

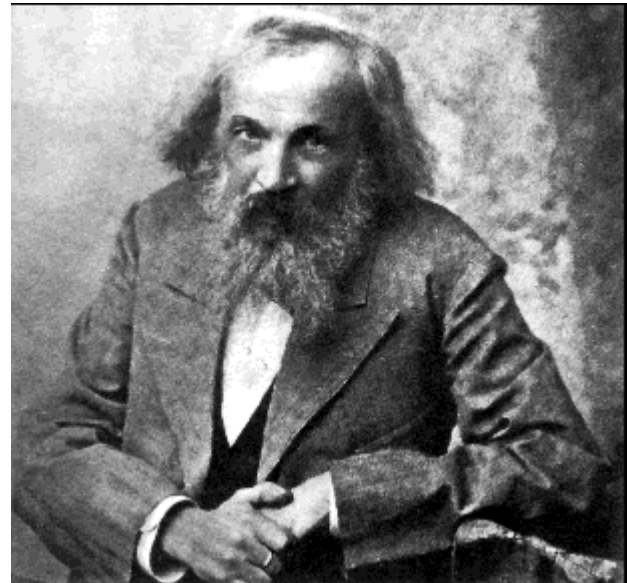
Periodic Table Notes (PTE)

Essential questions:

- How is the PTE arranged?
- Where are metals, nonmetals and semi metals on the PTE?
- What are the properties of metals, nonmetals and semimetals?
- What are the properties of elements in each family?

Mendeleev

- Russian Chemist who looked for patterns of properties of the elements.
- He grouped the elements according to the patterns and by increasing atomic mass.
- This allows us to predict the properties of missing elements.



