Introduction to Types of Bonds
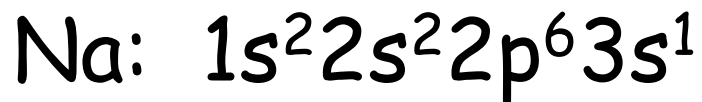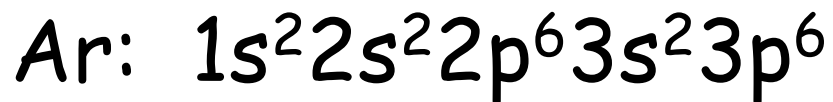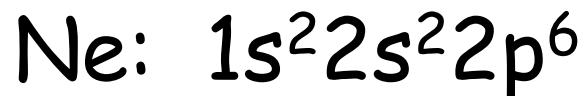
Why bother making bonds?

Atoms want to have a full outer shell like the noble gases have:

Why bother making bonds?

Atoms want to have a full outer shell like the noble gases have:

Ne: $1s^2 2s^2 2p^6$

Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$

Na: $1s^2 2s^2 2p^6 3s^1$

*NOTICE: A full outer shell = 8 e$^-$

One valence electron

What happens during a chemical reaction?

A CHEMICAL REACTION IS A CHANGE TO THE ELECTRONS:

transferring or sharing electrons in order to make "bonds"

Which electrons are involved in bonding?

⌘ <u>**Valence Electrons:**</u> The e- in the highest occupied energy level of an atom

During a Chemical Reaction

- Ionic – electrons transferred

- Covalent – electons shared

- Metallic – free flowing electrons

Types of Chemical Bonds

<u>Ionic</u>
Bond between: (Metal - Nonmetal)

<u>Covalent</u>
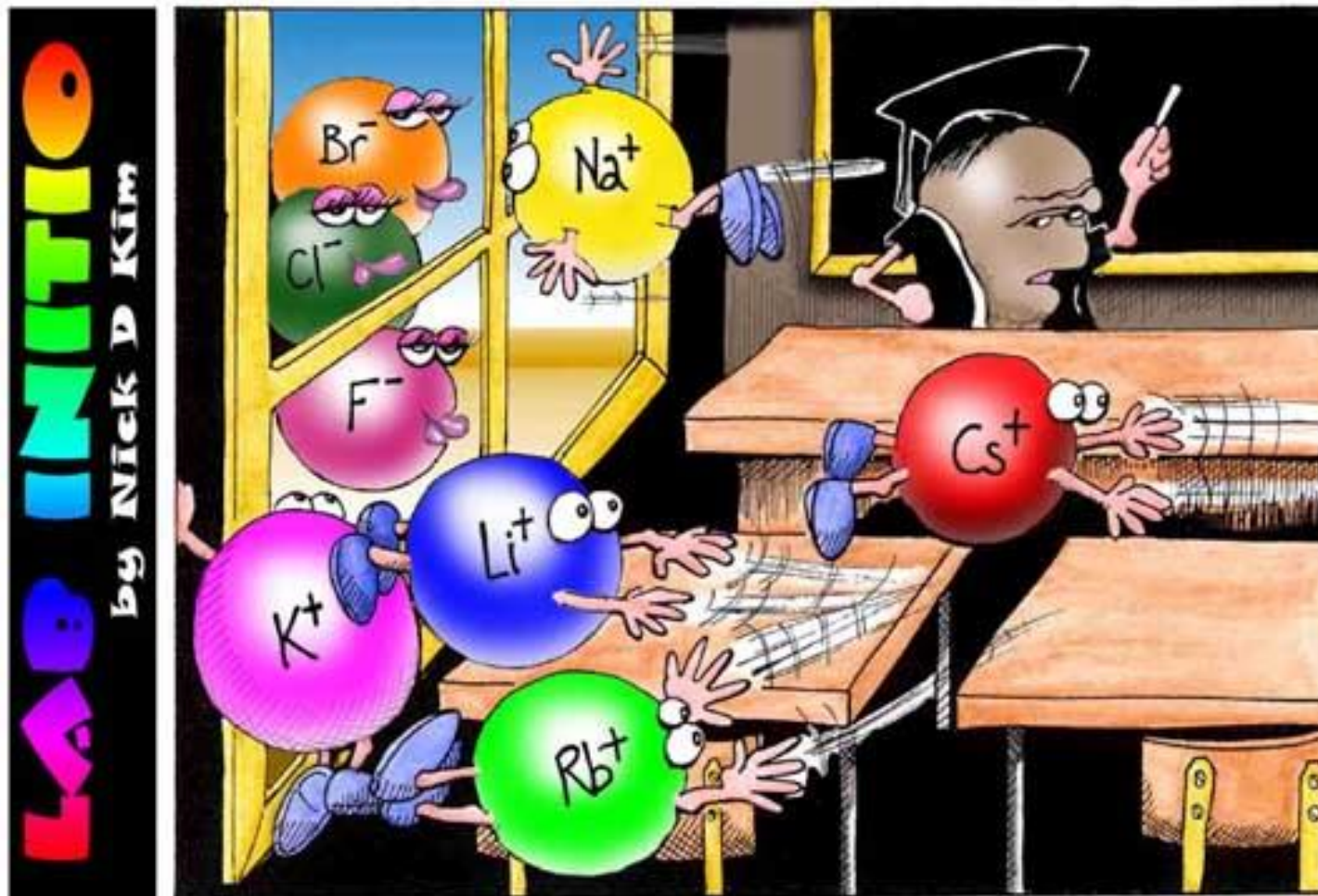Bond between: (Nonmetal - Nonmetal)

