The Basics of Chemical Bonds

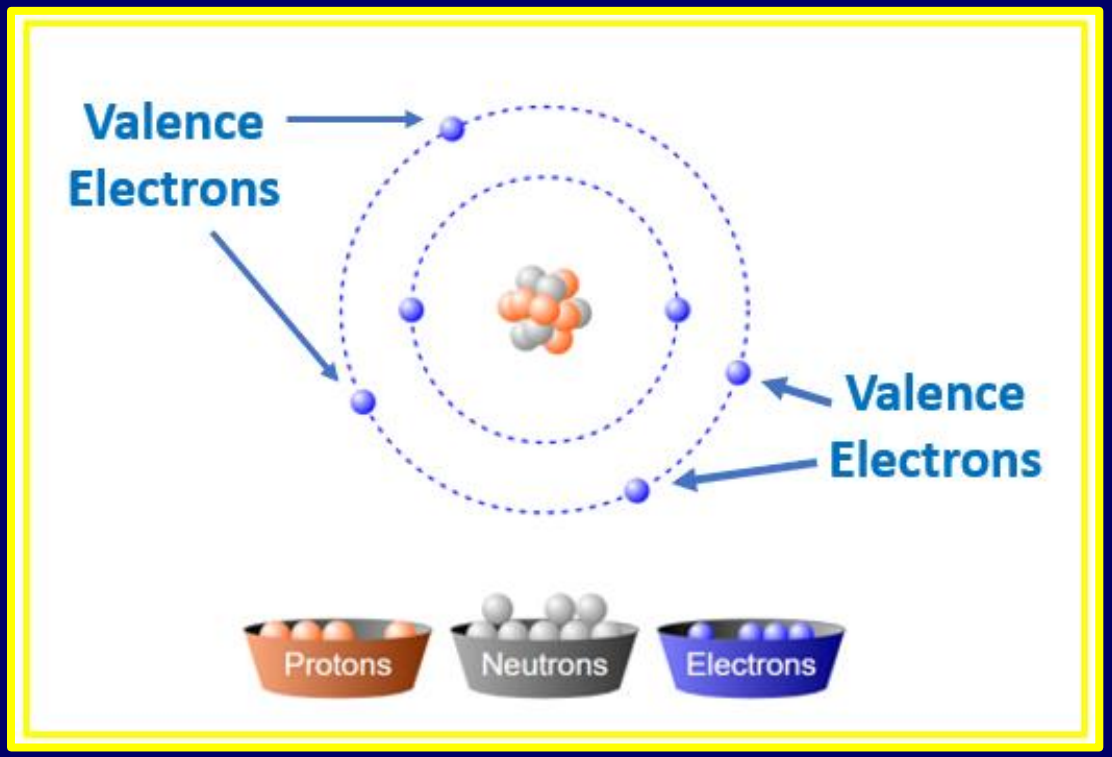
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can explain how ionic, covalent, hydrogen ,and metallic bonds are formed.
- I can identify which compounds are formed by ionic, covalent, and metallic bonds.