THE PERIODICITY OF THE ELEMENTS

The Elements	Their Properties in the Free State				The Composition of the Hydrogen and Organometallic Compounds	Synthetic and Atomic Weights	The Composition of the Sulphur Oxides			The Properties of the Sulphur Oxides			Small Periods or Series
	r	s	d	A			B	A	R ₂ O ₃		d ² (2A + s/16) V		
	[1]	[2]	[3]	[4]			[5]	[6]	[7]	[8]	[9]	[10]	
Hydrogen	1	—	—	1	—	H	1	—	—	—	—	—	1
Lithium	3	—	—	7	—	Li	7	—	—	—	—	—	2
Beryllium	4	—	—	9	—	Be	9	—	—	—	—	—	2
Boron	5	—	—	11	—	B	11	—	—	—	—	—	2
Carbon	6	—	—	12	—	C	12	—	—	—	—	—	2
Nitrogen	7	—	—	14	—	N	14	—	—	—	—	—	2
Oxygen	8	—	—	16	—	O	16	—	—	—	—	—	2
Fluorine	9	—	—	19	—	F	19	—	—	—	—	—	2
Sodium	11	—	—	23	—	Na	23	—	—	—	—	—	3
Magnesium	12	—	—	24	—	Mg	24	—	—	—	—	—	3
Aluminium	13	—	—	27	—	Al	27	—	—	—	—	—	3
Silicon	14	—	—	28	—	Si	28	—	—	—	—	—	3
Phosphorus	15	—	—	31	—	P	31	—	—	—	—	—	3
Sulphur	16	—	—	32	—	S	32	—	—	—	—	—	3
Chlorine	17	—	—	35.5	—	Cl	35.5	—	—	—	—	—	3
Potassium	19	—	—	39	—	K	39	—	—	—	—	—	4
Calcium	20	—	—	40	—	Ca	40	—	—	—	—	—	4
Scandium	21	—	—	44	—	Sc	44	—	—	—	—	—	4
Titanium	22	—	—	48	—	Ti	48	—	—	—	—	—	4
Vanadium	23	—	—	51	—	V	51	—	—	—	—	—	4
Chromium	24	—	—	52	—	Cr	52	—	—	—	—	—	4
Manganese	25	—	—	55	—	Mn	55	—	—	—	—	—	4
Iron	26	—	—	56	—	Fe	56	—	—	—	—	—	4
Cobalt	27	—	—	59	—	Co	59	—	—	—	—	—	4
Nickel	28	—	—	59	—	Ni	59	—	—	—	—	—	4
Copper	29	—	—	63.5	—	Cu	63.5	—	—	—	—	—	4
Zinc	30	—	—	65.4	—	Zn	65.4	—	—	—	—	—	4
Gallium	31	—	—	70	—	Ga	70	—	—	—	—	—	5
Germanium	32	—	—	72.6	—	Ge	72.6	—	—	—	—	—	5
Arsenic	33	—	—	75	—	As	75	—	—	—	—	—	5
Selenium	34	—	—	79	—	Se	79	—	—	—	—	—	5
Bromine	35	—	—	80	—	Br	80	—	—	—	—	—	5
Krypton	36	—	—	84	—	Kr	84	—	—	—	—	—	5
Rubidium	37	—	—	85.5	—	Rb	85.5	—	—	—	—	—	6
Strontium	38	—	—	87.6	—	Sr	87.6	—	—	—	—	—	6
Yttrium	39	—	—	89	—	Y	89	—	—	—	—	—	6
Zirconium	40	—	—	91.2	—	Zr	91.2	—	—	—	—	—	6
Niobium	41	—	—	93	—	Nb	93	—	—	—	—	—	6
Molybdenum	42	—	—	96	—	Mo	96	—	—	—	—	—	6
Ruthenium	44	—	—	101	—	Ru	101	—	—	—	—	—	7
Rhodium	45	—	—	103	—	Rh	103	—	—	—	—	—	7
Palladium	46	—	—	106.3	—	Pd	106.3	—	—	—	—	—	7
Silver	47	—	—	108	—	Ag	108	—	—	—	—	—	7
Cadmium	48	—	—	112.4	—	Cd	112.4	—	—	—	—	—	7
Iodine	53	—	—	127	—	I	127	—	—	—	—	—	8
Tin	50	—	—	118.7	—	Sn	118.7	—	—	—	—	—	8
Antimony	51	—	—	120	—	Sb	120	—	—	—	—	—	8
Tellurium	52	—	—	127.6	—	Te	127.6	—	—	—	—	—	8
Bismuth	83	—	—	209	—	Bi	209	—	—	—	—	—	8
Polonium	84	—	—	210	—	Po	210	—	—	—	—	—	8
Francium	87	—	—	223	—	Fr	223	—	—	—	—	—	8
Radium	88	—	—	226	—	Ra	226	—	—	—	—	—	8
Actinium	89	—	—	227	—	Ac	227	—	—	—	—	—	8
Thorium	90	—	—	232	—	Th	232	—	—	—	—	—	9
Protactinium	91	—	—	231	—	Pa	231	—	—	—	—	—	9
Uranium	92	—	—	238	—	U	238	—	—	—	—	—	9
Neptunium	93	—	—	237	—	Np	237	—	—	—	—	—	9
Plutonium	94	—	—	244	—	Pu	244	—	—	—	—	—	9
Americium	95	—	—	243	—	Am	243	—	—	—	—	—	9
Curium	96	—	—	247	—	Cm	247	—	—	—	—	—	9
Berkelium	97	—	—	247	—	Bk	247	—	—	—	—	—	9
Californium	98	—	—	251	—	Cf	251	—	—	—	—	—	9
Einsteinium	99	—	—	252	—	Es	252	—	—	—	—	—	9
Fermium	100	—	—	253	—	Fm	253	—	—	—	—	—	9
Mendelevium	101	—	—	258	—	Md	258	—	—	—	—	—	9
Nobelium	102	—	—	259	—	No	259	—	—	—	—	—	9
Lanthanum	57	—	—	139	—	La	139	—	—	—	—	—	10
Cerium	58	—	—	140.1	—	Ce	140.1	—	—	—	—	—	10
Praseodymium	59	—	—	140.9	—	Pr	140.9	—	—	—	—	—	10
Neodymium	60	—	—	141.9	—	Nd	141.9	—	—	—	—	—	10
Europium	62	—	—	152	—	Eu	152	—	—	—	—	—	10
Gadolinium	63	—	—	157.3	—	Gd	157.3	—	—	—	—	—	10
Terbium	64	—	—	158.9	—	Tb	158.9	—	—	—	—	—	10
Dysprosium	65	—	—	162.5	—	Dy	162.5	—	—	—	—	—	10
Ytterbium	66	—	—	167.3	—	Yb	167.3	—	—	—	—	—	10
Lutetium	67	—	—	175	—	Lu	175	—	—	—	—	—	10
Hafnium	72	—	—	178.5	—	Hf	178.5	—	—	—	—	—	11
Tantalum	73	—	—	181	—	Ta	181	—	—	—	—	—	11
Tungsten	74	—	—	183.8	—	W	183.8	—	—	—	—	—	11
Rhenium	75	—	—	186.2	—	Re	186.2	—	—	—	—	—	11
Osmium	76	—	—	190.2	—	Os	190.2	—	—	—	—	—	11
Iridium	77	—	—	192.2	—	Ir	192.2	—	—	—	—	—	11
Platinum	78	—	—	195.1	—	Pt	195.1	—	—	—	—	—	11
Gold	79	—	—	197	—	Au	197	—	—	—	—	—	11
Mercury	80	—	—	200.6	—	Hg	200.6	—	—	—	—	—	11
Thallium	81	—	—	204.4	—	Tl	204.4	—	—	—	—	—	11
Lead	82	—	—	207.2	—	Pb	207.2	—	—	—	—	—	11
Bismuth	83	—	—	209	—	Bi	209	—	—	—	—	—	11
Polonium	84	—	—	210	—	Po	210	—	—	—	—	—	11
Astatine	85	—	—	210	—	At	210	—	—	—	—	—	11
Francium	87	—	—	223	—	Fr	223	—	—	—	—	—	11
Radium	88	—	—	226	—	Ra	226	—	—	—	—	—	11
Actinium	89	—	—	227	—	Ac	227	—	—	—	—	—	11

