Unit 4 The Periodic Table

Periodic Table History

Periodic Table History

1817 – Döbereiner

Grouped elements in

TRIADS

Three elements with similar properties

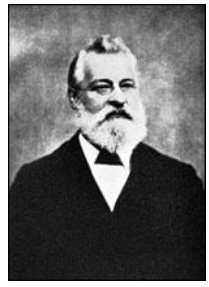
Alkali formers		Salt formers	
Li	7	Cl	35.5
Na	23	Br	80
K	39	I	127

Periodic Table History

1865 – Newlands

Law of Octaves

Similar properties every EIGHT elements



Newlands' Octaves

H	Li	Ga	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co,Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce,La	Zr	Di,Mo	Ro,Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba,V	Ta	W	Nb	Au
Pt,Ir	Tl	Pb	Th	Hg	Bi	Os

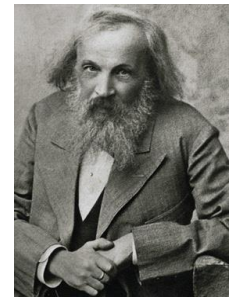
Periodic Table History

1870 – Mendeleev

8 Column table based on

ATOMIC MASS

Elements with similar properties were in the same column



Mendeleev Table

	Gruppe I. R^1O	Gruppe II. RO	Gruppe III. R^2O^3	Gruppe IV. RH^4 RO^2	Gruppe V. RH^3 R^2O^5	Gruppe VI. RH^2 RO^3	Gruppe VII. RH R^2O^7	Gruppe VIII. — RO^4
1	H = 1							
2	Li = 7	Be = 9,4	B = 11	C = 12	N = 14	O = 16	F = 19	
3	N = 23	Mg = 24	Al = 27,3	Si = 28	P = 31	S = 32	Cl = 35,5	
4	K = 39	Ca = 40	— = 44	Ti = 48	V = 51	Cr = 52	Mn = 55	Fe = 56 Co = 59 Ni = 60, Cu = 63.
5	(Cu = 63)	Zn = 65	— = 68	— = 72	As = 75	Se = 78	Br = 80	
6	Rb = 85	Sr = 87	?Yt = 88	Zr = 90	Nb = 94	Mo = 56	— = 100	Ru = 104, Rh = 104, Pd = 106, Ag = 104.
7	(Ag = 104)	Cd = 112	In = 113	Sn = 118	Sb = 122	Te = 125	J = 127	
8	Cs = 133	Ba = 137	?Di = 138	?Ce = 140	—	—	—	— — — —
9	)—)	—	—	—	—	—		
10	—	—	?Er = 178	?La = 180	Ta = 182	W - 184	—	Os = 195, Ir = 197, Pt = 198, Au = 199.
11	(Au = 199)	Hg = 200	Tl = 204	Pb = 207	Bi = 208		—	
12	—	—	—	Th = 231	—	U = 240	—	— — — —

https://www.youtube.com/watch?v=kuQ0Um4Wcz0

Periodic Table History

1913 – **Moseley**

Arranged elements based on

ATOMIC NUMBER

PERIODIC LAW:

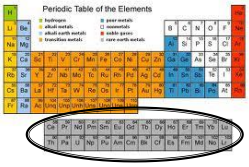
The properties of the elements recur periodically as their atomic numbers increase

Henry Gwyn Jeffreys Moseley

Periodic Table History

1944 – **Seaborg**

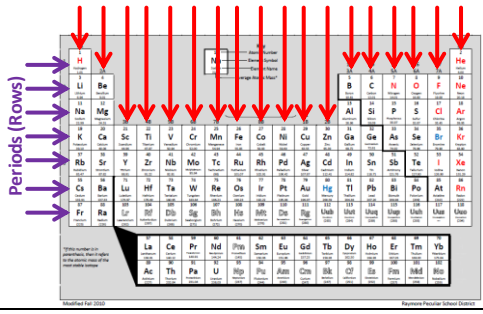
Last rearrangement of the periodic table – created the actinide series (**f-block**)



Unit 4 The Periodic Table

Modern Periodic Table

Groups vs. Periods



Group Names

Group **A** Main Group Elements (s-block and p-block)
Group **B** Transition Elements.

