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:

\[
\text{Ne: } 1s^22s^22p^6 \\
\text{Ar: } 1s^22s^22p^63s^23p^6
\]

\[
\text{Na: } 1s^22s^22p^63s^1 \quad \text{One valence electron}
\]

*NOTICE:*

A full outer shell = 8 e⁻
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?

**Valence Electrons:**
The e- in the highest occupied energy level of an atom
During a Chemical Reaction...

- **Ionic** – electrons transferred
- **Covalent** – electrons shared
- **Metallic** – free flowing electrons
Types of Chemical Bonds

**Ionic**
Bond between: (Cation – Anion) – usually…. (Metal - Nonmetal)

**Covalent**
Bond between: (Nonmetal - Nonmetal)

**Metallic**
Bond between: (Metal - Metal)
IONIC BONDS

Transferring Electrons
(to make ions, then ions are attracted to each other)
Ionic Bonds

“The name is Bond. James Bond.
Shaken not stirred”

“The name is Bond. Ionic Bond.
Taken not shared”

“Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive...?”
Sodium (Na) has 11 electrons

\[ 1s^22s^22p^63s^1 \]
One valence electron

By losing this electron it becomes…
\[ \text{Na}^+ \quad 1s^22s^22p^6 \]
Which has a full outer electron level.

Chlorine (Cl) has 17 electrons

\[ 1s^22s^22p^63s^23p^5 \]
Seven valence electrons

By gaining an electron it becomes...
\[ \text{Cl}^- \quad 1s^22s^22p^63s^23p^6 \]
Which also has a filled outer energy level.

Example: Na & Cl…
Ionic Bonds

Metal + Nonmetal

Wants to get rid of an electron
low ionization energy

Wants to gain an electron
high electronegativity

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.
Sodium Chloride – an Ionic Compound

Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻
Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺
Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻
Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺ Cl⁻ Na⁺
Properties of Ionic Compounds

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

• Many are soluble in water (the bonds are broken by water molecules getting in between the atoms)
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 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
Because chemical properties are due to the electron configuration of the valence electrons. During bonding, this configuration changes.
**COVALENT BONDS**

**Sharing Electrons**

(between two atoms – not as good as ionic, but better than nothing!)
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...
Some examples - don’t need to write them down

2 hydrogen atoms + 2 hydrogen atoms → hydrogen molecule
2 fluorine atoms + 2 fluorine atoms → fluorine molecule
2 oxygen atoms + carbon atom = carbon dioxide molecule
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
(electrons float around randomly, don’t “belong” to one atom anymore)
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 and Ductile
• Have a wide range of melting points.
Fold-up

TYPES of BONDS

- Ionic
- Covalent
- Metallic
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Three clock questions related to types of bonds. One for Each Type of Bond - see p. 4 in your notebook (or the next slide on this document)

What makes up each type of bond?

Properties?

Examples?

What is happening in each?

Etc, etc, etc!!
The Clock Questions

The 12 clock questions are just a few ideas to help focus your attention and guide your learning of the science content and concepts.

1. Write a science fiction story.
2. Paraphrase this information into 2 sentences.
3. Create and solve 3 original problems.
4. Write four "What if..." statements about this topic.
5. Create a visual illustration explaining this information.
6. Write a letter to ____ about this issue.
7. Compare & contrast 2 or more ideas with a Venn Diagram.
8. Create a concept map to show the relationships within this topic.
9. Make vocabulary cartoons from this topic.
10. Explain the application of this information to a real life situation.
11. What more do I want to learn about this topic?
12. What's my study plan to learn this information?