<u>Metallic</u>
Bond between: (Metal - Metal)

IONIC BONDS

Transferring Electrons

Ionic Bonds

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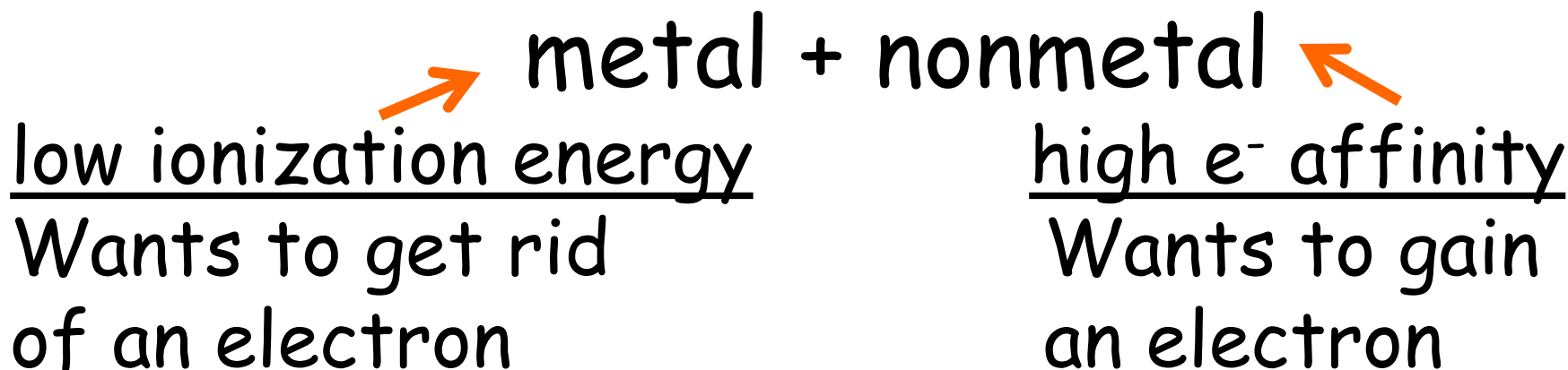
Ionic Bonds

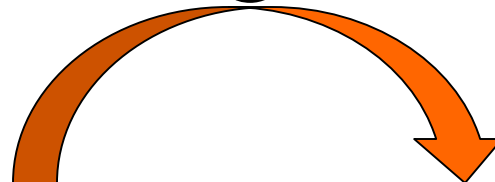"The name is Bond. James Bond.

Shaken not stirred"

"The name is Bond. Ionic Bond.