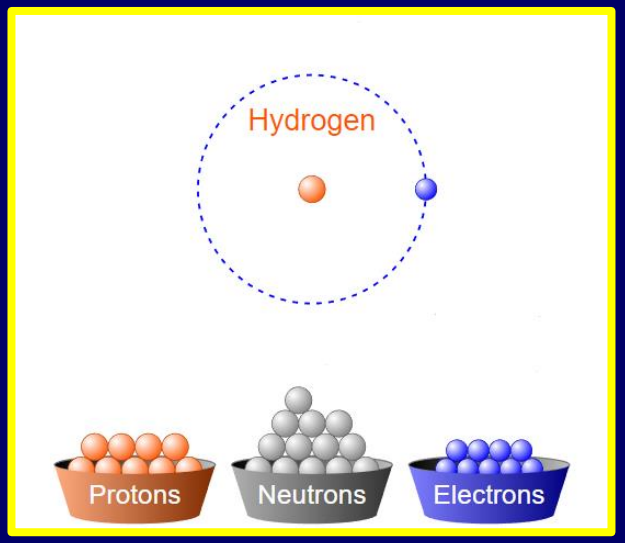
Valence Electrons

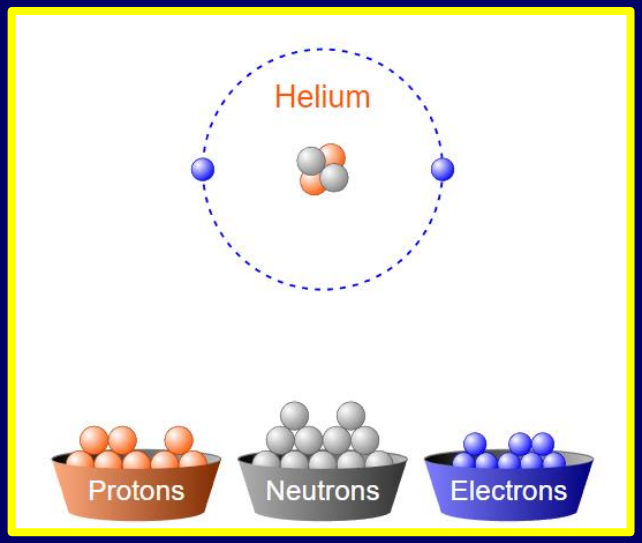
Recall that valence electrons are the electrons found in the outer energy level of any atom.



Full Outer Energy Levels

All atoms want as many valence electrons as their outer energy level can hold.

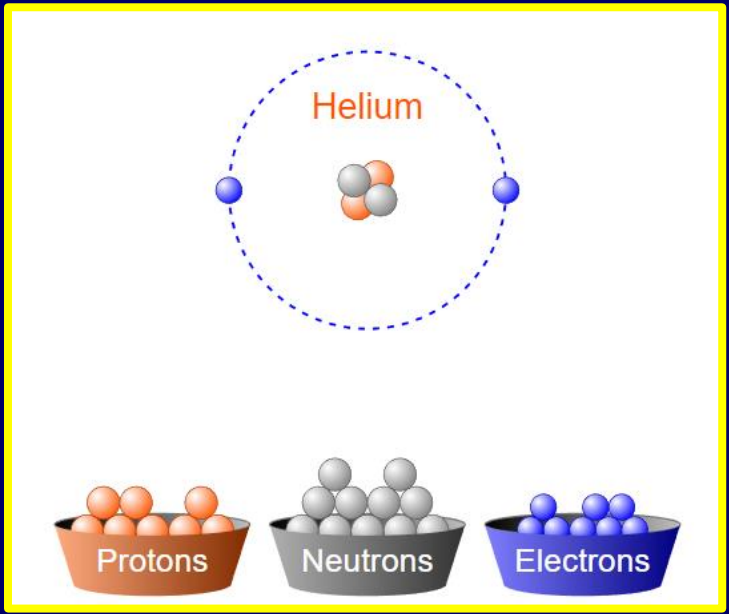




Both hydrogen and helium have only one energy level, so each atoms wants 2 valence electrons.

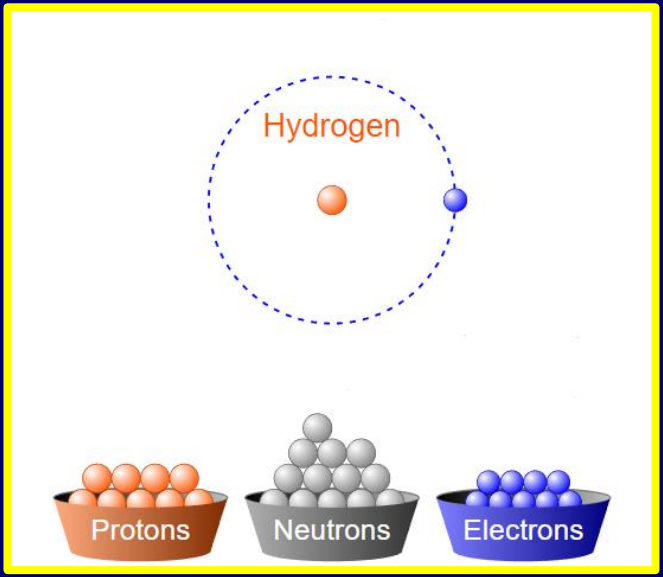
Helium

Because helium's outer energy level is full, with 2 valence electrons, it will never react with any other atom, making it a very stable atom.



