

# BONDING

ch 5

# BONDING

- Combining Atoms of Elements to make Compounds.
- Compounds: Combinations of elements.
- Molecules: Combinations of atoms.
- All compounds are molecules, but not reverse.

# MOLECULE

- Neutral particle formed when electrons are shared.
- Molecular compounds usually have lower melting & boiling points.
- Do not conduct electricity.

# BONDING

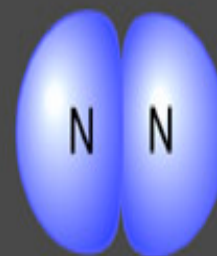
MOLECULES:



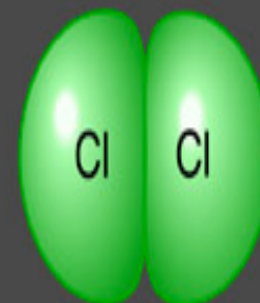
$\text{H}_2$   
hydrogen



$\text{O}_2$   
oxygen

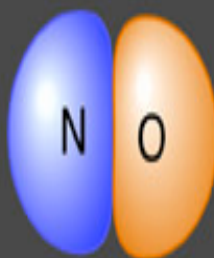


$\text{N}_2$   
nitrogen

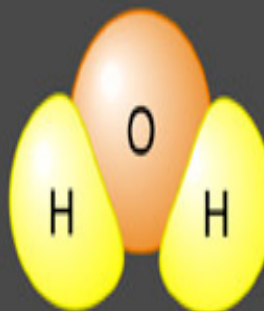


$\text{Cl}_2$   
chlorine

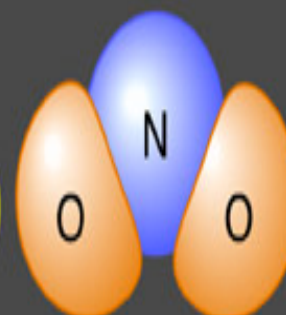
COMPOUNDS/  
MOLECULES:



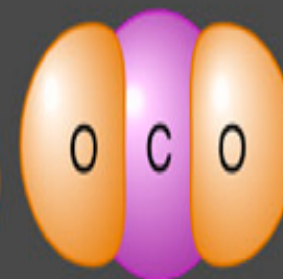
$\text{NO}$   
nitrogen oxide



$\text{H}_2\text{O}$   
water



$\text{NO}_2$   
nitrogen dioxide



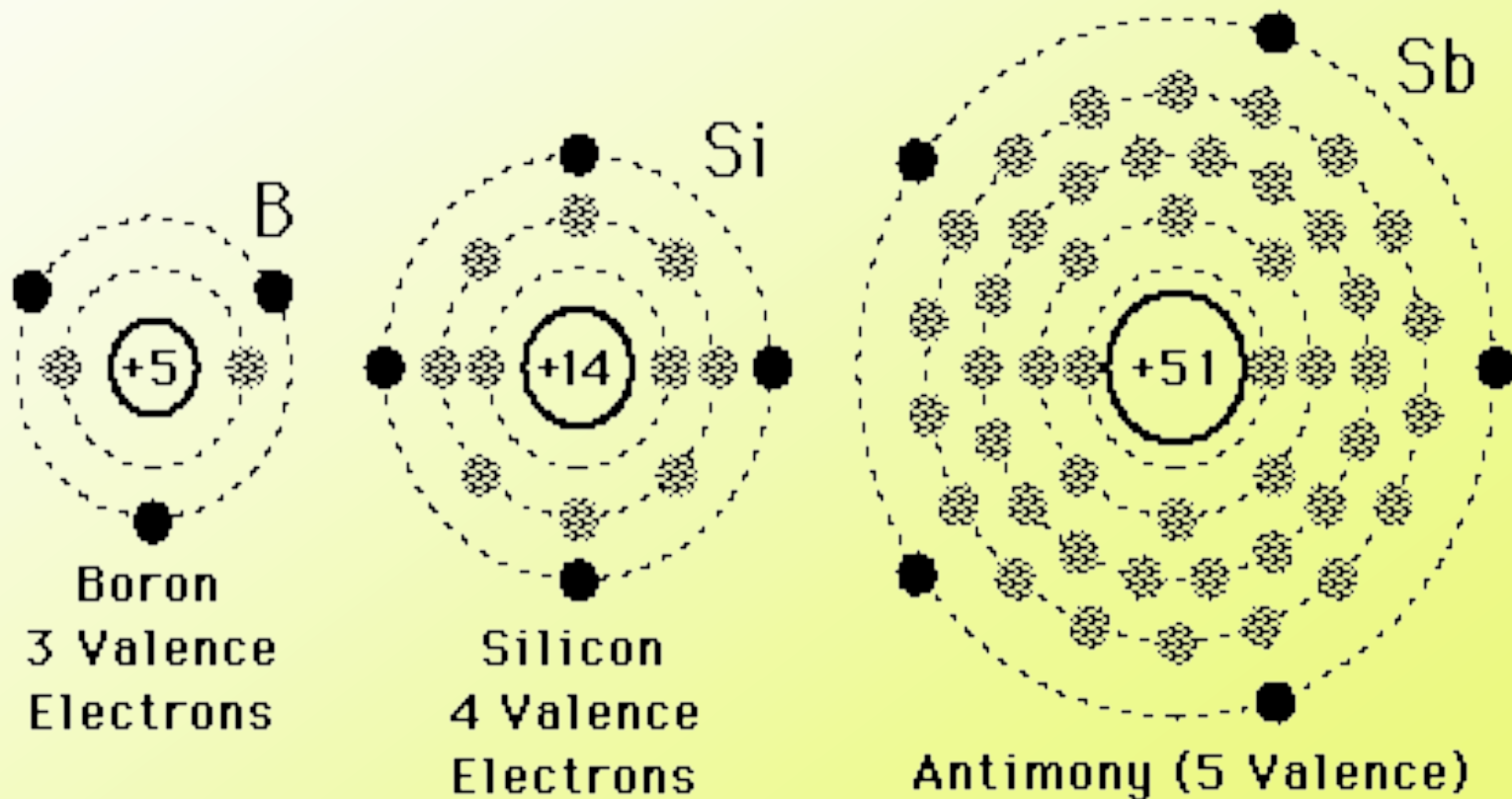
$\text{CO}_2$   
carbon dioxide

# KEY INFO:

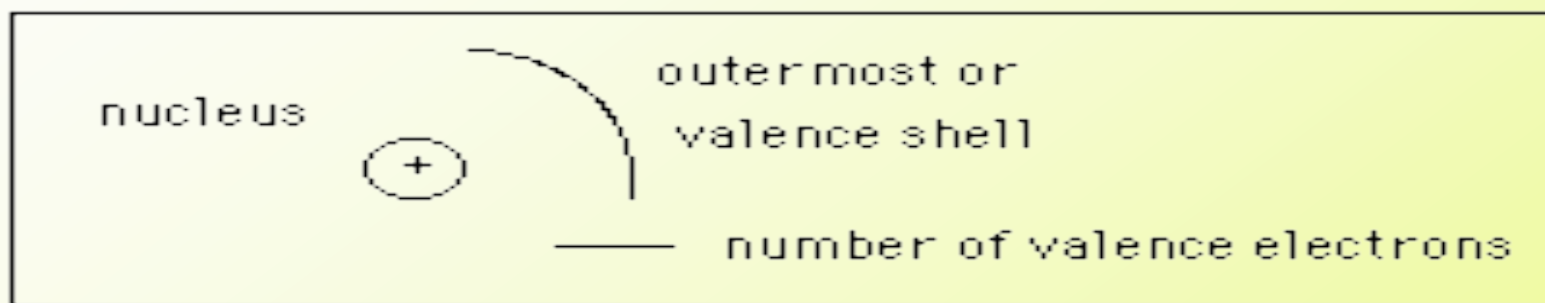
- PERIODS - gives us # energy rings/orbits.
- GROUPS- gives us # valence electrons.

# VALENCE ELECTRONS

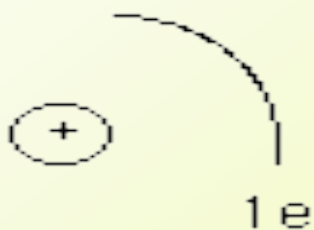
- Electrons on the outer-most energy ring. -Highest energy ring



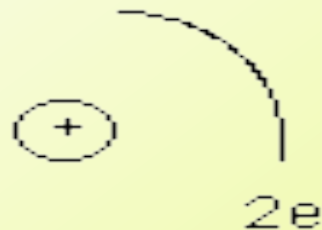
# VALENCE ELECTRONS



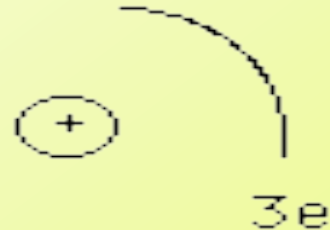
Group I



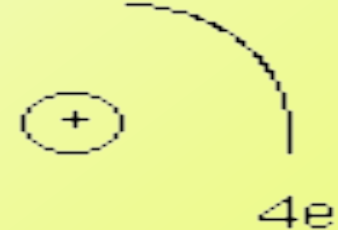
Group II



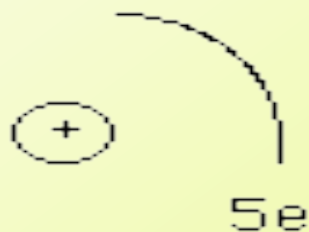
Group III



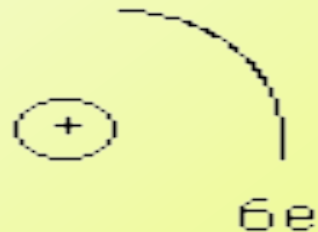
Group IV



Group V



Group VI



Group VII



Group VIII



# ELECTRON DOT DIAGRAM:

Element symbol and dots to show valence electrons.





# Valence Electrons

IA

IIA

IIIA

IVA

VA

VIA

VIIA

VIIIA

Li·

·Be·

· $\overset{\cdot}{\text{B}}$ ·

· $\overset{\cdot}{\underset{\cdot}{\text{C}}}$ ·

· $\overset{\cdot}{\underset{\cdot}{\text{N}}}$ ·

· $\overset{\cdot}{\underset{\cdot}{\text{O}}}$ ·

· $\overset{\cdot}{\underset{\cdot}{\text{F}}}$ ·

· $\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{Ne}}}$ ·

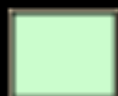
In general, the number of valence electrons of a representative element is equal to the group number

# VALENCE ELECTRONS

I	II											III	IV	V	VI	VII	0
H •																	He ••
Li •	• Be •											• B •	• C ••	• N ••	• O ••	• F ••	• Ne ••
Na •	• Mg •											• Al •	• Si •	• P ••	• S ••	• Cl ••	• Ar ••
K •	• Ca •											• Ga •	• Ge •	• As ••	• Se ••	• Br ••	• Kr ••
Rb •	• Sr •											• In •	• Sn •	• Sb ••	• Te ••	• I ••	• Xe ••
Cs •	• Ba •											• Tl •	• Pb •	• Bi ••	• Po ••	• At ••	• Rn ••