Mosley

-He re-arranged the elements by increasing atomic number

-First to establish a clear connection between nuclear charge (protons) and atomic number.

-This is how the periodic table is arranged now

-



Horizontal Rows

- Called “Periods”
- The properties gradually change as you move left to right across the Periodic Table.
- Indicates the number of electron shells

Vertical Columns

- Called “Groups” or “Families”
- They have similar chemical and physical properties.
- Indicates the number of valence electrons

In your journal...

- How is the PTE organized?
 - Vertical columns?
 - Horizontal rows?
 - What order are the elements in?

Squares on the Periodic table

- Symbol
- Atomic number
- Name
- Atomic mass

Symbol

- Not an abbreviation – never a period
- One or two letters
- First is always capitalized
- Second is never capitalized

B. Atomic Number

The number of protons the atom has

C. Mass number (Atomic Mass)

The number of protons plus the number of neutrons in an atom

(The mass of the nucleus; neutrons = mass number - atomic number)

E. Name

- The element's names are selected by a committee of scientists. Some are named after scientists or places.

Answer in your journal

- What information is found in each square?

The Periodic Table

Semimetals

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.81	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminum 13 Al 26.981	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	seelenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
caesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04								
francium 87 Fr [223]	radium 88 Ra [226]	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendeleevium 101 Md [258]	nobelium 102 No [259]								
		57-70 *	Lu 71 174.97	Hf 72 178.49	Ta 73 180.95	W 74 183.84	Re 75 186.21	Os 76 190.23	Ir 77 192.22	Pt 78 195.08	Au 79 196.97	Hg 80 200.59	Tl 81 204.38	Pb 82 207.2	Bi 83 208.98	Po 84 [209]	At 85 [210]	Rn 86 [222]					
		89-102 **	Lr 103 [262]	Rf 104 [261]	Db 105 [262]	Sg 106 [266]	Bh 107 [264]	Hs 108 [269]	Mt 109 [268]	Uun 110 [271]	Uuu 111 [272]	Uub 112 [277]	ununquadium 114 Uuq [289]										

* Lanthanide series

** Actinide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendeleevium 101 Md [258]	nobelium 102 No [259]

Metals, Nonmetals, and Semimetals

- Metals and nonmetals are separated by a stair-step line on the right side of the table.
- Metals are found to the left of the line and nonmetals are found to the right of the line.
- Elements that border the line on both sides are called semi-metals.