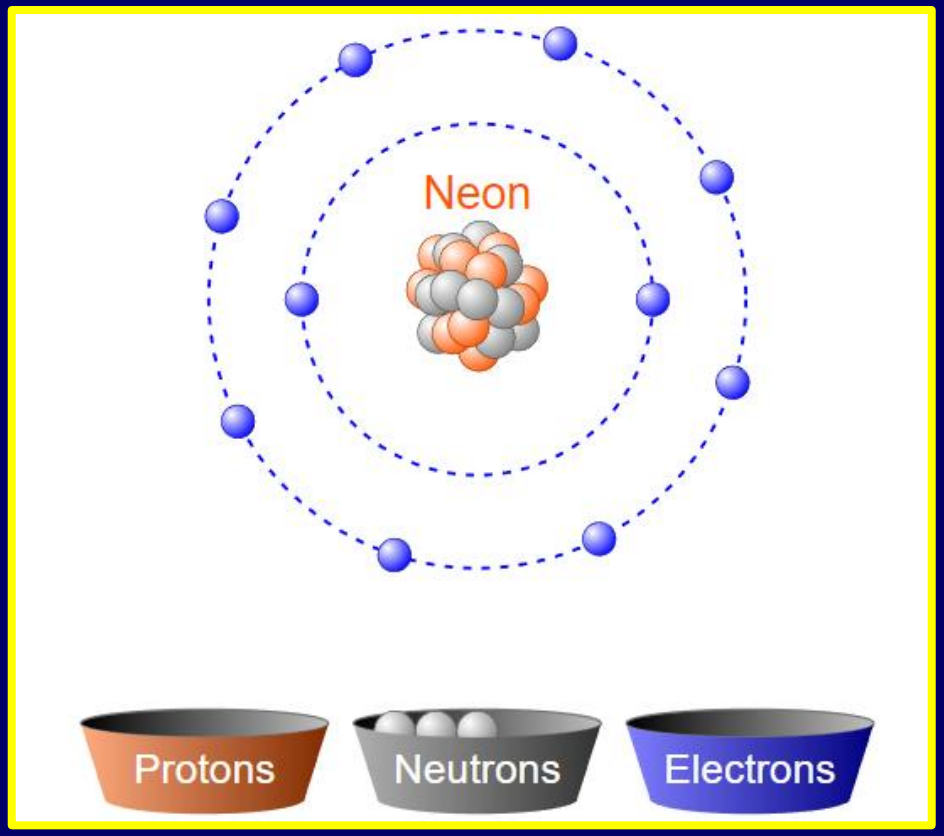
Hydrogen

Because hydrogen's outer energy level is not full, hydrogen will react with other atoms to try to fill its outer energy level, making hydrogen a very reactive atom.



Octet Rule

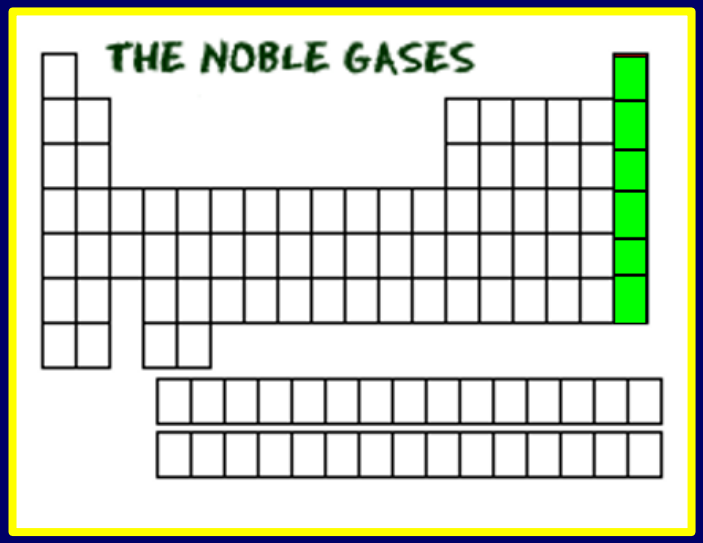
All other elements have 2 or more energy levels and want 8 valence electrons.



This is known as the Octet Rule.

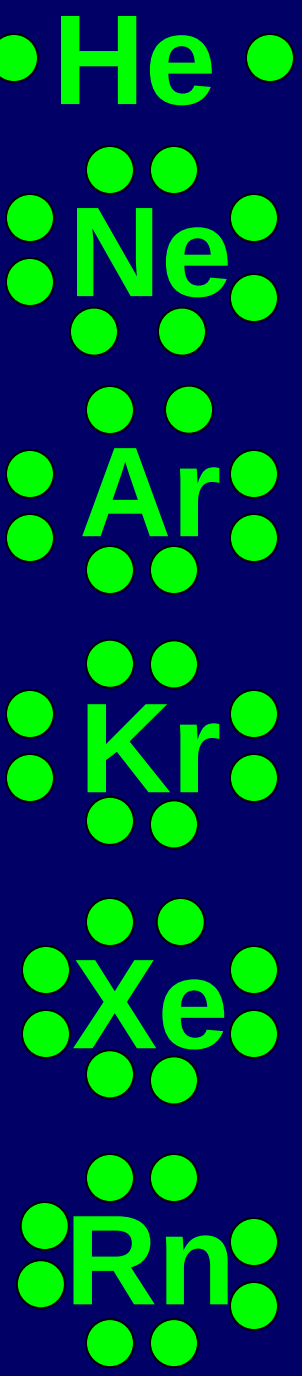
Noble Gases

The last group on the periodic table all have 8 valence electrons, except helium, which has 2 valence electrons.



