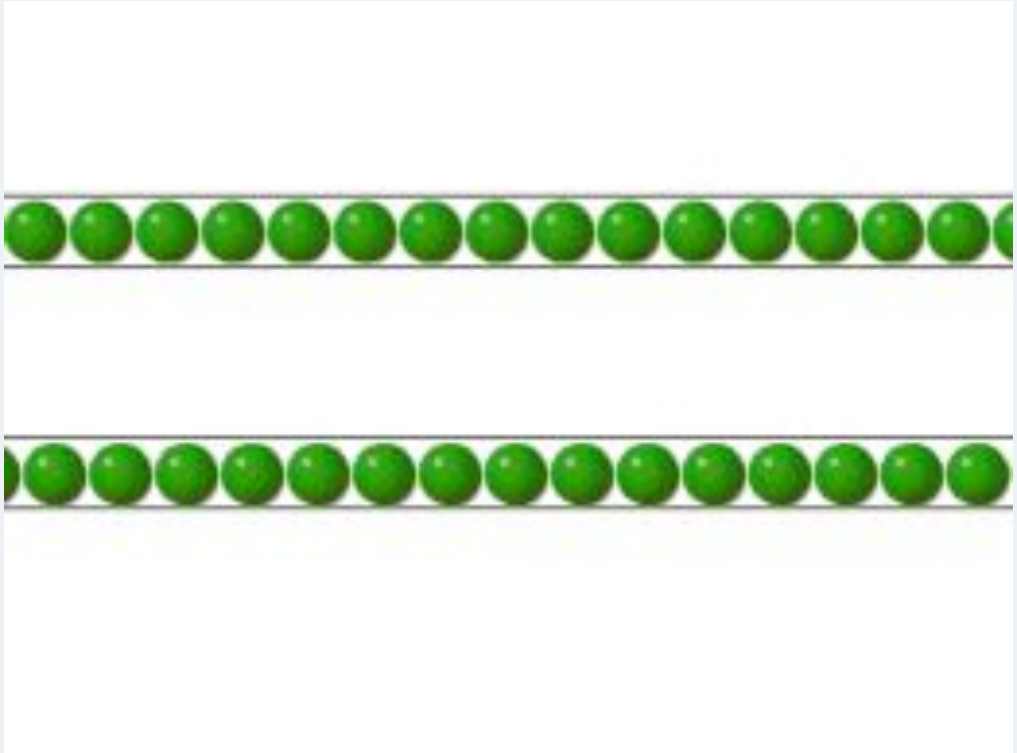
When you watch TV, use a computer, or even turn on a light, you depend on moving charges for the electrical energy that you need.