Taken not shared"

Ionic Bonds

metal + nonmetal

low ionization energy
Wants to get rid
of an electron

high e$^-$ affinity
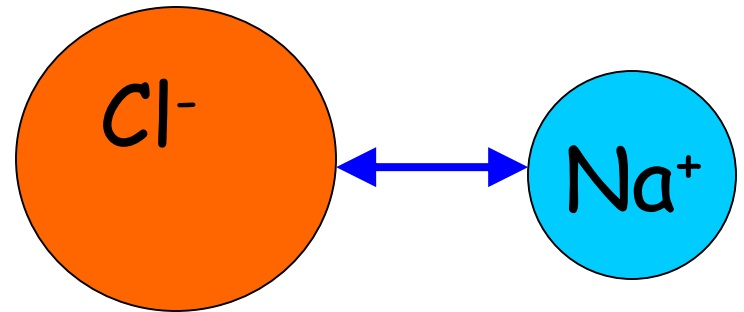Wants to gain
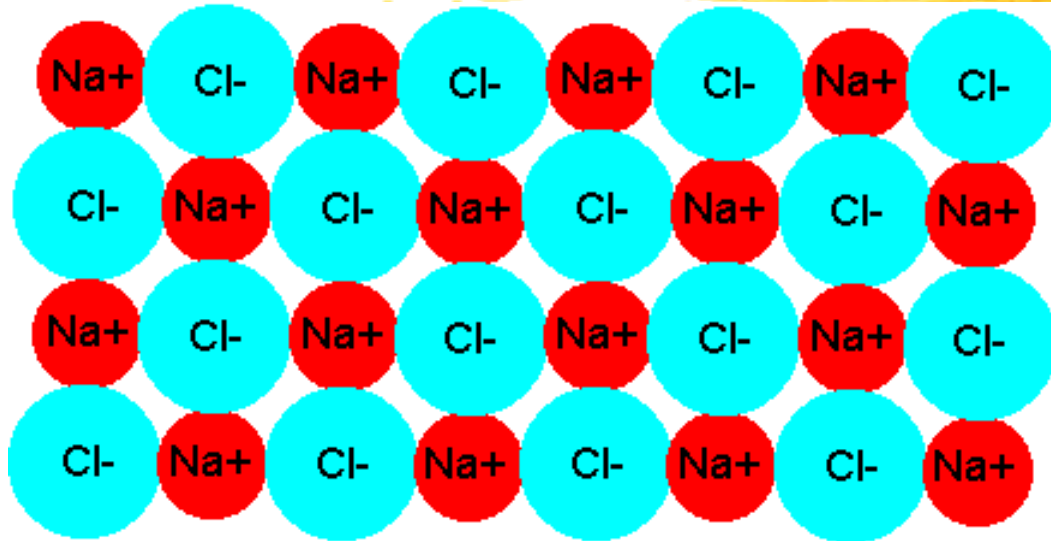an electron

Therefore:

e$^-$

Metal   +   Nonmetal
Cation (positive) + Anion (negative)

NaCl – opposites attract!

The two "happy" ions now attract each other electrically. The resulting attraction is an ionic bond. A bond between ions.
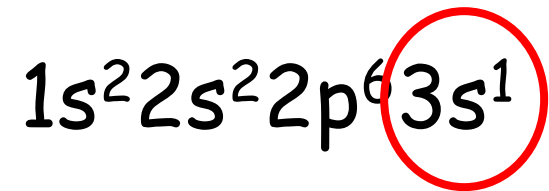
Cl⁻ ⟷ Na⁺

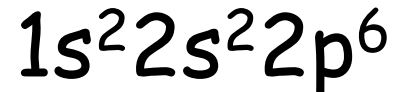# Sodium Chloride (Ionic Compound)

Example: Na & Cl…

Sodium (Na) has 11 electrons

$1s^2 2s^2 2p^6 \boxed{3s^1}$

One valence electron

By losing this electron Na^+ becomes

$$1s^2 \underline{2s^2 2p^6}$$

Which has a full outer electron level.

Chlorine (Cl) has 17 electrons

$$1s^2 2s^2 2p^6 3s^2 3p^5$$
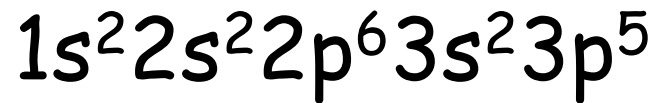
By gaining an electron it becomes…

Cl^- $1s^2 2s^2 2p^6 \underline{3s^2 3p^6}$
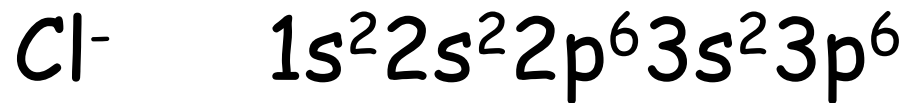
Which also has a filled outer energy level.

