### A bit of review...

- Atoms for particular elements are <u>ALWAYS</u> trying to have a full set of electrons in their outer energy level. For the most part...this is going to be <u>8 electrons (octet rule)</u>.
- Elements are organized into "<u>groups</u>" or "<u>families</u>" (both another name for columns) <u>based on their number of valence electrons</u>.
- For the most part, the family "<u>number</u>" tells you how many valence electrons are found in a neutral atom for that element.

# So I sort of didn't tell you the whole story. But let me fill in the



gaps																			
	_	I.A																	VIII.A
	1	н 1	II.A	1										III.A	IV.A	V.A	VI.A	VII.A	He 2
	s	Li 3	Be 4							В 5	С 6	N 7	0 8	F 9	Ne 10				
	a Na My 11 12			III.B	III.B 10.B 0.B 01.B 011.B 011.B 11.1										Si 14	Р 15	S 16	CI 17	Ar 18
	٩	К 19	Ca 20	Se 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
	5	Rb 37	Sr 38	ү 39	Zr 40	NЬ 41	Mo 42	To 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	1 53	Xe 54
	6	Cs 55	Ba 56	La 57	Hf 72	Та 73	₩ 74	Re 75	0s 76	lr 77	Pt 78	Au 79	Hg 80	TI 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
	٦	Fr 87	Ra 88	Ac 89	Rf 104	DЬ 105	Sg 106	Bh 107	Hs 108	Mt 109	Ds 110	Rg 111	Uub 112	Uut 113	Uuq 114	Uup 115	Uuh 116	Uus 117	Uuo 118
			6	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	ҮЬ 70	Lu 71		
			5	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

 As previously stated, atoms are always trying to have 8 valence electrons in their outer energy level....



	I.A																	VIII.A
1	H																	He
	1	II.A											III.A	IV.A	V.A	VI.A	VII.A	2
z	Ļ	Be											В	Ç.	N	0	F	Ne
$\square$	3	4											5	6	7	8	8	10
3	Na	Mg	Mg AI Si P S C														CI	Ar
$\square$		12	III.B	IV.B	U.B	VI.B	VII.B		VIII.B		I.B	II.B	13	14	15	16	17	18
5	K	Ca	Se	Ti	X	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
$\square$	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
5	Rb	Sr	Y	Zr	Nb	Mo	To	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	1	Xe
$\square$	37	38	39	40	41	42	43	44	46	46	47	48	49	50	51	52	53	54
6	Cs	Ba	La	Hf	Ta	W	Re	0s	<u>lr</u>	Pt	Au	Hg	TI	Pb	Bi	Po	At	Rn
$\square$	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
1	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uug	Uup	Uuh	Uus	Uuo
	87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
		_					_			_				_				
		6	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Тb	Dy	Ho	Er	Tm	Yb	Lu		
		Ľ	58	59	60	61	62	63	64	65	66	67	68	69	70	71		
		h	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		
י	Fr 87	Ha 88	Ac 89 Ce 58 Th	Pr 59 Pa	UB 105 Nd 60 U	Sg 106 Pm 61 Np	8h 107 Sm 62 Pu	HS 108 Eu 63 Am	Mt 109 64 Cm	US 110 7b 65 8k	Rg 111 Dy 66 Cf	006 112 67 Es	Uut 113 Er 68 Fm	00q 114 7m 69 Md	0up 115 70 No	Uuh 116 71 Lr	0us 117	

There is an exception...the transition metals can fit more than just 8 electrons...they can fit 18 electrons in their outer energy level!!





### •Do we need to worry about these right now? The answer is no!





• We are really only concerned about what are known as the "Main Group" Elements. These all follow the "octet rule"  $\rightarrow$  8 in outer energy level makes the atom happy.





Non-Metals: Moving to the other side of the periodic table...the elements on the right side typically want to gain electrons



### Group 13: The Boron Family

13 5 В 13 AI 31 Ga 49 In 81 TI

•The name of the family comes from the *ELEMENT LOCATED AT THE TOP* (this will be the same for the 14 through 16 families).

• The "3" tells us that elements in the Boron Family have 3 valence electrons.

### Group 13: The Boron Family

Importance of Boron:

13

5.

12

В

AI

31

49

81

Ga

In

TI

 When Boron is mixed with silicon and oxygen (aka...glass), a type of extremely strong glass is made that does not shatter easily (PYREX).









### Group 13: The Boron Family



### **Importance of Aluminum:**

### **Uses for Aluminum**





### Aluminum

- Aluminum is light-weight, strong, and malleable.
- Aluminum is the most abundant metal in the Earth's crust and is found mixed with a mineral known as bauxite.



It takes only 5% as much energy to
recycle aluminum as it takes to pull it out of bauxite.

## Group 14: The Carbon Family



## Group 14: The Carbon Family

14

С

6

14

Si

32

50

82

Ge

Sn

Pb

• The metallic nature increases from top to bottom for the Carbon Family.

 Included in Group 14 is carbon, one of the most common elements in the human body.

## Group 14: The Carbon Family

<u>14</u> The metallic nature increases from top to bottom for the Carbon Family. 14 Si Silicon is a metalloid and has characteristics of BOTH metals and Ge non metals (semiconductor or metaloid) Sn Silicon accounts for 28% of Earth's

82 Pb

crust.