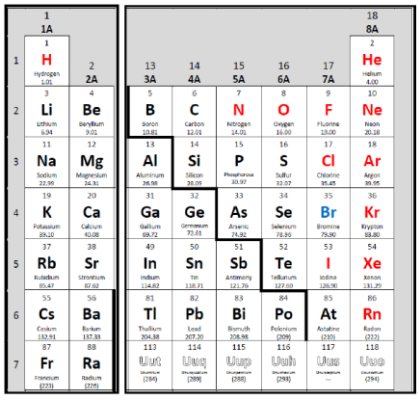
1A Alkali Metals (H, Li, Na, K, Rb, Cs, Fr)

2A Alkaline Earth Metals (Be, Mg, Ca, Sr, Ba, Ra)

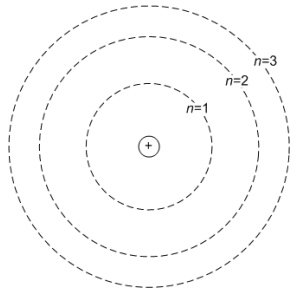
3 – 12 **Group B** **Transition Metals**

7A Halogens (F, Cl, Br, I, At)

8A Noble Gases (He, Ne, Ar, Kr, Xe, Rn)



Valence Electrons



VALENCE ELECTRONS

Electrons in the *OUTERMOST SHELL*

Highest Energy Level

(n = 1, 2, 3…)

Highest Energy Level

Group 1 (1A): Alkali Metals

Lithium (3e-)	$1s^2\ \mathbf{2s^1}$
Sodium (11e-)	$1s^2\ 2s^2\ 2p^6\ \mathbf{3s^1}$
Potassium (19e-)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \mathbf{4s^1}$

Group 2 (2A): Alkaline Earth Metals

Beryllium (4e-)	$1s^2\ \mathbf{2s^2}$
Magnesium (12e-)	$1s^2\ 2s^2\ 2p^6\ \mathbf{3s^2}$
Calcium (20e-)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \mathbf{4s^2}$

Highest Energy Level

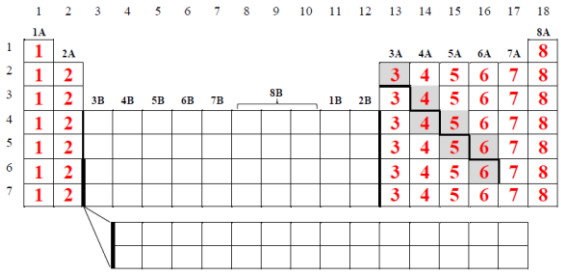
Group 17 (7A): Halogens

Fluorine (9e-)	$1s^2\ \mathbf{2s^2\ 2p^5}$
Chlorine (17e-)	$1s^2\ 2s^2\ 2p^6\ \mathbf{3s^2\ 3p^5}$
Bromine (35e-)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \mathbf{4s^2}\ 3d^{10}\ \mathbf{4p^5}$

Group 18 (8A): Noble Gases

Neon (10e-)	$1s^2\ \mathbf{2s^2\ 2p^6}$
Argon (18e-)	$1s^2\ 2s^2\ \mathbf{3s^2\ 3p^6}$
Krypton (36e-)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \mathbf{4s^2}\ 3d^{10}\ \mathbf{4p^6}$

Modern Periodic Table



Modern Periodic Table

OCTET RULE

8 valence electrons make the atom **UNREACTIVE**.

Unreactive = Very Stable

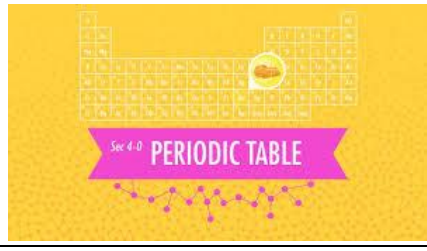
Atoms react with other atoms to fill their octet.