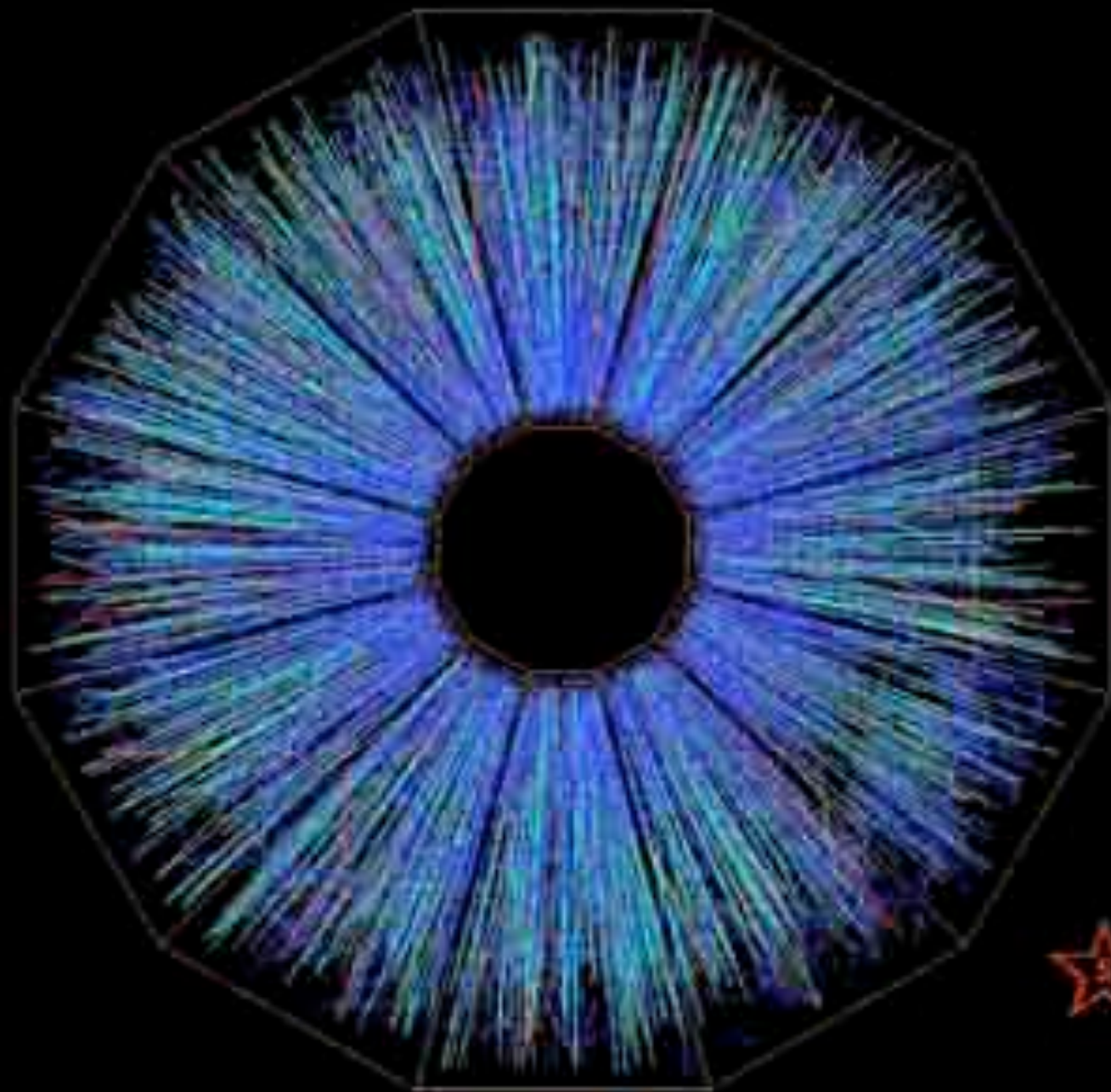
Metals



Metalloids



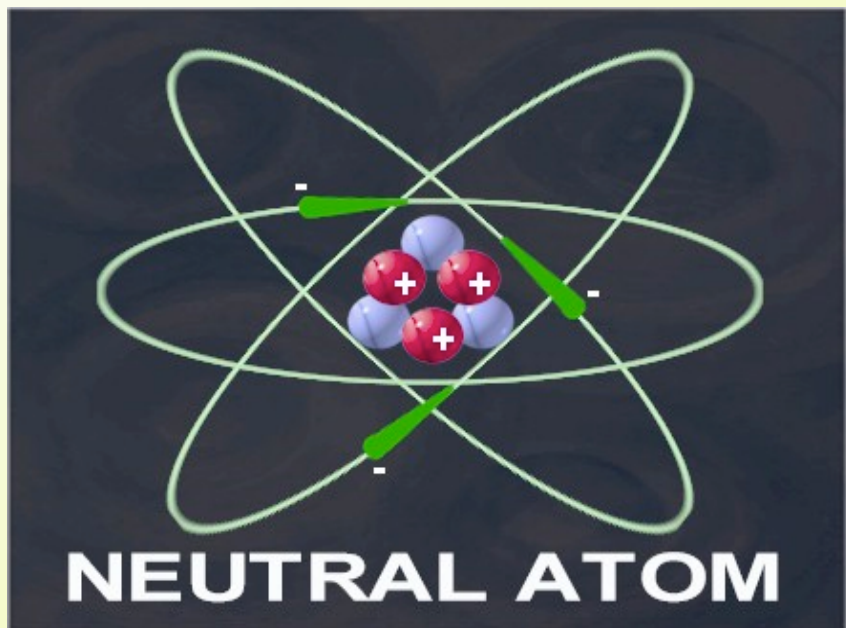
Nonmetals



# REACTIVITY

## Neutral Atom

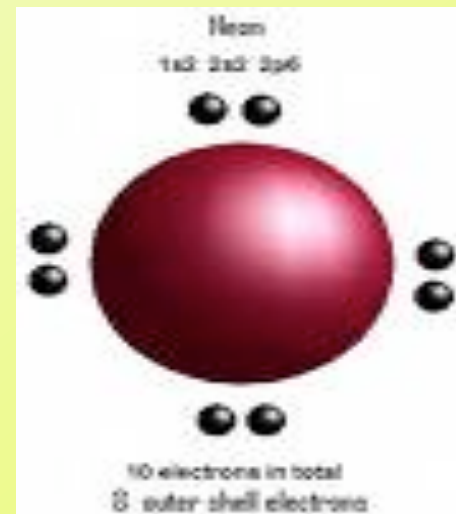
Protons =  
Electrons



## Stable Atom:

full ring=8  
electrons

-least reactive.