6

С

.00

50

## Carbon – many compounds!

- In its pure state, carbon is typically found as graphite or as diamonds.
- Both of these are made ENTIRELY of carbon atoms...they are just joined differently on the atomic level.





### Carbon – many compounds!









### Carbon continued

- Carbon is also an important part of:
  - Sugar: C<sub>6</sub> H<sub>12</sub> O<sub>6</sub>
  - Gasoline: C<sub>8</sub> H<sub>18</sub>
  - Chlorophyll: C<sub>55</sub> H<sub>72</sub> O<sub>5</sub>
     N<sub>4</sub>Mg





### Silicon - review



#### **Elemental Silicon**

Silicon is a metalloid and has characteristics of **BOTH** metals and non metals.

- Conducts electricity at high temperatures.
- Insulates at low temperatures.

 Very high melting point (melts at high temperatures).

### Silicon - review



Silicon accounts for 28% of the mass of the Earth's crust. Sand is made of molecules containing one atom of silicon joined with two atoms of oxygen.

#### **Elemental Silicon**



#### **Silicon Microchip**

### Silicon is a metalloid and has characteristics of BOTH metals and non metals.

Silicon

- Conducts electricity
- Very high melting point (melts at high temperatures).
- These qualities make it great for microchips

## Group 15: The Nitrogen Family



• The metallic nature increases from top to bottom for the Nitrogen Family.

• The elements of the Nitrogen Family contain 5 valence electrons.

## Group 15: The Nitrogen Family

15

22

51

83

P

As

Sb

Bi

• The metallic nature increases from top to bottom for the Nitrogen Family.

 The most important elements of the Nitrogen Family are Nitrogen and Phosphorous.

 Both Nitrogen and Phosphorous elements control reactions and allow plants and animals to release energy from food. → fertilizer.

### Reading a Fertilizer Bag



### Group 16: The Oxygen Family



# • All of the elements in the Oxygen Family have 6 valence electrons.

## Group 16: The Oxygen Family

16

Ο

8

16

S

34

52

84

Se

Te

Po

All of the elements in the Oxygen
 Family have 6 valence electrons →
 Very reactive.

 Included in this Family is <u>Oxygen</u>, the most abundant element in Earth's crust.

## Group 16: The Oxygen Family

16

Ο

8

16

S

34

52

84

Se

Te

Po

 Included in this Family is <u>Oxygen</u>, the most abundant element in Earth's crust.

• Oxygen is used by MOST complex forms of life to release energy from food.

### Ozone

- A form of Oxygen known as Ozone (three atoms of oxygen linked together) is both an irritation and a necessity.
- Ozone here on Earth: photocopiers / in subway stations / after lightning storms.
- In the upper atmosphere....







- In the upper atmosphere, ozone blocks harmful radiation from the Sun...without it, cancer rates would sky-rocket and life would not exist.
- Certain banned materials from aerosol cans and refrigeration devices attacks the ozone and can cause holes.

### Ozone Hole



**Certain banned** chemicals prevent oxygen atoms from combining together in sets of threes...thus, new ozone does not form.

<u>17</u> 9 F 17 CI 35 Br 53 85 At

 Each element in the Halogen group is known as a "halogen" and contains
 7 valence electrons → EXTREMELY
 REACTIVE!

• All of the halogens are reactive nonmetals.



Chlorine: gas at room temperature Bromine: liquid at room lodine: solid at room temperature



• The properties of fluorine allow it to be a major tool against tooth decay.

• Fluoride (F<sup>-</sup>) is absorbed into our teeth and quickly combines with other elements <u>INCLUDING</u> calcium to form a protective mineral layer.



•Chlorine is so reactive, that it has had many uses through time:

• Used in pools to get rid of bacteria.

• Used in chemical warfare.

9 F 17 CI 35 Br 53 85 At

• lodine is used by your body to keep your thyroid gland working properly.

• The thyroid glad controls the speed of reactions in your body.

 The best source of iodine is seafood...when fresh seafood became less common in peoples' diets, scientists added iodine to salt "iodized salt."

### **Ozone Destroyers**

- Ozone depleting substances have been used mostly by humans as aerosol can propellants or as refrigerants.
- Most of these substances contain BOTH of the elements fluorine and chlorine → VERY reactive Group 17 Halogen elements.





### **Ozone Destroyers**

- The CFCs that are released make it up into the atmosphere where they are broken down by the Sun's radiation...
- This creates the REAL ozone destroyers







### **Group 18: The Noble Gases**



- The noble gases are colorless and odorless and extremely **UNREACTIVE**.
- 54 Xe 86

Rn

2

10

18

36

Kr

Ar

He

 These elements are useful for storing other substances that easily react with other materials (dangerous chemicals, important documents, etc.)

### Noble Gases



### Group 18 Noble Gases: Neon Lights

- When a filament is given electricity, it glows. Since you are heating something up, the filament can burn out. → normal light bulb
- Using a noble gas both produces cool colors by exciting electrons and forming a plasma. Nothing is burning so lasts a long time
   DRIVE -THRI
  - → bar/restaurant lights