1. Gain electrons. } Ionic Bonding
2. Lose electrons. }
3. Share electrons. } Covalent Bonding

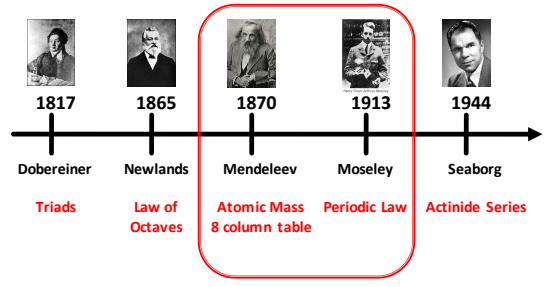
Crash Course Chemistry

The Periodic Table

https://www.youtube.com/watch?v=0RRVV4Diomg



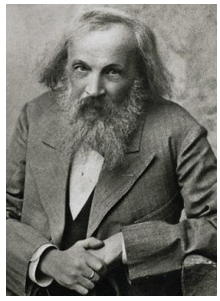
Periodic Table Timeline



Mendeleev Song

http://www.youtube.com/watch?v=kuQ0Um4Wcz0

http://www.youtube.com/watch?v=sm1uxjGm_N0



Mendeleev Lab of 1869

1. Empty the contents of the envelope.
2. Separate out the **UNKNOWN** elements.
3. Organize the elements into an 8-column table.
4. Insert the **UNKNOWN** elements based on common characteristics.
5. Identify the **UNKNOWN** elements

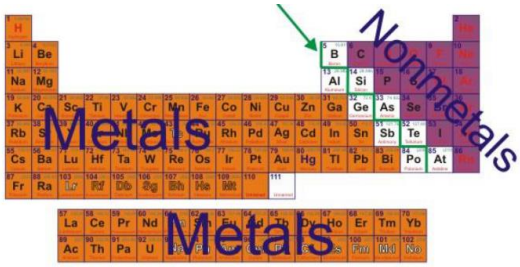
Mendeleev Lab of 1869

							He
Li	Be	B	C	N	O		Ne
Na		Al	Si	P		Cl	Ar
K	Ca	Ga		As	Se	Br	
	Sr	In	Sn		Te	I	Xe
Cs	Ba						

Unit 4 The Periodic Table

Groups vs. Periods
Metals vs. Nonmetals

Metals and Nonmetals



Metals and Nonmetals

METALS	NONMETALS
Typically Solids (Malleable and Ductile)	Gasses or BRITTLE solids
Shiny	Dull
Conductors (Heat and Electricity)	Insulators (Heat and Electricity)
LOSE valence electrons to fill octet	**GAIN** valence electrons to fill octet

Metals and Nonmetals

Metals
3 or fewer
VALENCE electrons

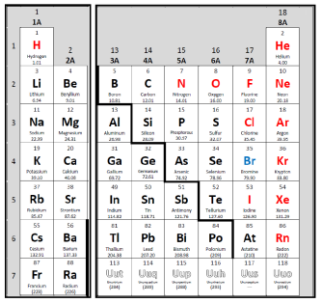
Nonmetals
5 or more
VALENCE electrons

Metalloids
Properties of both metals and nonmetals
Semiconductors
(B, Si, Ge, As, Sb, Te, Po)

Unit 4 The Periodic Table

Periodic Trends

Periodic Trends



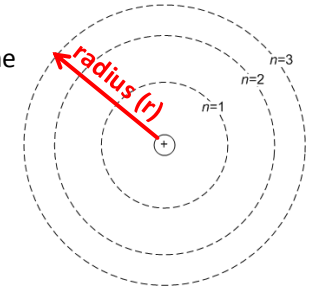
PREDICTABLE changes in a particular direction

(Focus on Main Group Elements)