Properties of Ionic Compounds

- They are solids with high melting points (typically > 400°C)

- Many are soluble in water

Properties of Ionic Compounds

- Molten compounds conduct electricity well because they contain mobile charged particles (ions).

- Aqueous solutions conduct electricity well for the same reason.

Properties of Compounds

Properties of compounds often have VERY different properties than the individual elements.

Sodium is an explosive metal

Chlorine is a poisonous gas.

Sodium Chloride you put on your fries
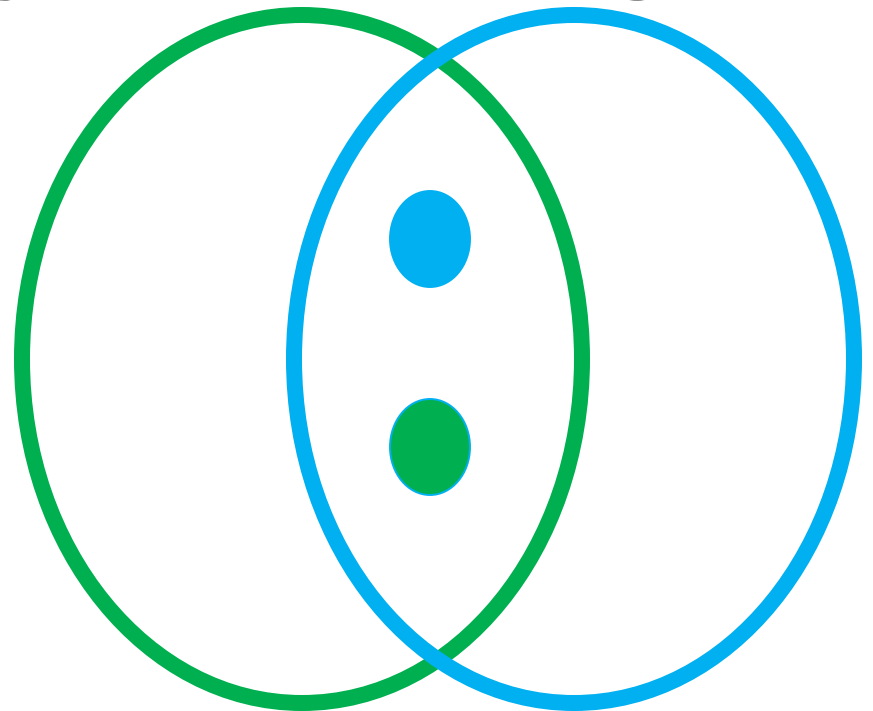
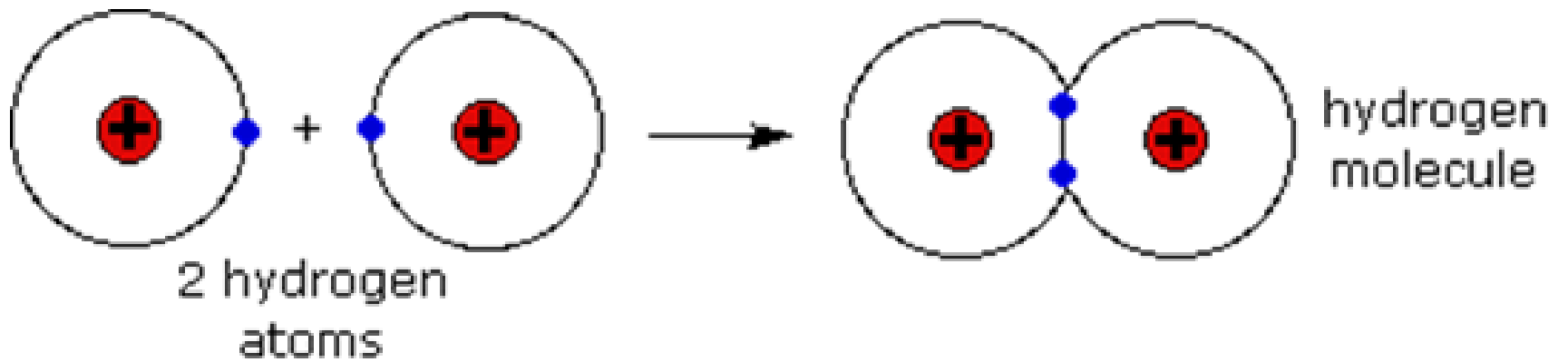# COVALENT BONDS