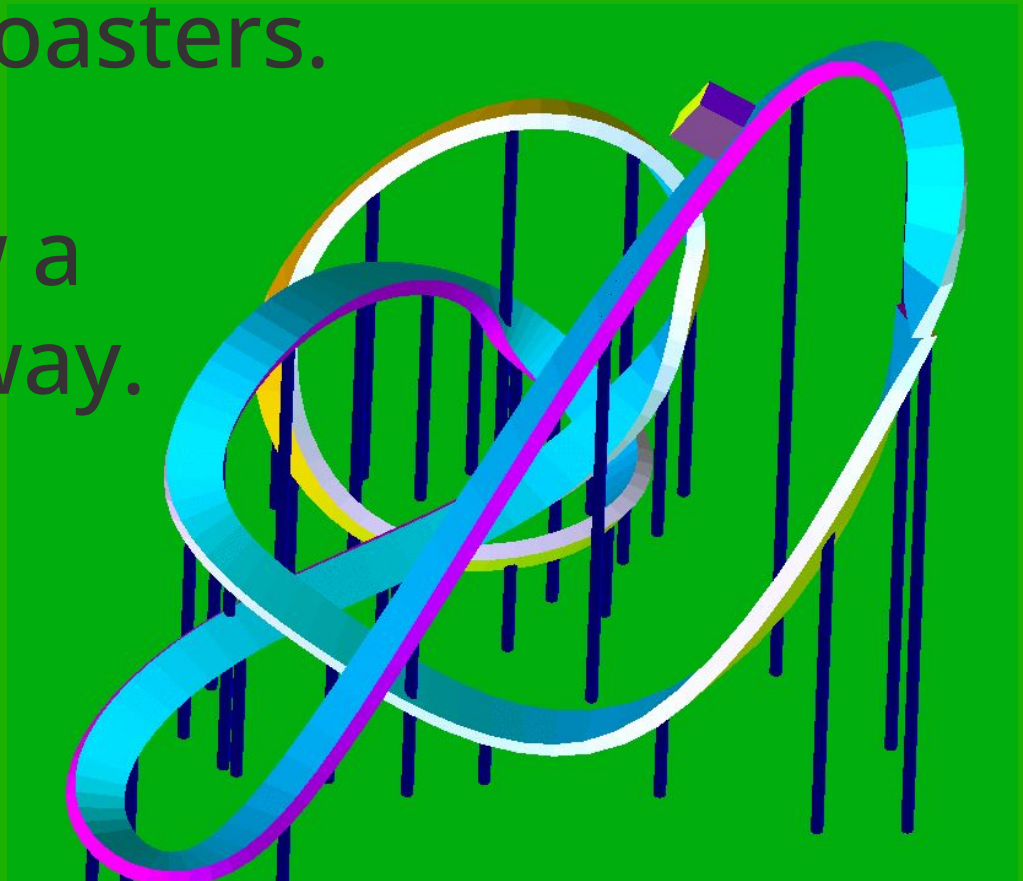


Higher Current = Faster Moving Electric Charges (Electrons)



Electric Currents are like roller coasters.

They follow a fixed pathway.



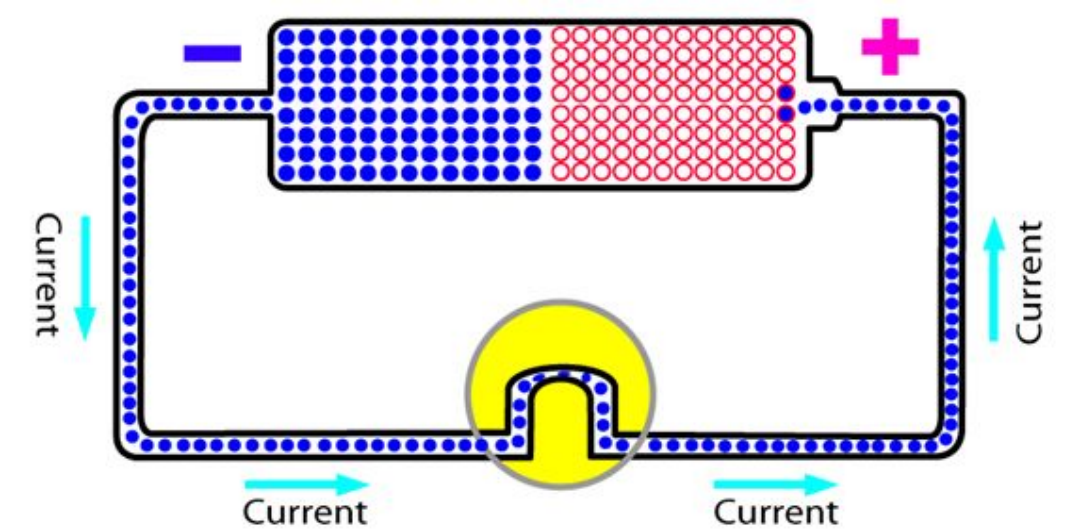
Electric Circuits

- **Circuits** control the movement of electric current by providing paths for electrons to follow.

- The path of an electric circuit is a **closed loop**.