# TYPES OF BONDS:

- METALLIC: metal + metal
- IONIC: metal + nonmetal
- COVALENT: nonmetal + nonmetal

# METALLIC BOND

- Metal atoms combine in regular patterns.   
--+--+--+--+--+  
+++--++++--++++  
----+----+----+----
- Valence electrons move freely through metal (from atom to atom).
- Kinetic energy

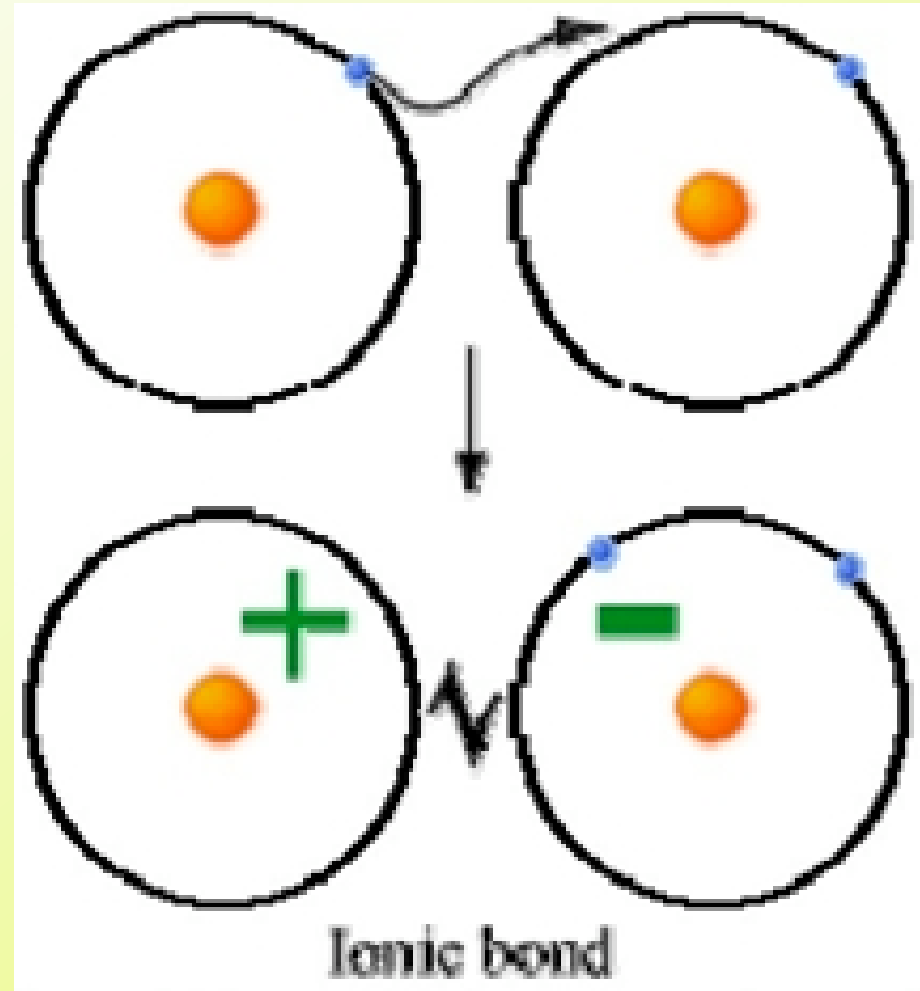
# ALLOY

- A mixture of 2 or more elements.
- 1 element is metal.
- Usually stronger and less reactive.