A. Metals

1. Found on the left of the periodic table.
2. Have only a few electrons in outer shell.
3. Most are solid, shiny, good conductors of heat and electricity, malleable, are ductile.
4. Alkali metals - Family/Group 1
5. Alkaline earth metals - Family/Group 2
6. Transition metals - Families/Groups 3-12

B. Nonmetals

1. Found on the right side of periodic table
2. Most are dull, not malleable or ductile, not good conductors of heat or electricity.
3. Valence electron shell is mostly or completely full

C. Semi-Metals (metalloids)

1. Found along the zig-zag (stair step) line on the periodic table; also called metalloids
2. They are semi-conductors that have properties of both metals and non-metals.
3. The outer electron shell is about half full.

Answer in your journal...

- Can you identify where the metals, non metals and semimetals are on the PTE
- What are the properties of metal?
- What are the properties of a nonmetal?
- What are the properties of a semimetal?

V. Groups (Families)

- Elements found in the same vertical column on the Periodic Table belong to the same family or group. Elements of a group all have similar physical and chemical properties and the same number of valence electrons.

Valence Electrons

- Electrons that are in the outer shell
- Valence Electrons determine reactivity
- A full shell is stable
- The valence shell is complete with 8 electrons

Reactivity

- **Empty or Full**
 - non reactive (inert)
- **Close to full or close to empty**
 - very reactive
- **Half full or half empty**
 - not as reactive

Lanthanides Gases

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180		
lithium 3 Li 6.941																			
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.06	chlorine 17 Cl 35.45	argon 18 Ar 39.948		
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.69	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80		
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.905	xenon 54 Xe 131.29		
caesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La 138.905	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]		
francium 87 Fr [223]	radium 88 Ra [226]	* 57-70		lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
		** 89-102		lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	darmstadtium 110 Ds [271]	roentgenium 111 Rg [272]	copernicium 112 Cn [277]	ununtrium 113 Uut [273]	ununquadium 114 Uuq [289]	ununpentium 115 Uup [288]	ununhexium 116 Uuh [289]	ununseptium 117 Uus [289]	ununoctium 118 Uuo [289]

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
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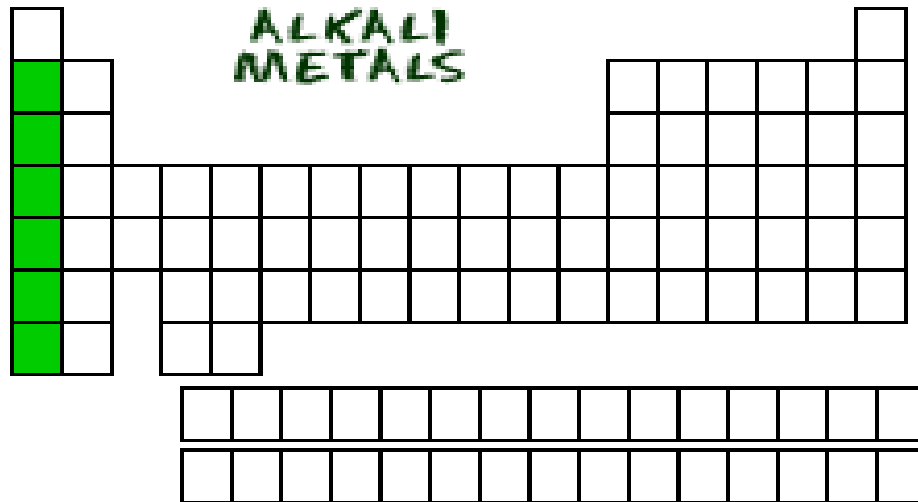
** Actinide series

actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendeleevium 101 Md [258]	nobelium 102 No [259]
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A. Alkali Family