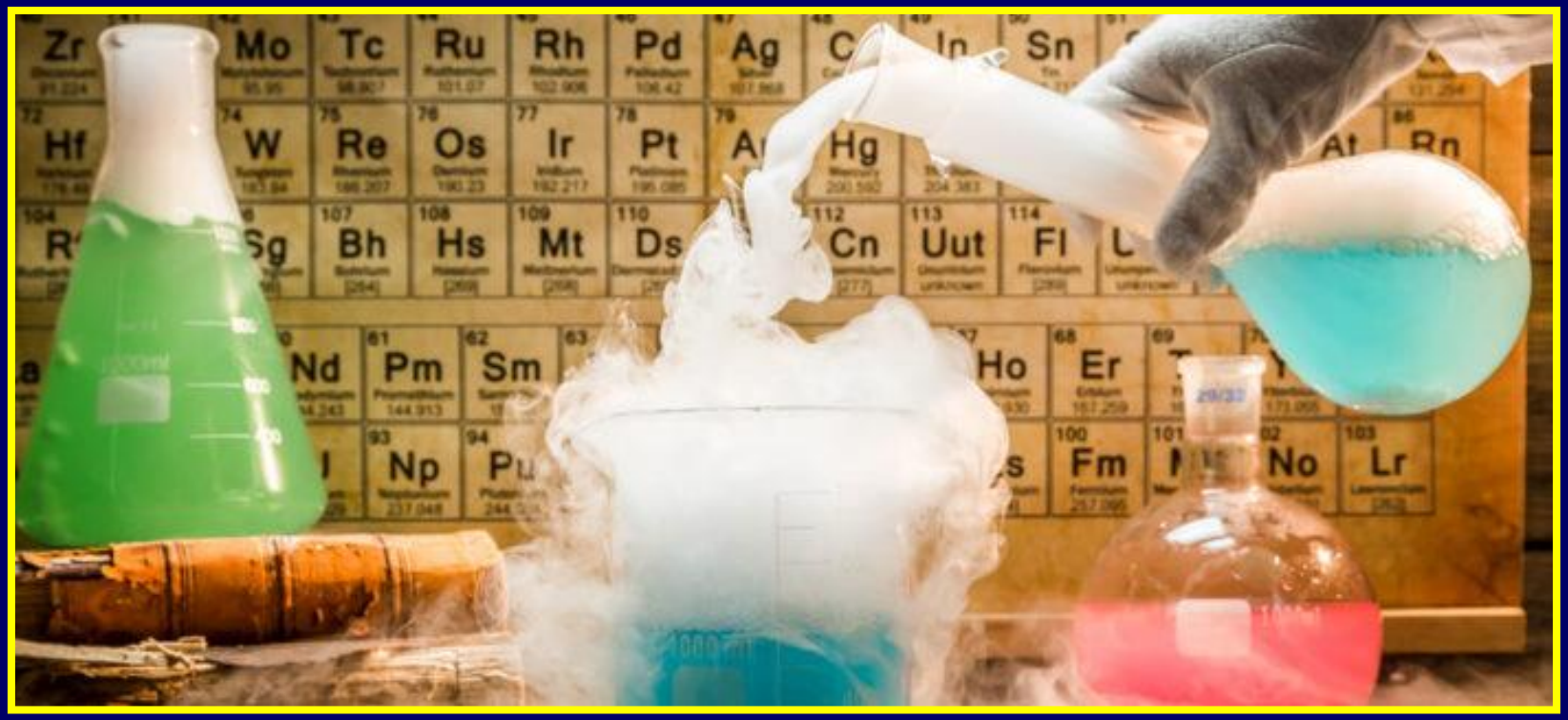
He	Helium
Ne	Neon
Ar	Argon
Kr	Krypton
Xe	Xenon
Rn	Radon

Like helium, since their outer energy level is full, these atoms will never react with other atoms.