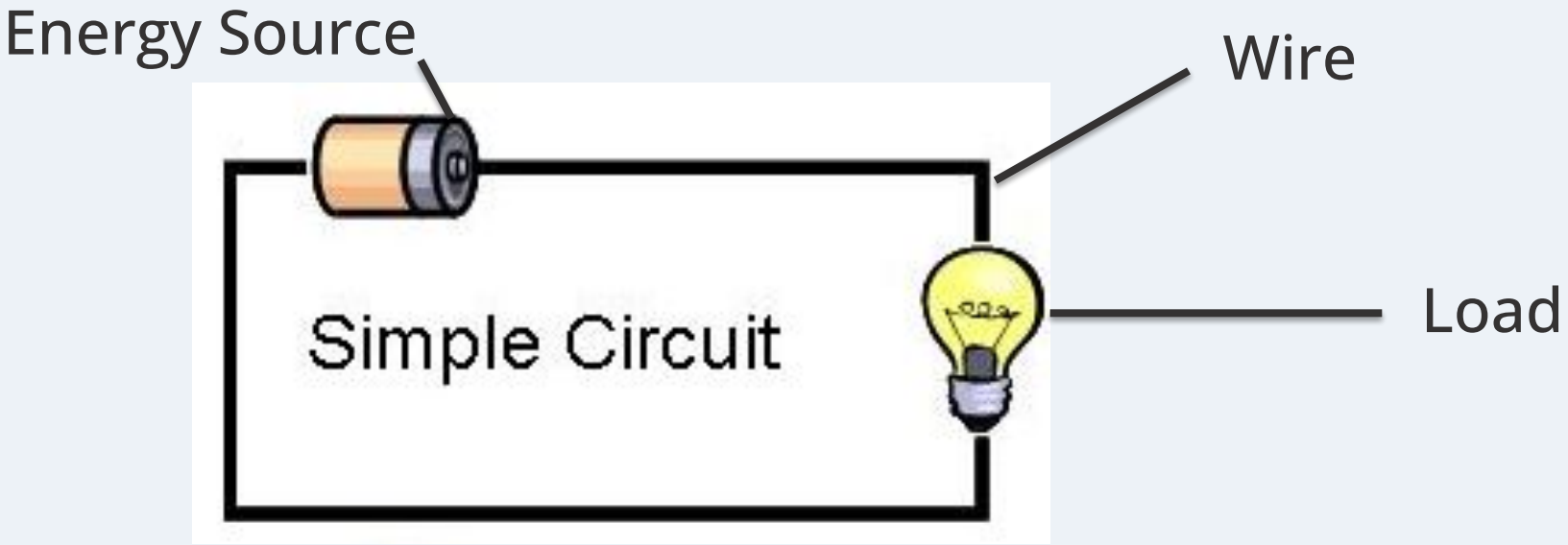
Electric Circuits

An electric circuit allows electrons to flow from a negative pole (excess electrons) to a positive pole (deficient in electrons)



Electric Circuits

All circuits need three basic parts: an energy source, wires, and the object that is going to change the electrical energy into another form of energy (load).