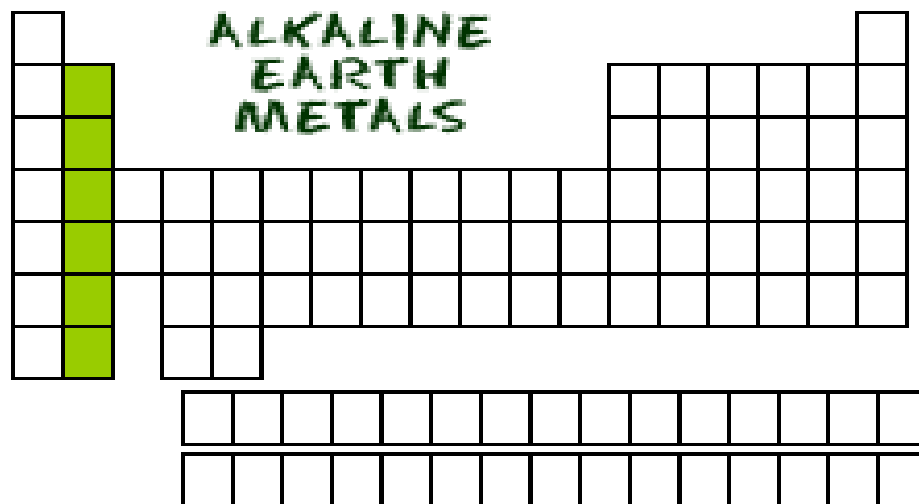
(1 Valence Electron)

- The most reactive metals
- Shiny and soft
- Can be cut with a knife



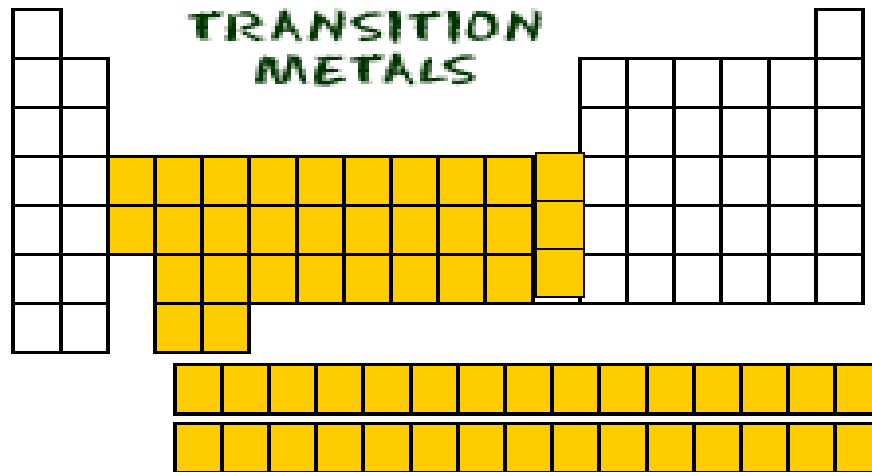
B. Alkaline Earth Metals (2 Valence Electrons)