Sharing Electrons

Nonmetal - Nonmetal
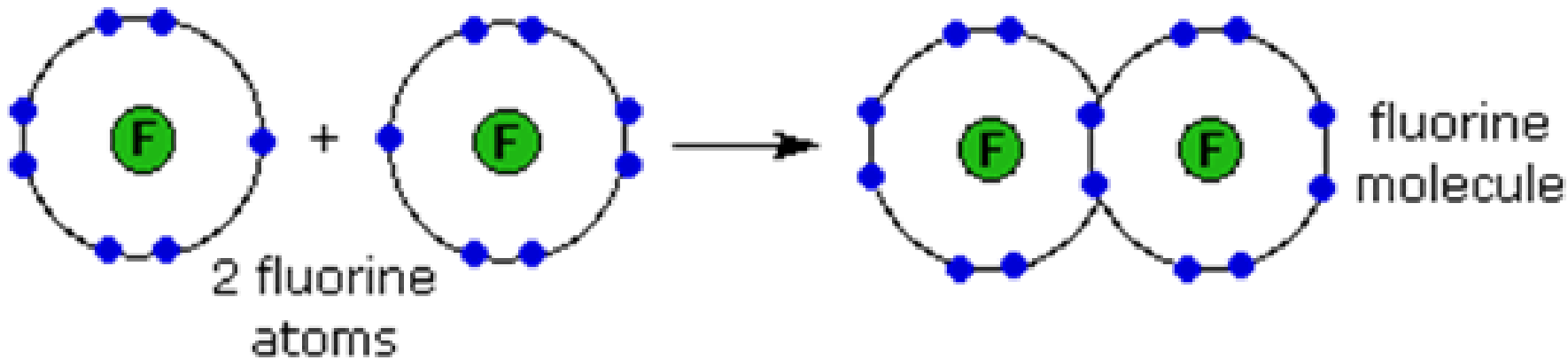
Sharing electrons tricks each element into thinking it has 8

Each atom THINKS it owns both electrons...

Even though they are sharing!