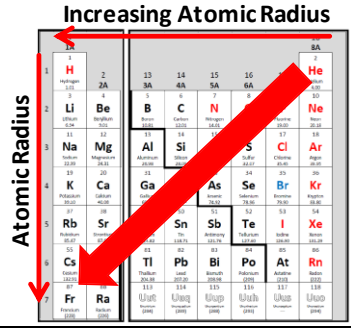
Trend 1 Atomic Radius

The distance from the **nucleus** to the **valence shell**

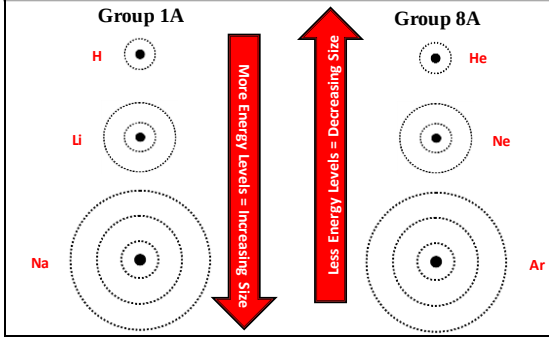
SIMPLY PUT
Atom SIZE



Trend 1 Atomic Radius



Trend 1 Atomic Radius



Trend 1 Atomic Radius

More Protons = Stronger Pull = Smaller Atom

Carbon: 6 protons | Nitrogen: 7 protons | Oxygen: 8 protons

Period 2

Less Protons = Weaker Pull = Larger Atom

Increasing Atomic Radius

DOWN THE GROUP

New shells are being added.

Valence electrons have are **farther away** from the nucleus…

This **increases the distance** between the valence shell and nucleus.

ACROSS (R – L) THE PERIOD

Electrons in the same shell but the # protons decrease.

This decreases the positive pull on the **electrons**.

Allowing the electrons to slightly drift away from the nucleus.

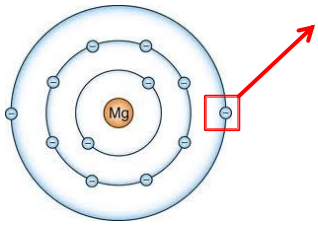
Trend 2 Ionization Energy

The **energy** needed to remove an electron from the valence (outermost) shell.

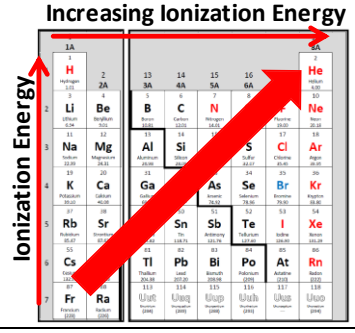
Group 2A

12
Mg
Magnesium
24.31

Alkaline Earth



Trend 2 Ionization Energy ……



Increasing Ionization Energy

UP THE GROUP

Shells are being taken away.

Shells are closer to the **nucleus** …

Increasing the amount of energy needed to **remove** an electron.

ACROSS (L – R) THE PERIOD

Electrons in the same shell but the # protons increase.

This increases the positive pull on the **electrons** …

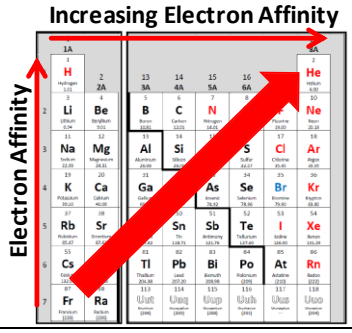
This increases the amount of energy needed to **remove** an electron.

Trend 3 Electron Affinity

Affinity = An Attraction or "Liking"

The ability to **ATTRACT** and **HOLD** an electron.

Trend 3 Electron Affinity



Increasing Electron Affinity

UP THE GROUP

Shells are being taken away.

Shells are closer to the **nucleus** increasing the force of attraction…

This increases the amount of energy released when an electron is **added**.

ACROSS (L – R) THE PERIOD

Electrons increase in the shells.

Nonmetals tend to gain electrons to fill octet.

Whereas…

Metals tend to lose electrons to fill octet.