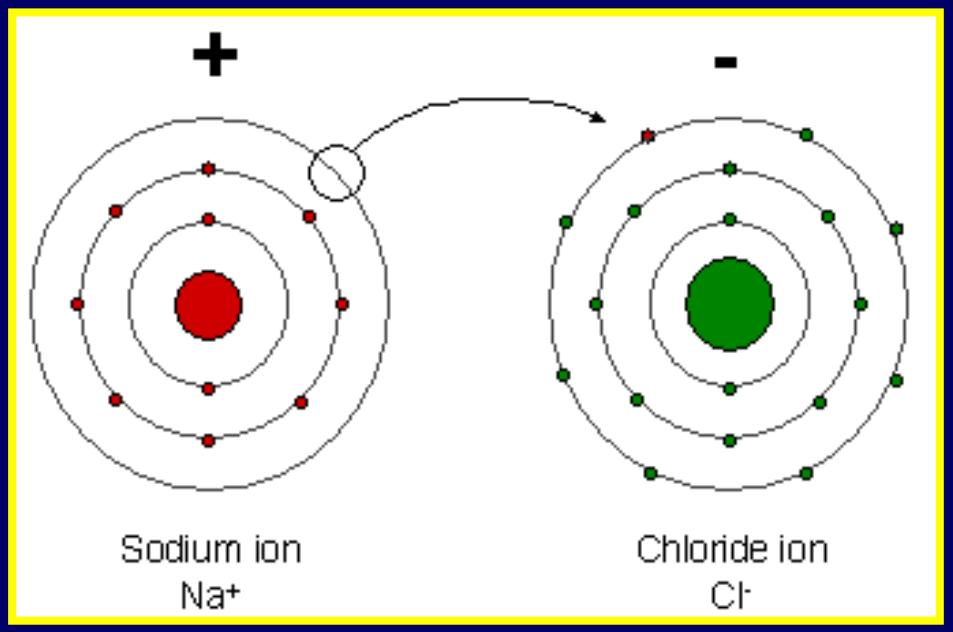
Meeting the Octet Rule

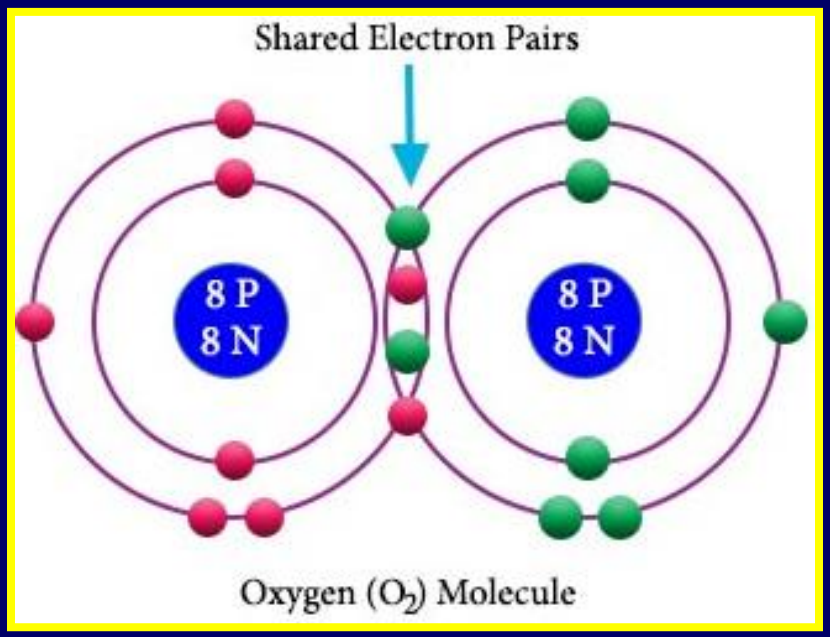
Like hydrogen, all the other elements will react with other atoms, through chemical reactions, until they meet the octet rule.