They each "donate" what they can to the bond

2 hydrogen atoms → hydrogen molecule

+ 2 fluorine atoms → fluorine molecule

2 { O } + { C } → { O } { C } { O } carbon dioxide molecule

2 oxygen atoms   carbon atom

4

4 fluorine
atoms

+

carbon
atom

a molecule of
carbon tetrafluoride
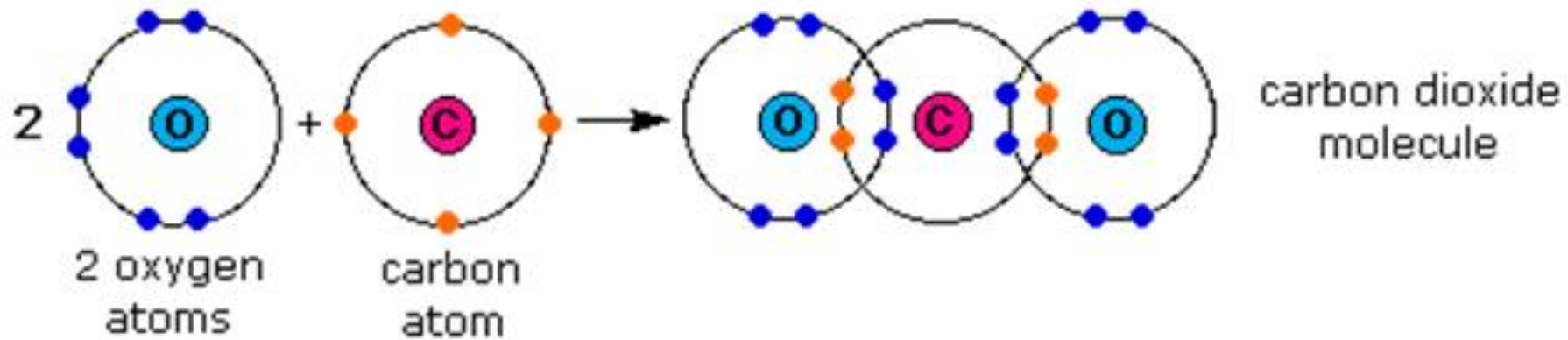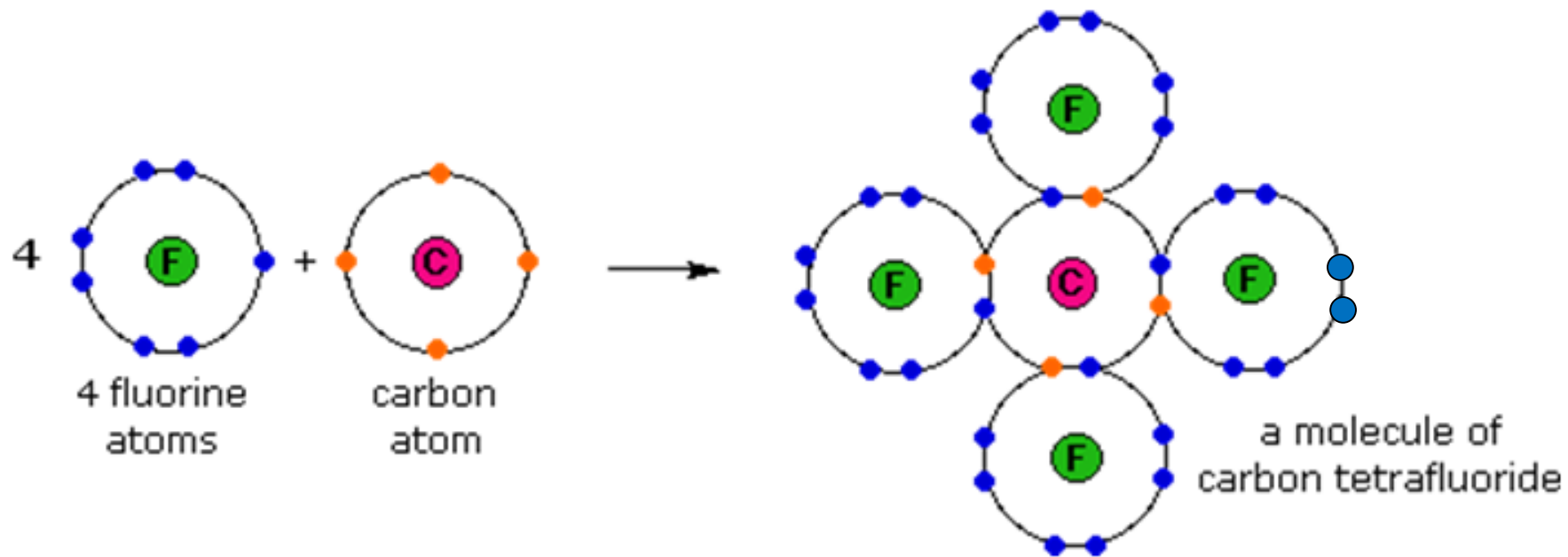
Properties of Covalent Bonds

- Don't Conduct Electricity

- Low melting points

- Usually not soluble in water

METALLIC BONDS

Free Flowing Electrons

Metal – Metal

Electrons are able to flow freely through the metal in a "SEA OF ELECTRONS"

Watch this video clip:

https://www.youtube.com/watch?v=V5tj-xADB1c
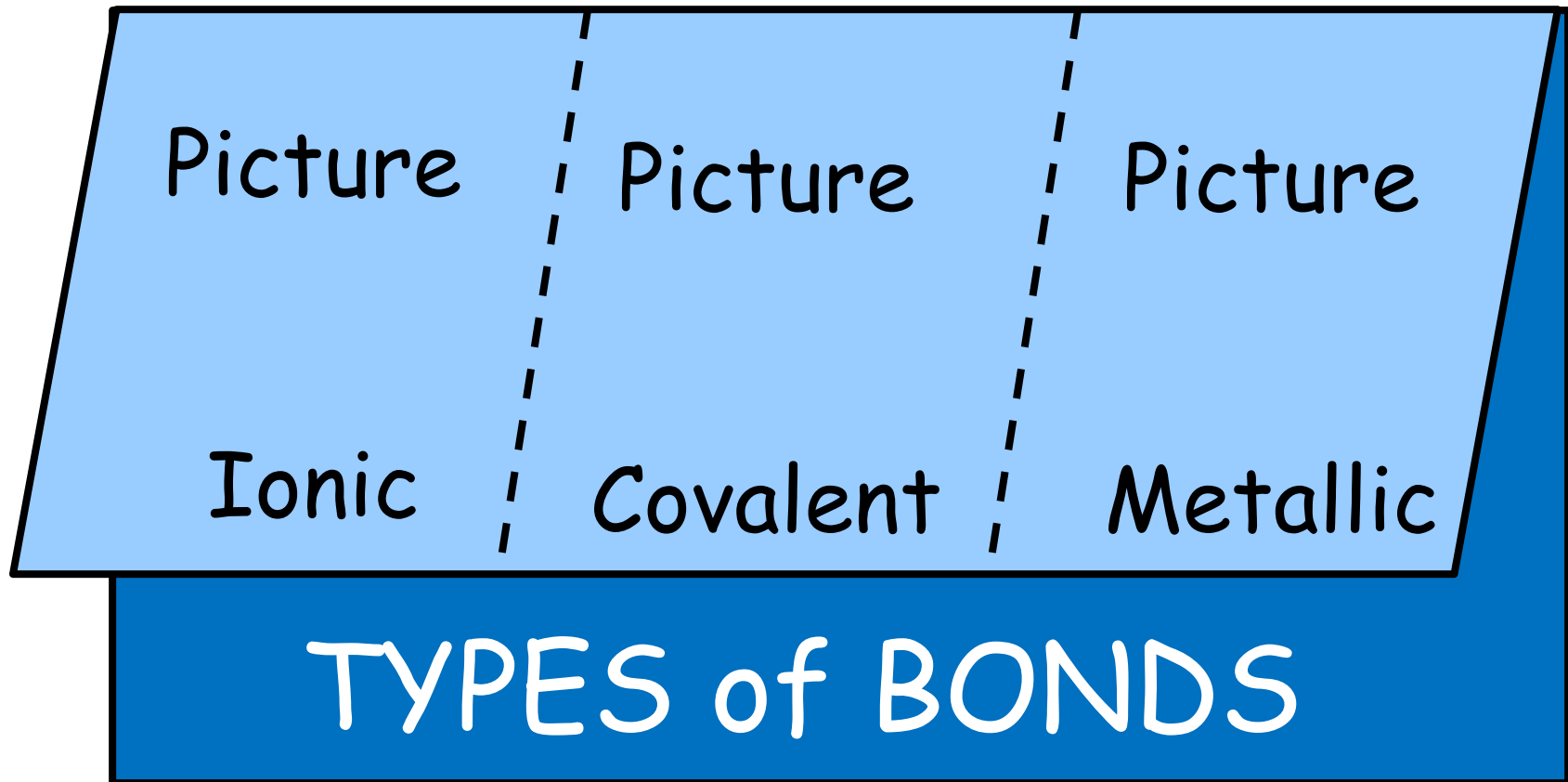
Properties of Metals

- Solid at room temperature (except for mercury...it is a liquid!)
- Conduct electricity
- Malleable
- Ductile
- Have a wide range of melting points.

WHY ARE PROPERTIES OF COMPOUNDS/MOLECULES SO DIFFERENT THAN THE PROPERTIES OF THE INDIVIDUAL ATOMS THEY MAKE UP?

Because chemical properties are due to the electron configuration of the valence electrons. During bonding, this configuration changes.

Fold-up

Picture	Picture	Picture
Ionic	Covalent	Metallic

TYPES of BONDS

Properties	Properties	Properties
Example	Example	Example
Ionic	Covalent	Metallic

Three clock questions related to types of bonds. One for Each Type of Bond - see p. 4 in your notebook

What makes up each type of bond?

Properties?

Examples?

What is happening in each?

Etc, etc, etc!!