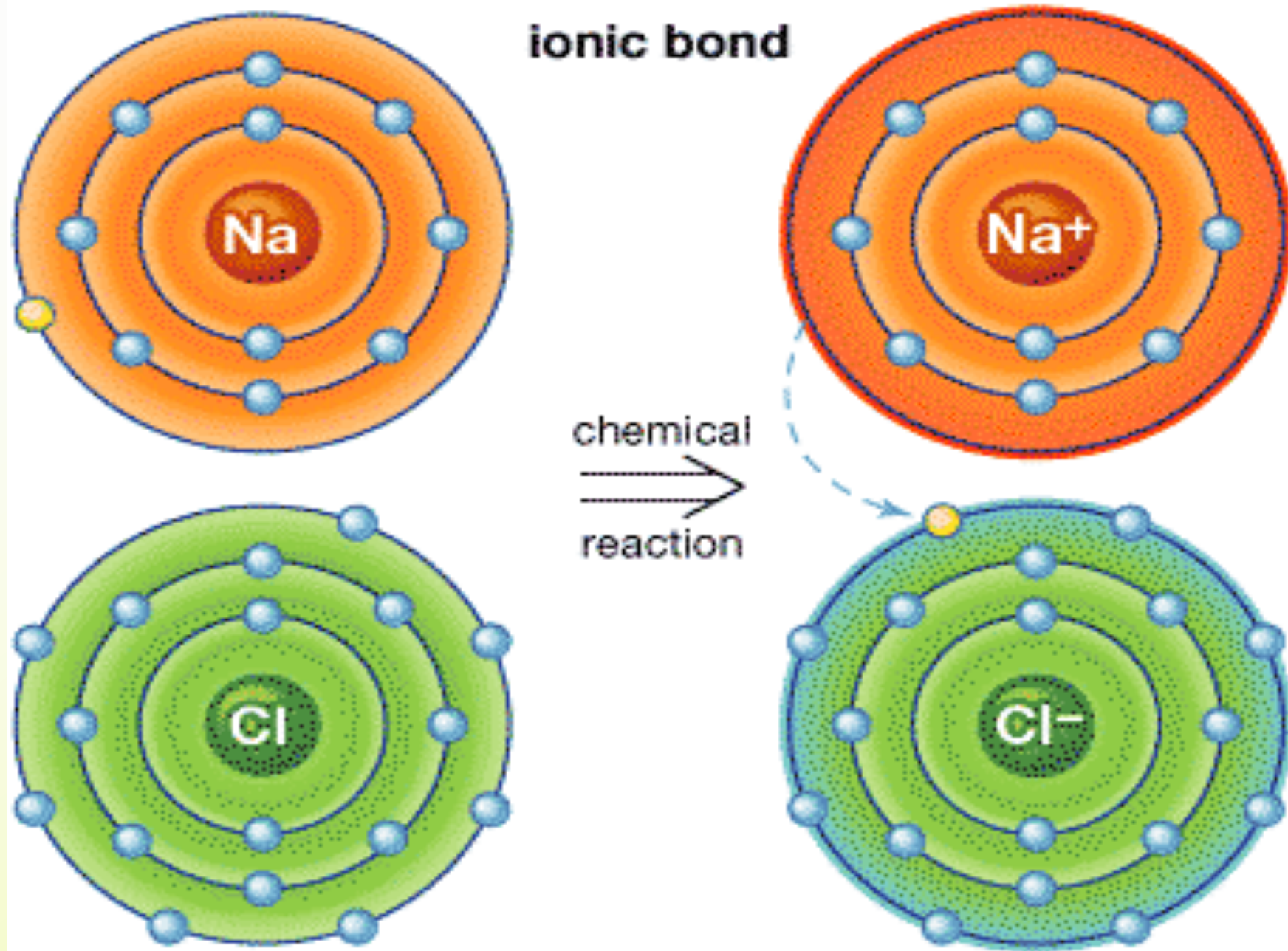
# IONIC BONDING

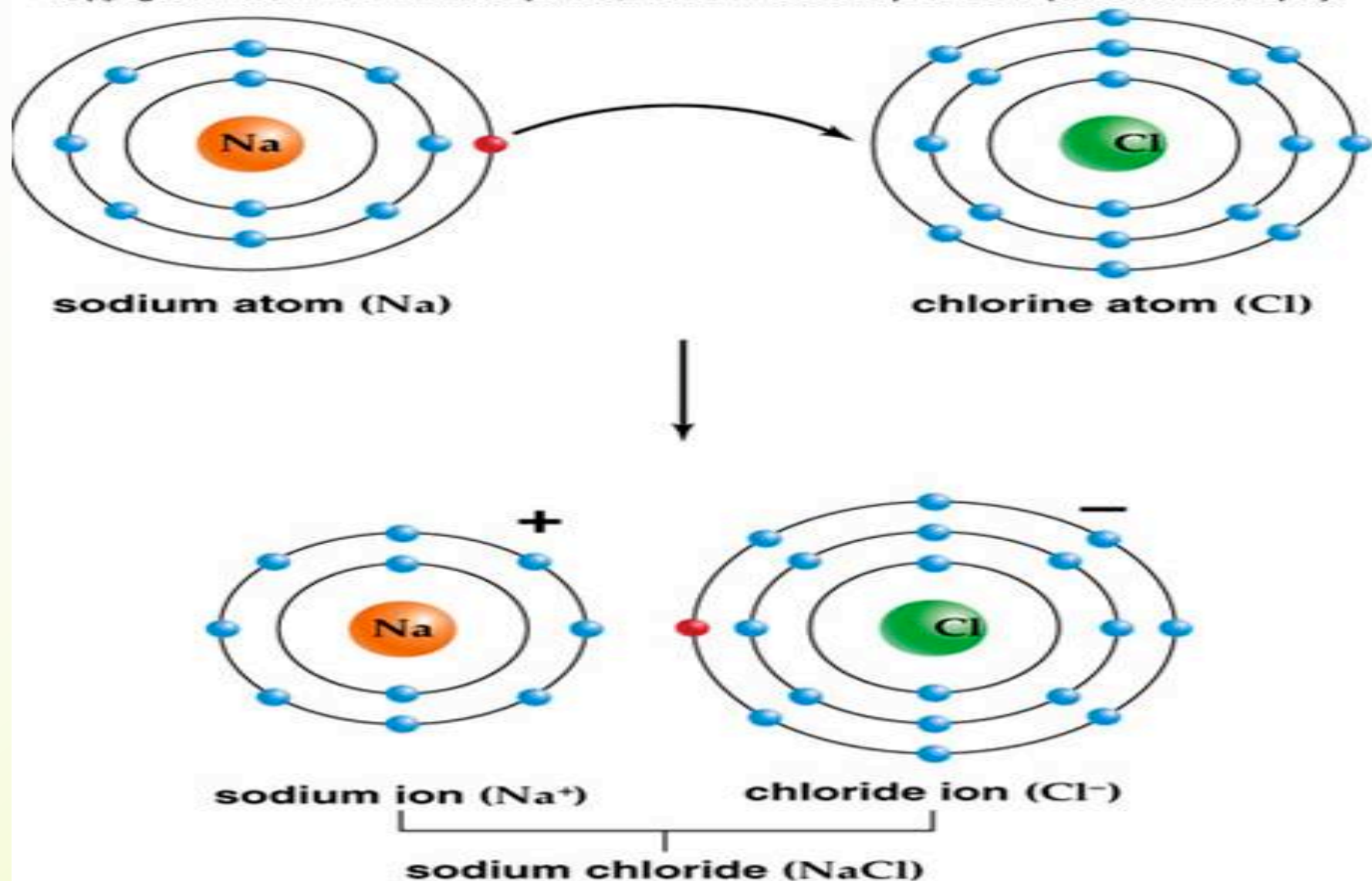
- Combining elements.
- $M + NM$
- Electrons are gained or lost and ions are formed.