Load Examples

Changes electrical energy to other forms of energy



Light Bulb

Car





Speaker



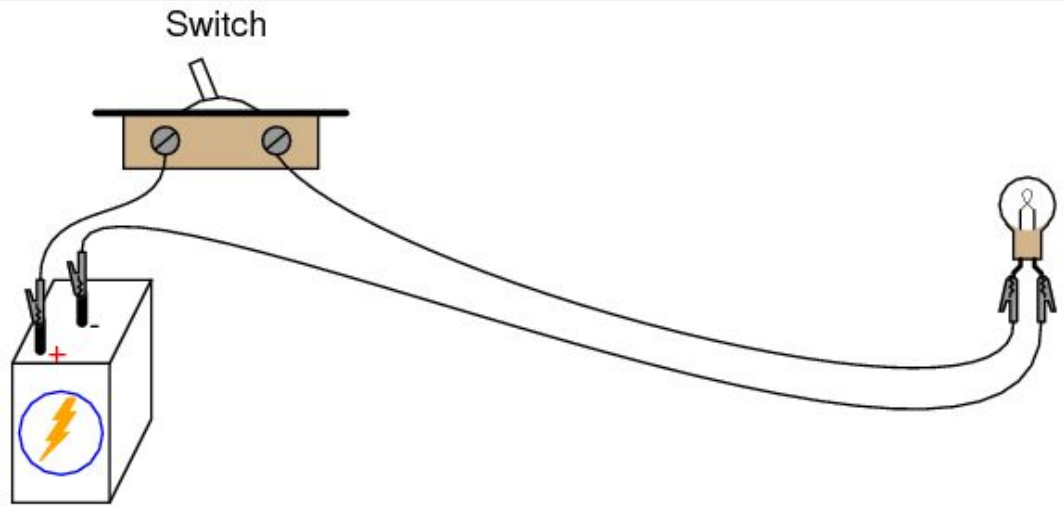
Fan



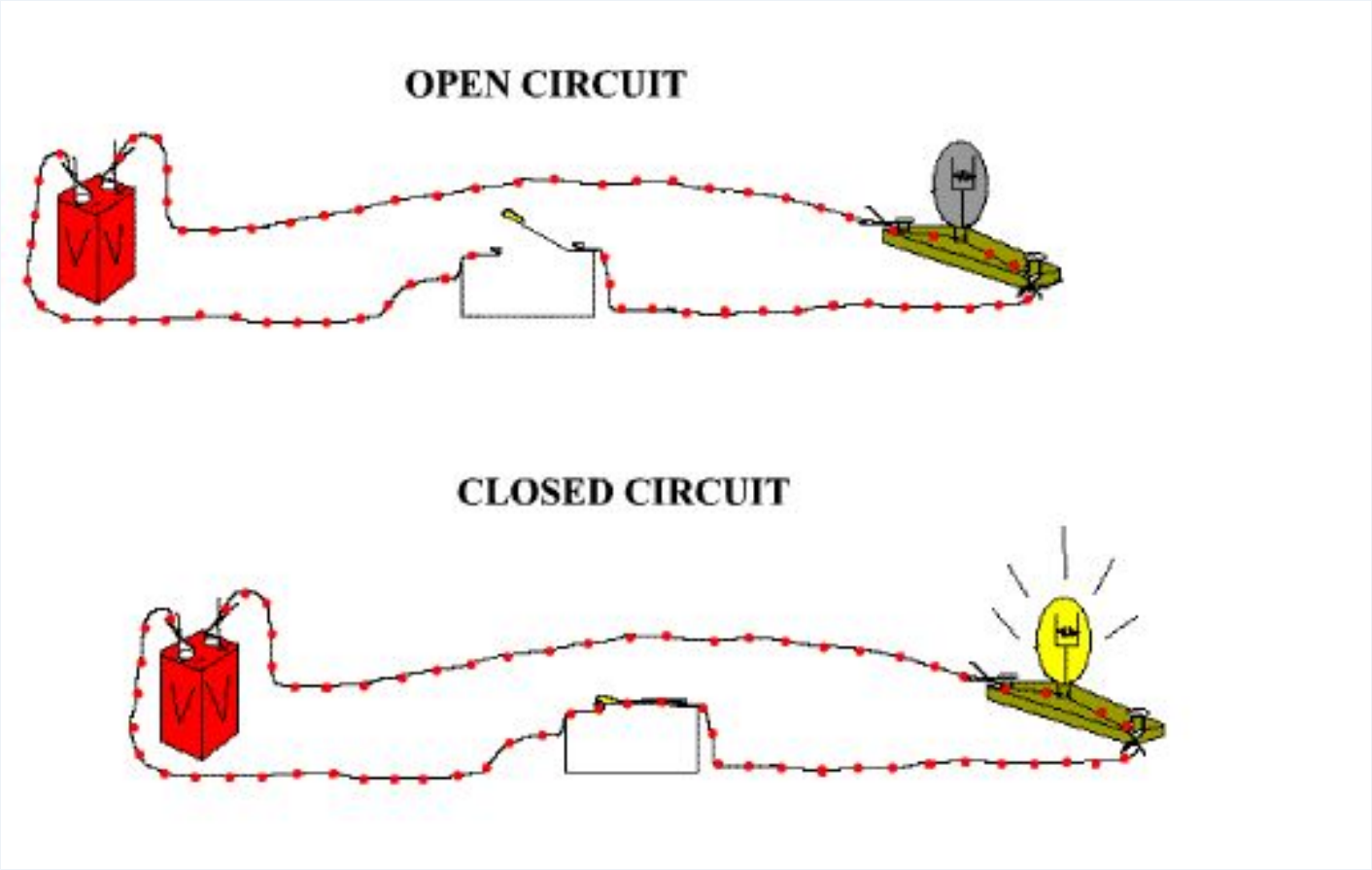
Toaster

Electric Circuits

Sometimes a circuit also contains a switch that is used to open and close a circuit.