- Very Reactive
- Silver colored metals, more dense than family #1



C. Transition Metals

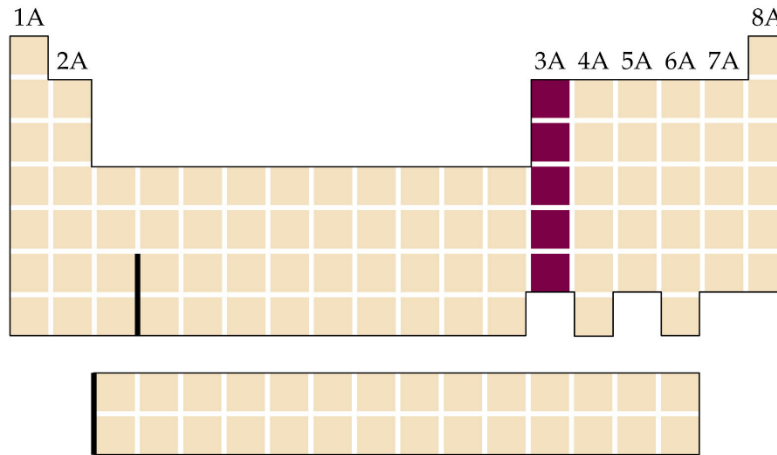
- Have 1-2 Valence electrons
- Includes many common metals such as copper, iron, gold, and silver



D. Boron Family

(3 valence electrons)

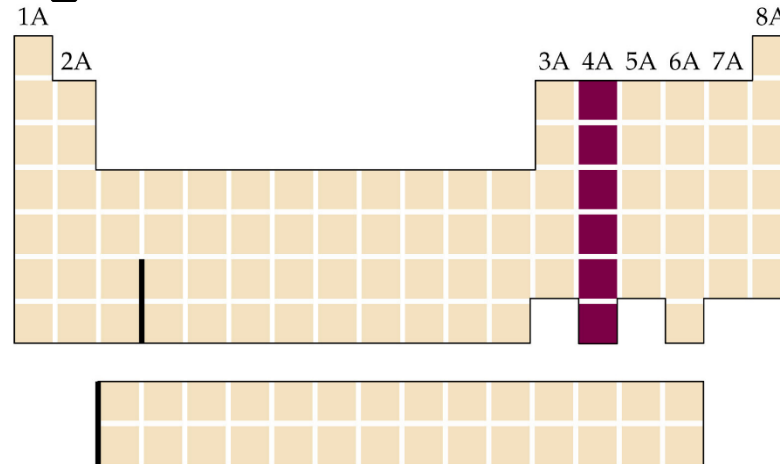
- Reactive Solids



E. Carbon Family

(4 Valence electrons)

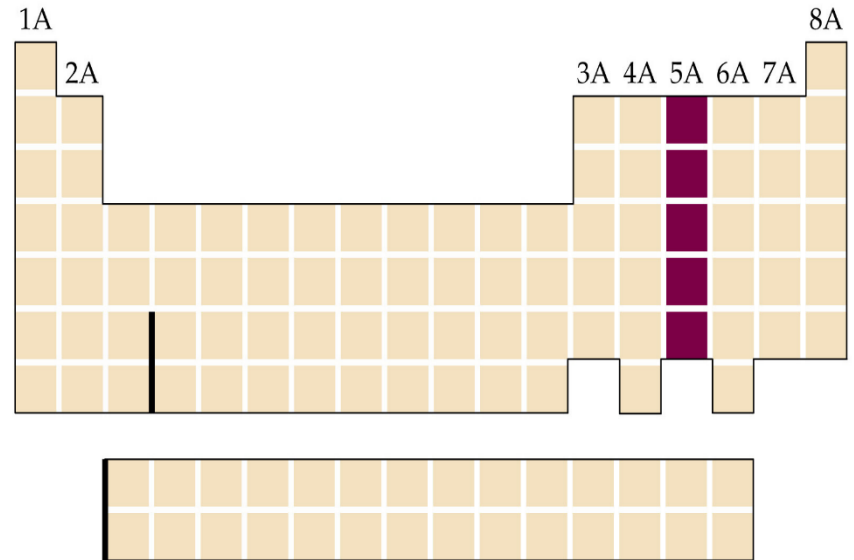
- Reactivity varies
- All are solids
- Carbon based molecules make up all living things



F.Nitrogen Family

(5 valence electrons)