## ionic bond



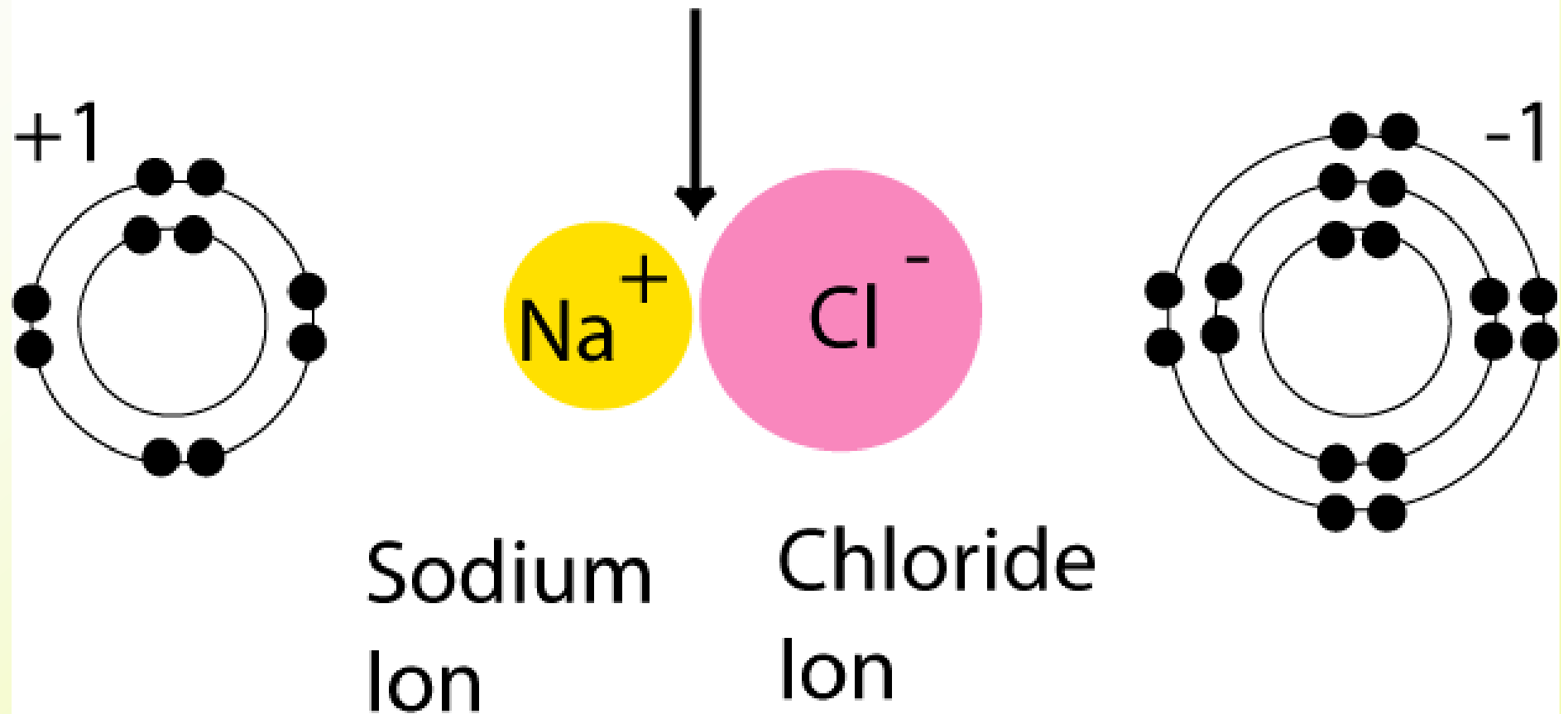


a.

# IONIC BONDS: Give or Take

# Ionic Bonds

## Electrostatic Attraction between two ions



Which end will lose?

Which end will gain?

I	II											III	IV	V	VI	VII	0		
H ●																		He ●●	
Li ●	Be ●●											B ●●	C ●●	N ●●	O ●●	F ●●	Ne ●●●●		
Na ●	Mg ●●											Al ●●	Si ●●	P ●●	S ●●	Cl ●●	Ar ●●●●		
K ●	Ca ●●													Ga ●●	Ge ●●	As ●●	Se ●●	Br ●●	Kr ●●●●
Rb ●	Sr ●●													In ●●	Sn ●●	Sb ●●	Te ●●	I ●●	Xe ●●●●
Cs ●	Ba ●●													Tl ●●	Pb ●●	Bi ●●	Po ●●	At ●●	Rn ●●●●

Metal

Metalloid

Nonmetal

# ION

An atom with a + or – charge.

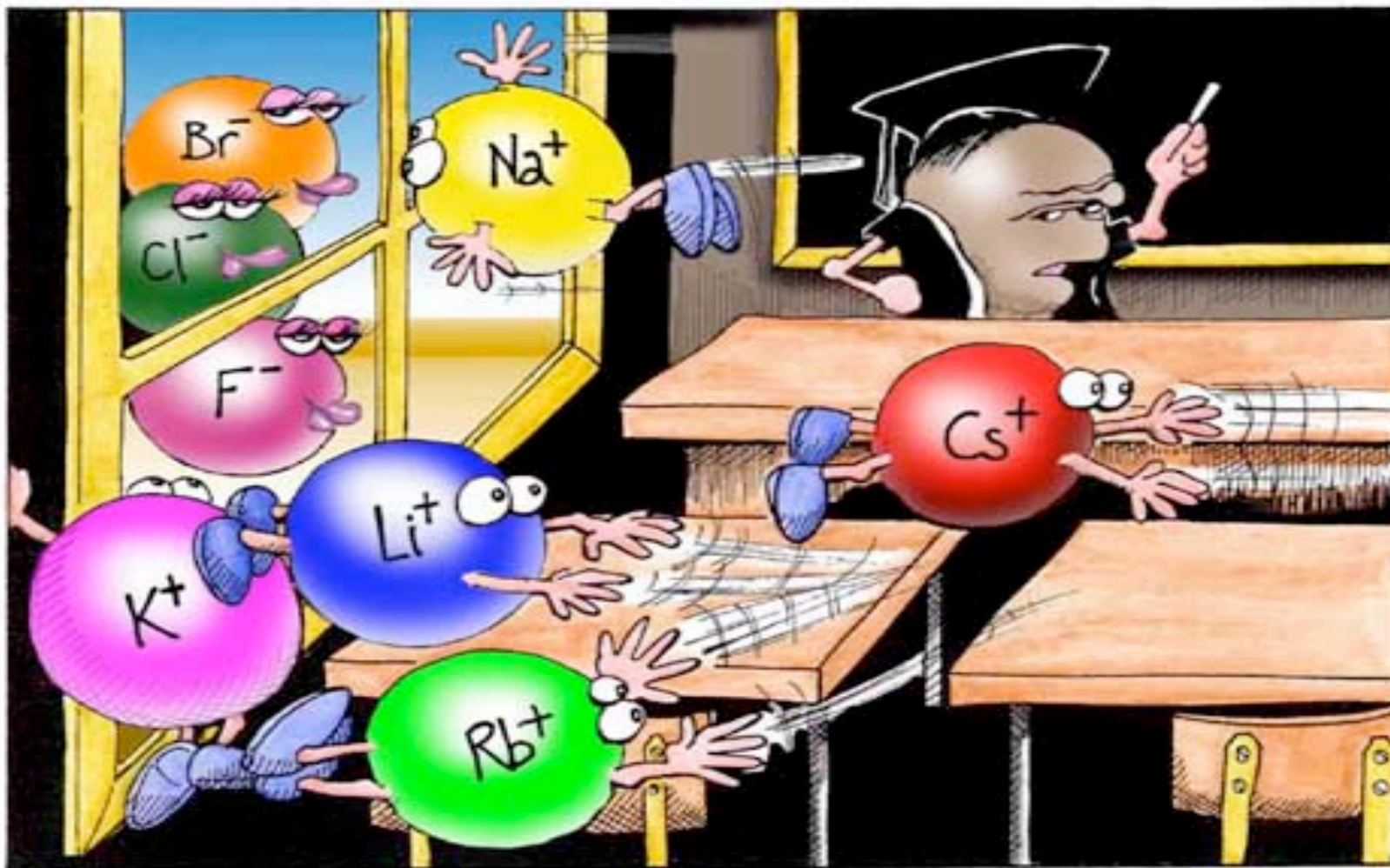
When the number of protons & electrons are not equal. Taken or given during bonding.