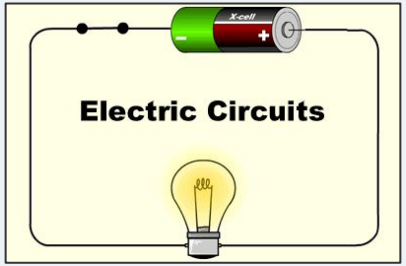


Electric Circuits



Connections in a Circuit

- Electrons flow from negative to positive; therefore, a complete circuit must have wires that connect the negative pole of the energy source to the positive pole of the energy source.
- The circuit is established when there is a continuous path for electricity to travel from one end of the energy source to the other end.

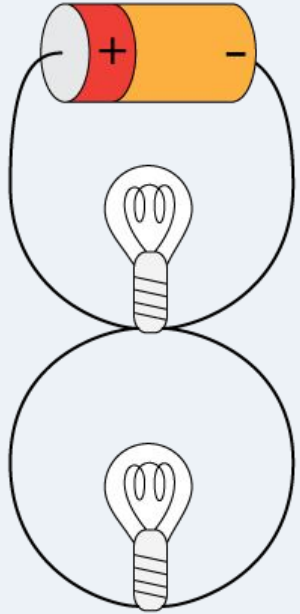


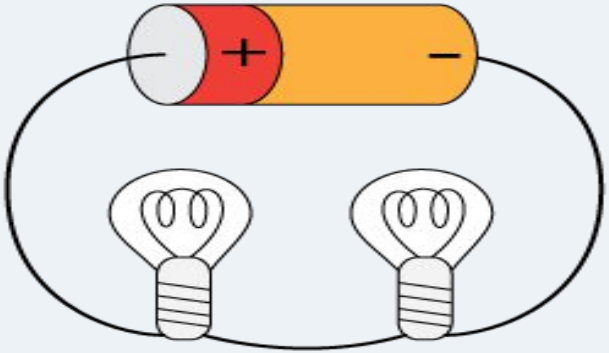
Electric Circuits

- With a partner, look around the room and identify all of the objects that use electrical energy.
- All of the things you counted are loads in a large circuit. Most circuits have more than one load.

Different Types of Circuits

- Circuits are distinguished based on the way on which loads are connected.
- With a partner, discuss the differences in which the electric current will travel.

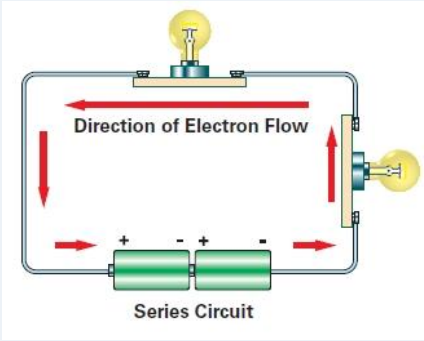


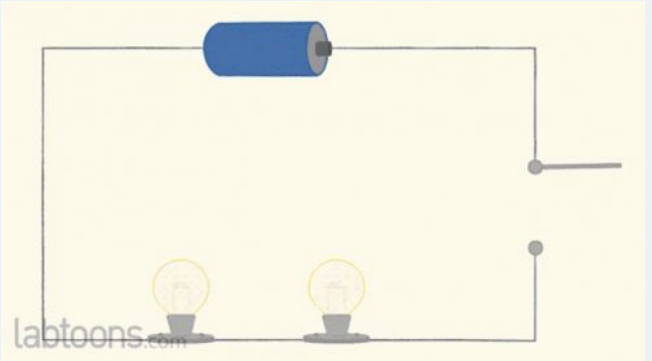


Series Circuit

In a **Series Circuit** there is only **one path** for the electric current or electricity to flow.