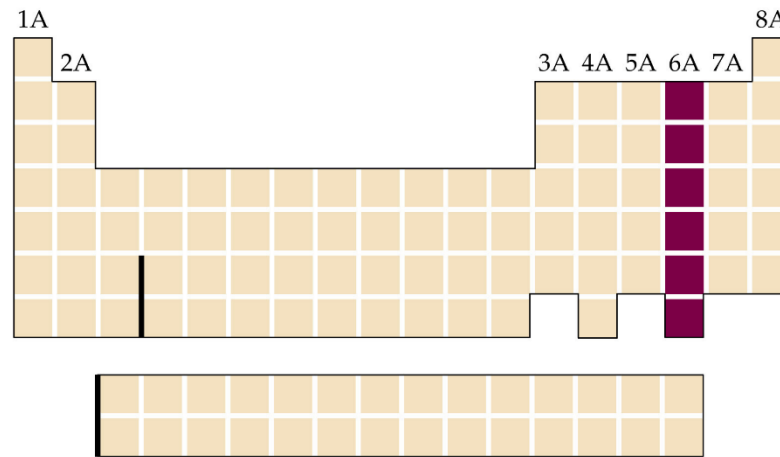
- Reactivity varies
- Nitrogen is the most common element in the atmosphere



G. Oxygen Family

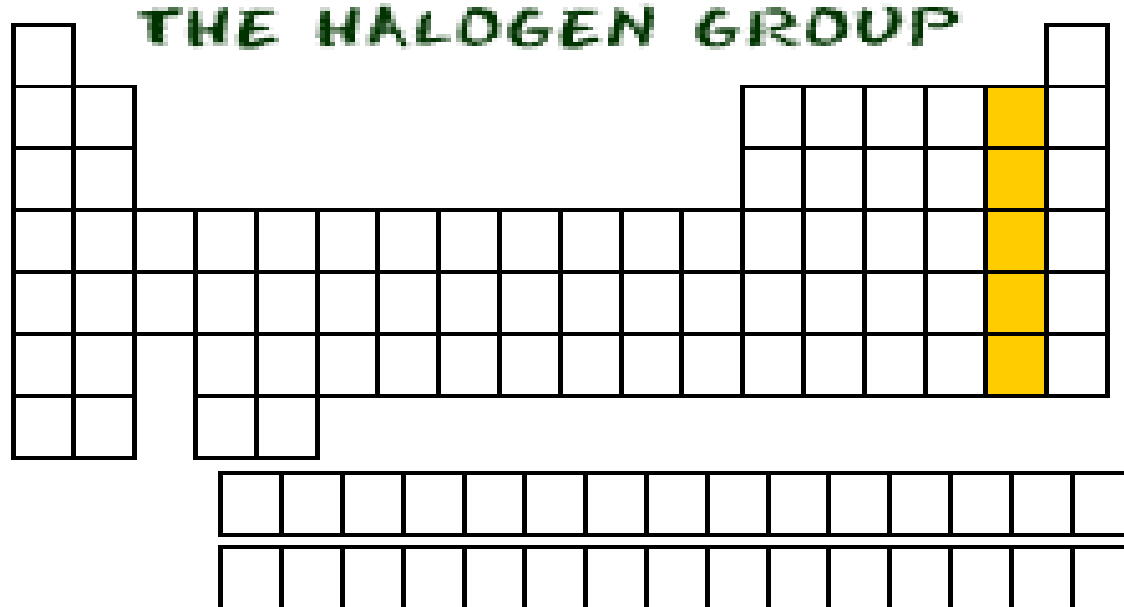
(6 valence electrons)