Meeting the Octet Rule

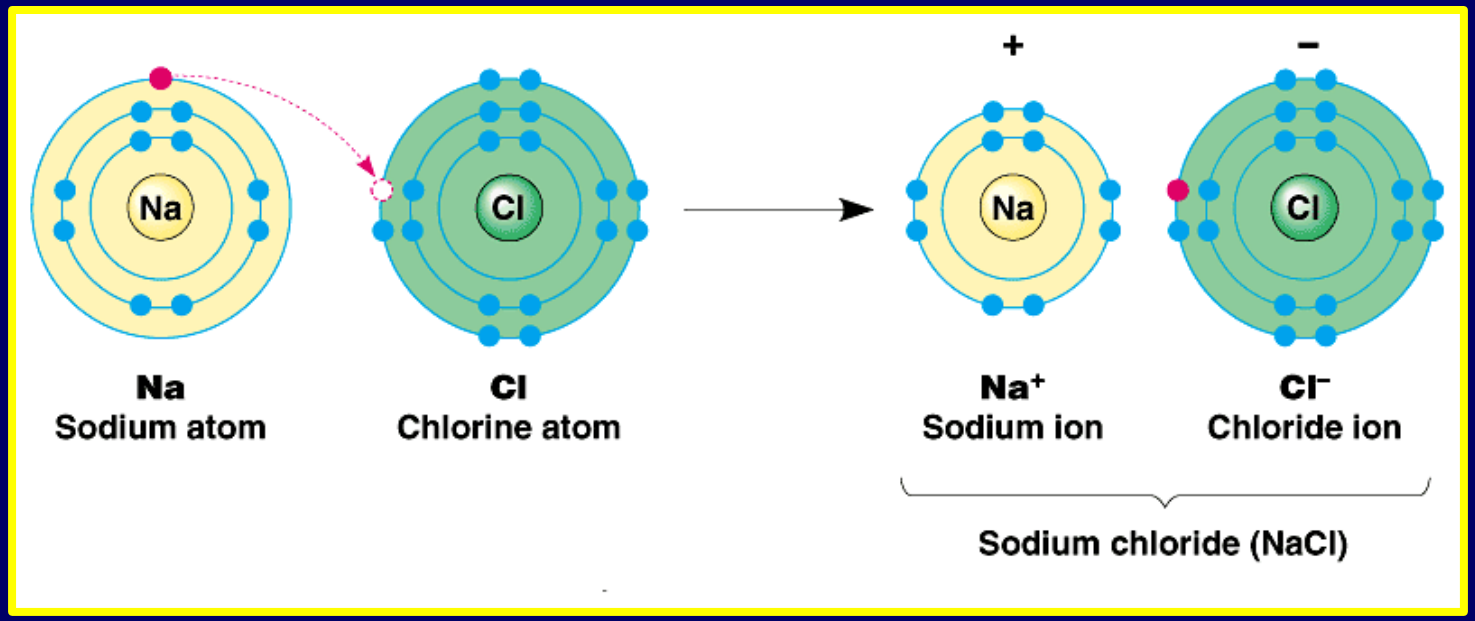
To meet the octet rule, atoms can gain, lose, or share valence electrons.





Chemical Bonds

When atoms lose, gain, or share valence electrons, a chemical bond is formed between the atoms and a new compound is created.



Type of Chemical Bonds

There are four main types of chemical bonds:

Ionic Bonds

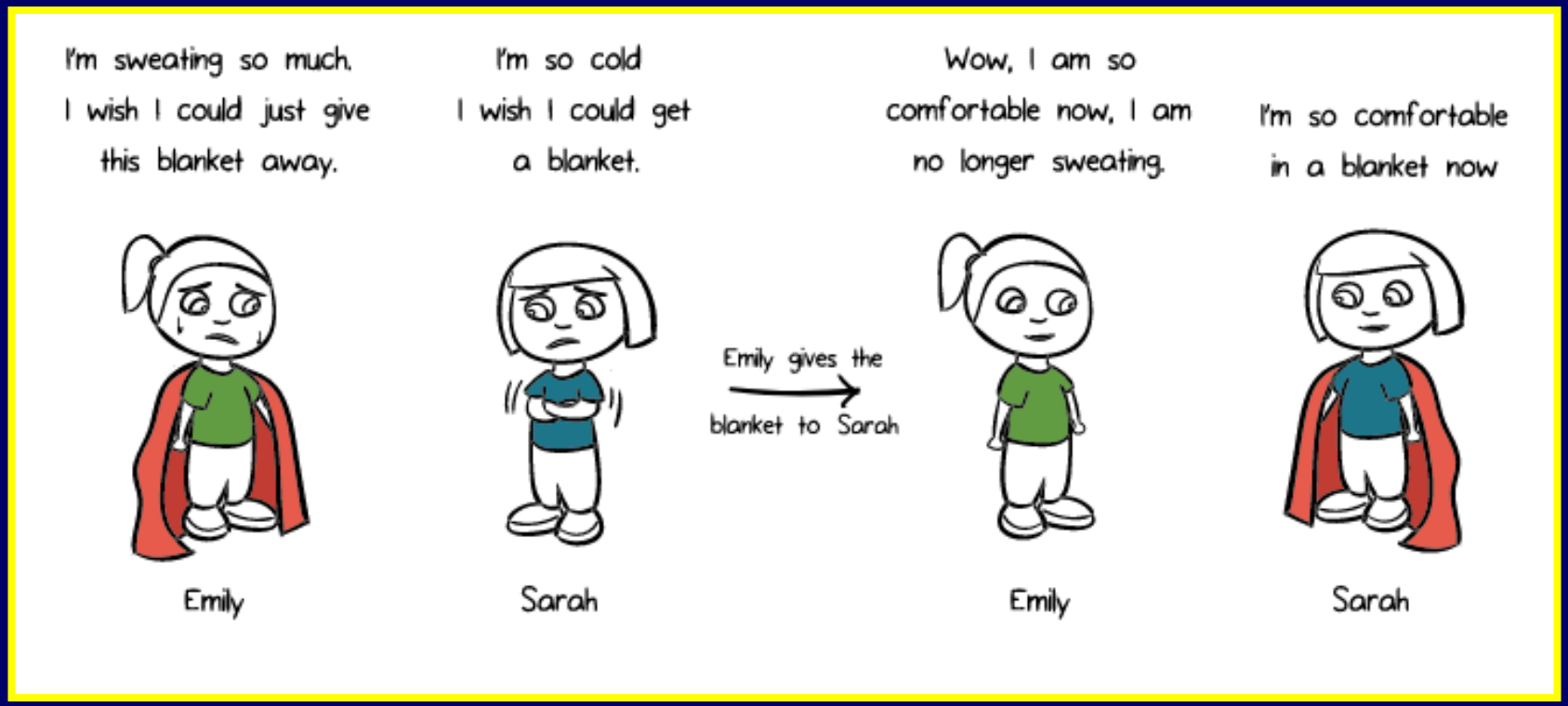
Covalent Bonds

Hydrogen Bonds

Metallic Bonds

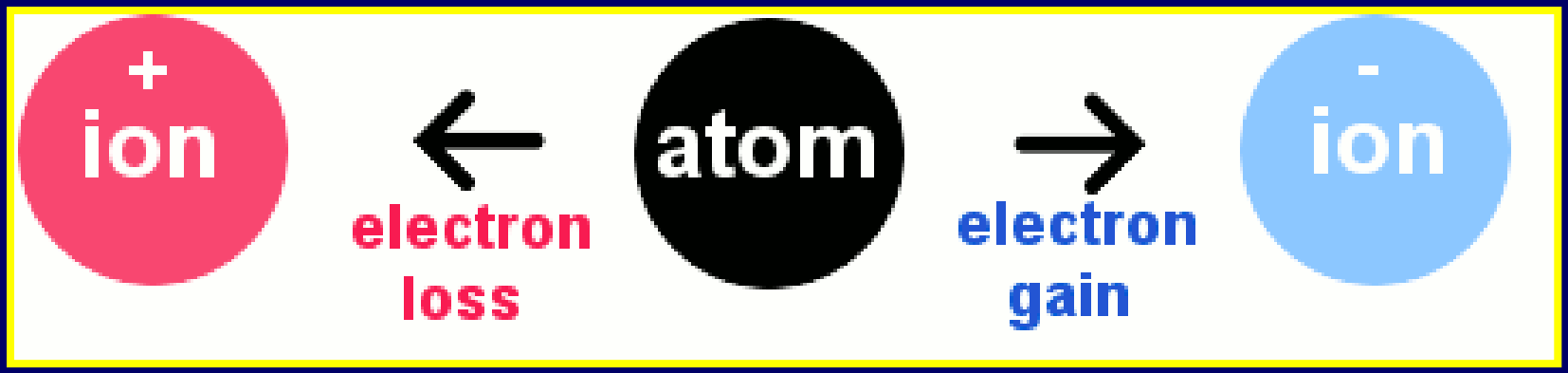
Ionic Bonds

Ionic bonds are formed when a metal and a non-metal exchange electrons.