- **All** of the **loads** in a **series circuit** share the **same current.**
- If there is any **break** in the circuit, the charges will **stop flowing.**

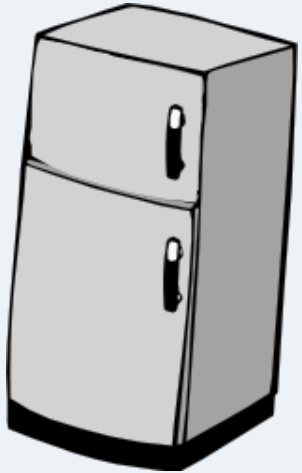




Series Circuit

Imagine if your refrigerator and a lamp were in a series circuit together. Your refrigerator would run only when the lamp was on. And when the bulb burns out, the refrigerator would stop working.





Series Circuit

There are some cases when a series circuit is useful. For example, series circuits are useful in wiring burglar alarms. Why?

If any part of the circuit in a burglar alarm fails, there will be no current in the system. The lack of current signals that a problem exists, and the alarm will sound.

Can you think of any other examples?

Imagine that your house is wired in a series circuit.

What would have to happen if you wanted to watch TV?



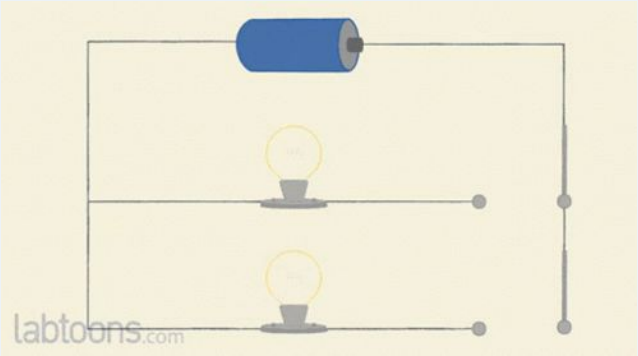
You would have to turn on other appliances in order to watch TV.

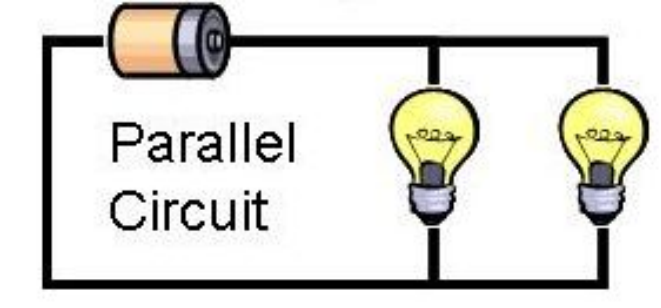
Circuits in buildings are wired in Parallel.