- Description: hard, brittle solids with high melting points. When melted or dissolved in water, they conduct electricity.



# CHARGED IONS

**LAB INITIO**  
by Nick D Kim



"Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive...?"

# Periodic Table of the Elements

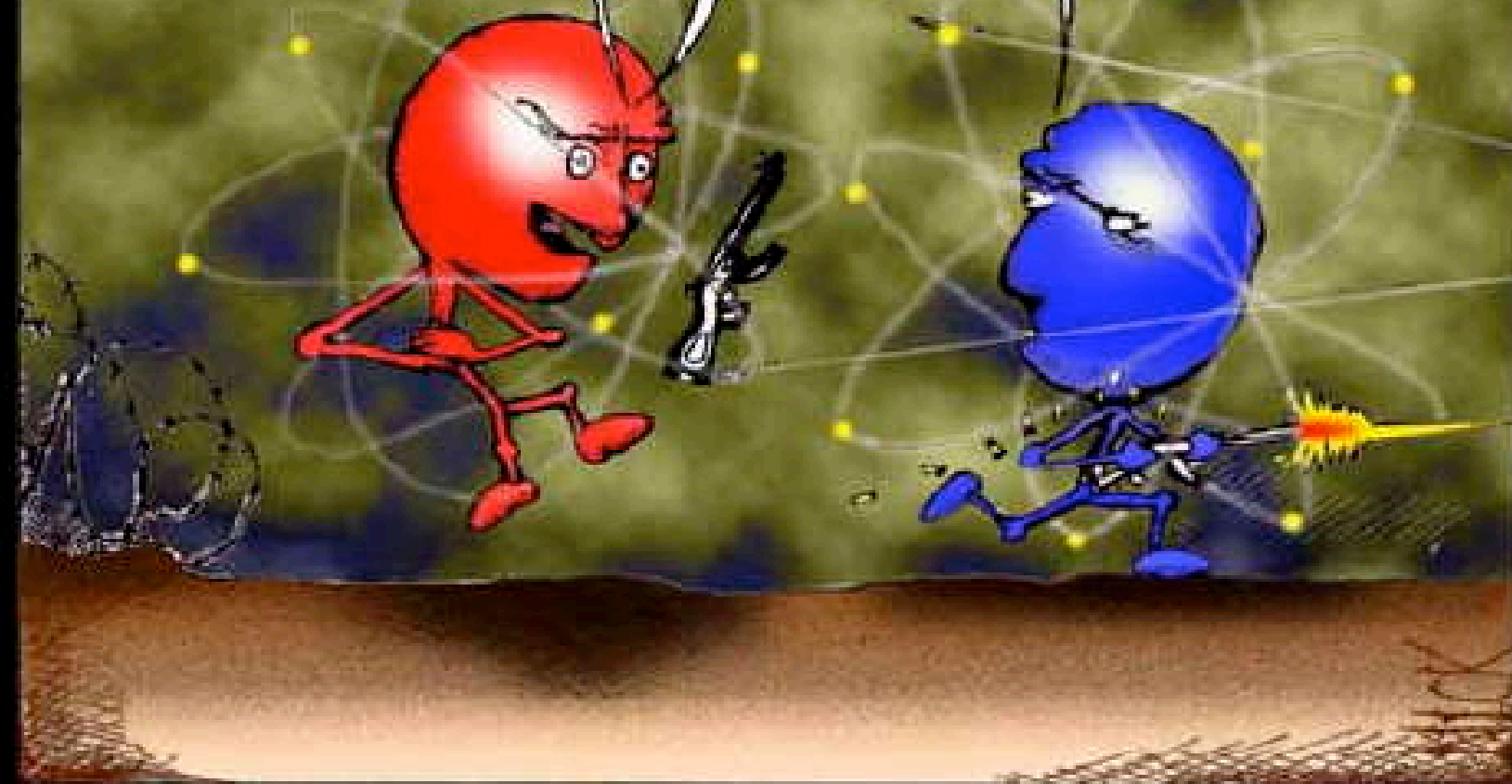
# Periodic Table of the Elements

1																	2																
1	2													3	4	5	6	7	8	9	10												
1	2													3	4	5	6	7	8	9	10												
3	4													11	12													13	14	15	16	17	18
11	12													19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
Na	Mg													K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54																
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86																
Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																
87	88	89	104	105	106	107	108	109	110	111	112	113																					
Fr	Ra	+Ac	Rf	Ha	Sg	Ns	Hs	Mt	110	111	112	113																					

I'm hit! I'm hit! I've lost an electron!!

Are you sure??

I'm positive!!!