- Reactive



H. Halogen Family (7 valence electrons)

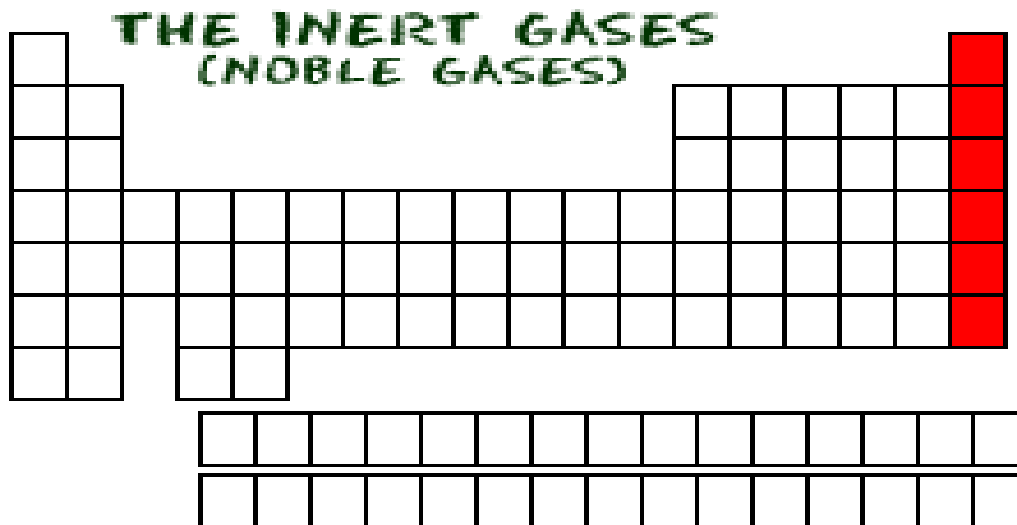
- These are the
MOST REACTIVE NONMETALS
- Some are used as cleaners



I. Inert Gases (Noble Gases)

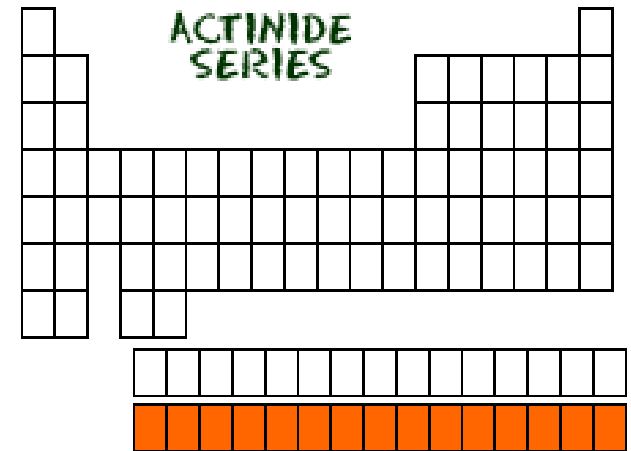
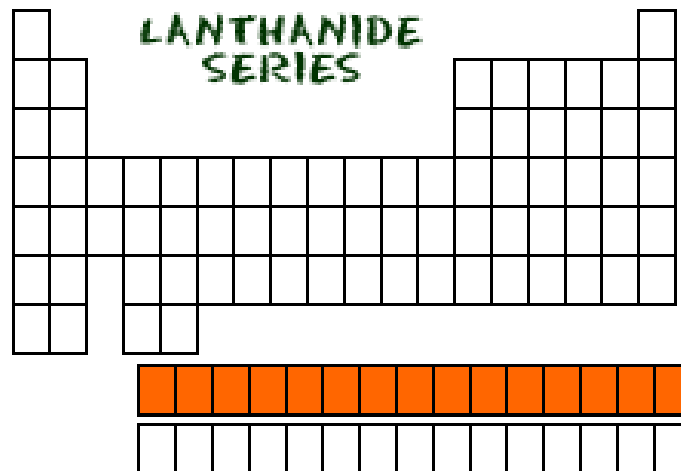
(8 valence electrons)

- Stable – Not reactive!!
- All are nonmetals, and all are gases
- Helium only has 2 valence electrons because it only HAS 2 electrons total



Lanthanide and Actinide Families (2 valence electrons)

- These are a part of the transition element family



Liquids, gases and semi metals

- The majority of elements are solids (so we are not labeling those)
- Find and mark (be creative) the liquids
- Find and mark (be creative) the gases
- Darken the stair step line for metalloids and outline the boxes of elements that are semi-metals

The End