Parallel Circuit

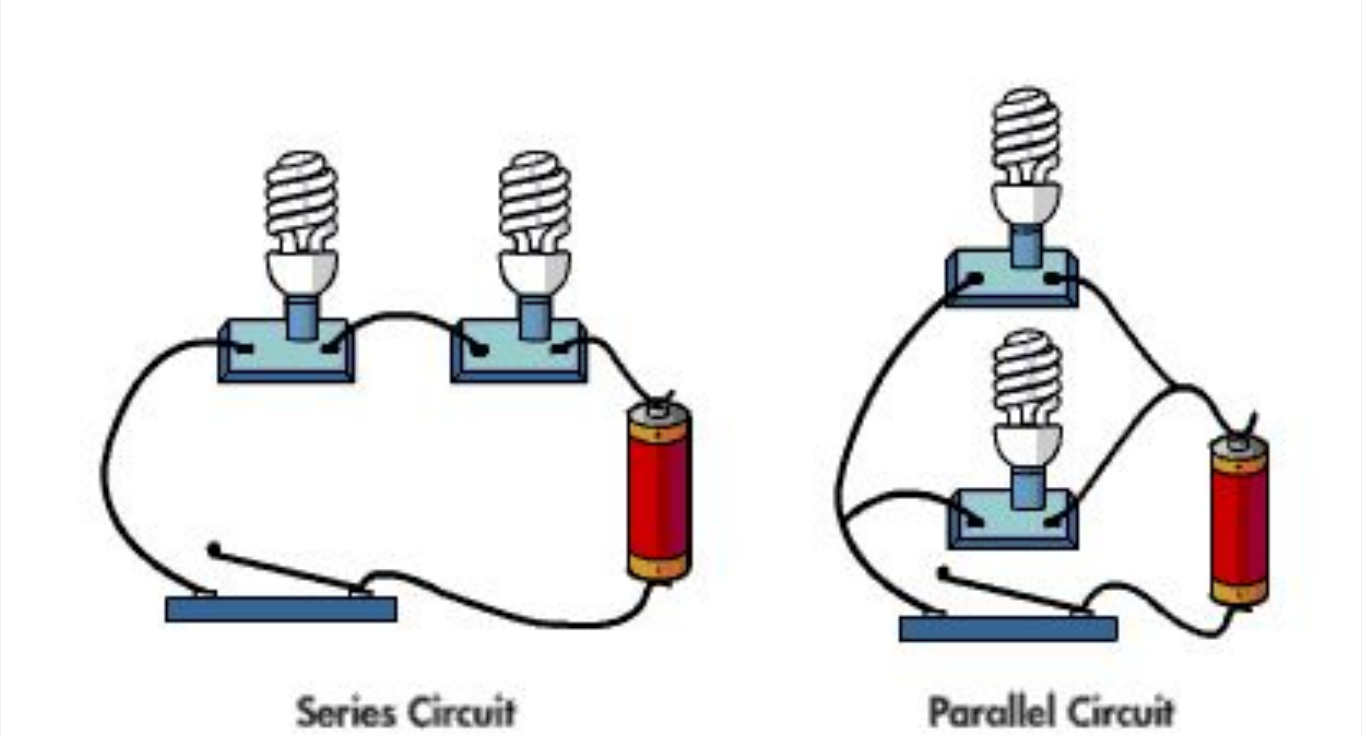
In a **Parallel Circuit** there is **more than one path** for the electric current or electricity to flow.

- The electric current **branches** so that electrons flow through **each of the paths**
- If one path is **broken**, electrons **continue** to flow to the **other paths.**





Comparing Series & Parallel



Comparing Series & Parallel

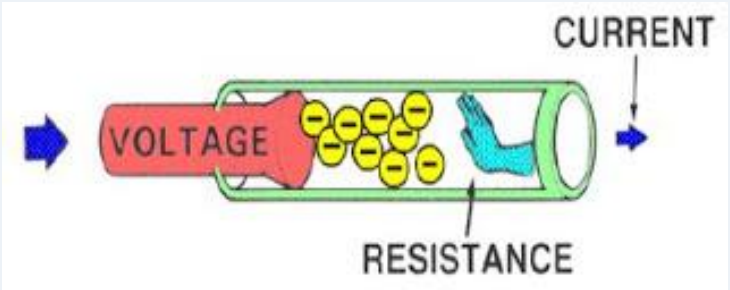
What are the advantages of using a parallel circuit to a series circuit?

The load in a parallel circuit will still work if one of the loads is broken or missing. You can use one load at a time, even it another load fails.

Comparing Series & Parallel

In a Series circuit, the current has to travel through each bulb; therefore, adding more light bulbs makes each bulb **dimmer** because the **resistance** of the whole circuit has **increased.**

Resistance is how difficult it is for electrons to flow through a material (friction).



Comparing Series & Parallel

Another advantage of a Parallel circuit is that you can connect loads that need different currents to the same parallel circuit.

For example, you can connect a hair dryer, which needs a high current to run, to the same circuit as a lamp, which needs less current to run.

Recall that an **electrical conductor** is a material in which charges can **move easily (electrons flow freely)**.

An **electrical insulator** is a material in which charges **cannot move easily (their electrons cannot flow freely).**

Ohm's Law

Pumped Up Circuits Song

$$I=V/R$$

Current = (I)

Voltage = (V)

Resistance = (R)

You can also write the equation as:

$$V=IR$$

$$R=V/I$$



Thanks!



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