Another casualty in the War of the Atoms

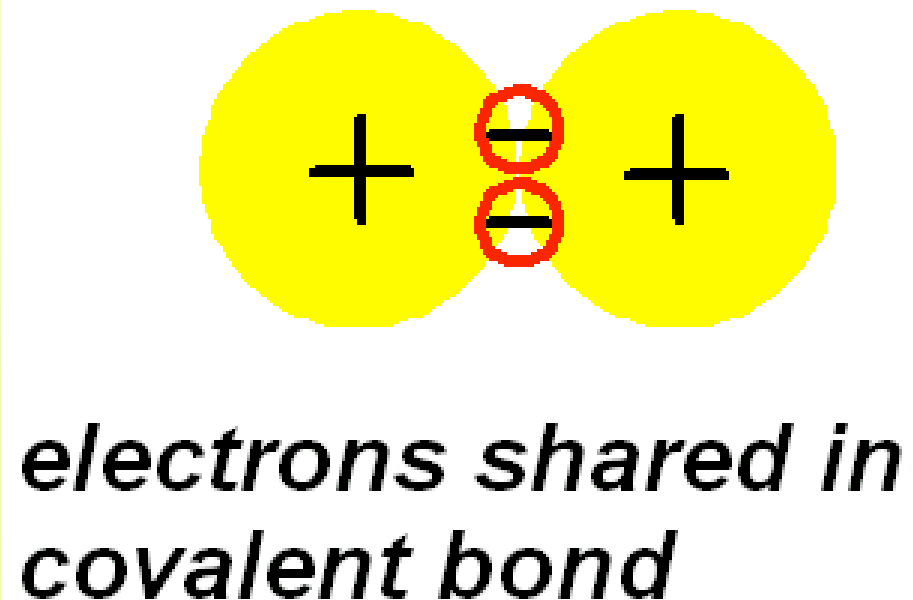




# COVALENT BONDING

---

- When atoms **SHARE** electrons.
- Usually between 2 nonmetals.



# COVALENT BONDING

- Double bond:  
share 2 pairs of  
electrons.

ie:  $O=O$

- Triple bond:  
share 3 pairs of  
electrons.

ie:  $N \equiv N$

## Compounds of Carbon

Carbon Monoxide

CO



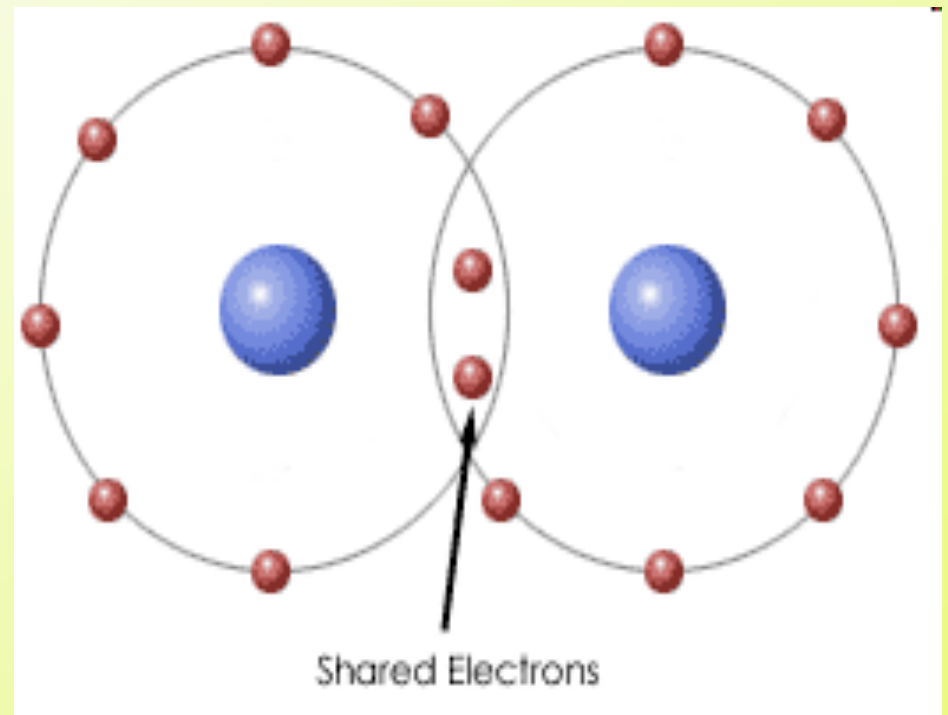
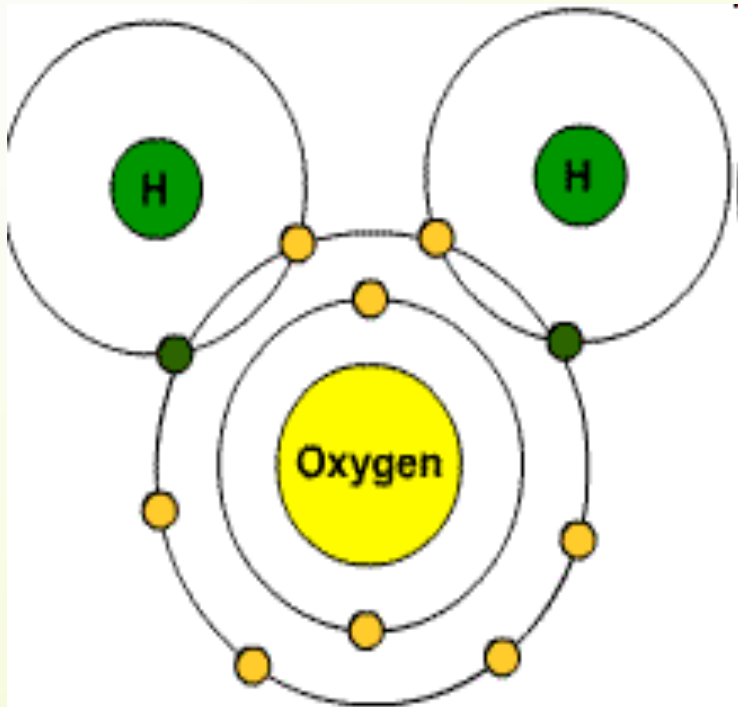
Carbon Dioxide

CO<sub>2</sub>



C. Ophardt, c. 2003

# COVALENT BONDS: Share



# BONDING

- POLAR BOND: Electrons shared unequally. ie:  $\text{H}_2\text{O}$
- NONPOLAR: Electrons shared equally. ie:  $\text{F}_2$





LET'S TAKE TIME TO THINK ABOUT WHAT  
WE HAVE LEARNED. :)