Ions

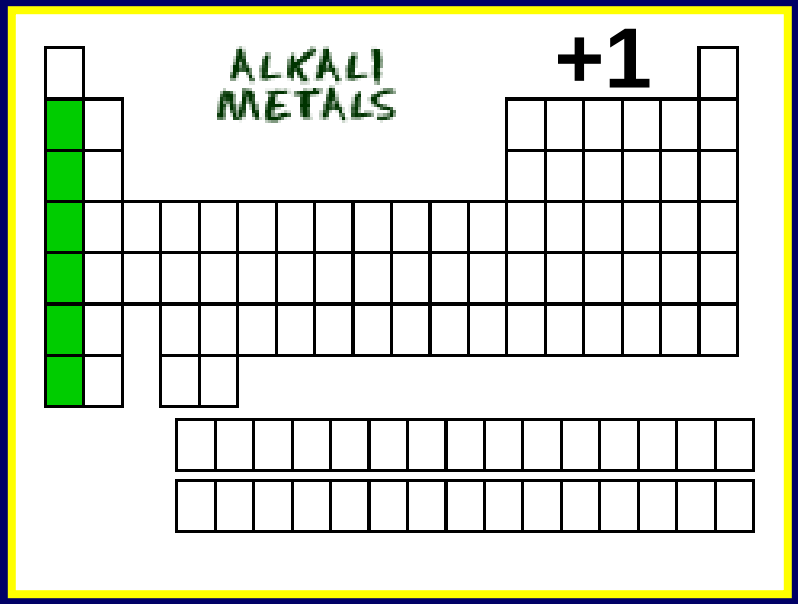
When atoms gain or lose electrons, they develop a charge and are called Ions.

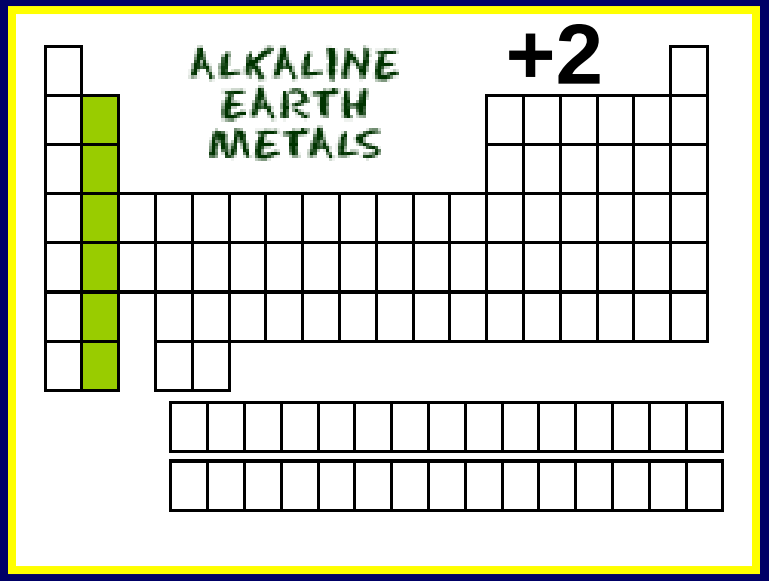


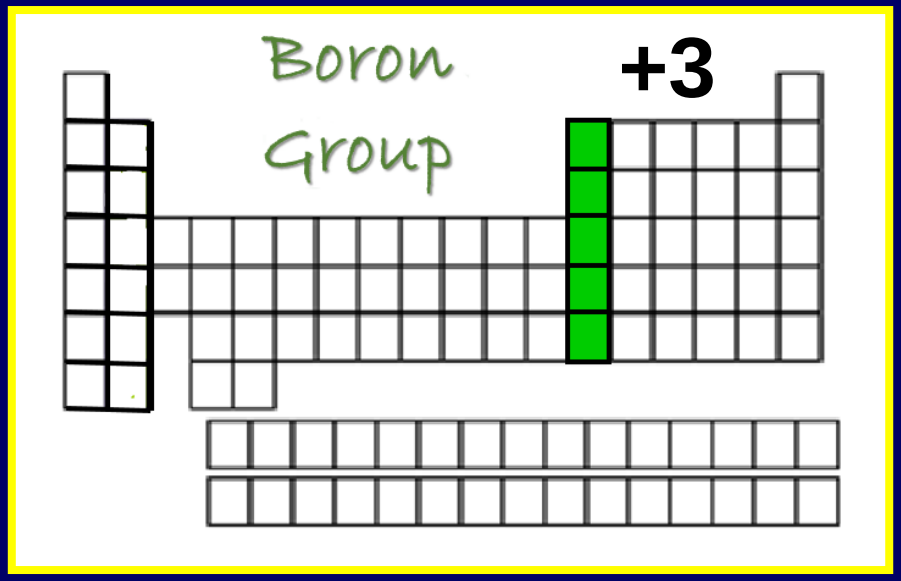
In other words, an ion is an atom with a positive or negative charge.

Metals → Positive Ions

Metals lose electrons and develop a positive change, in the process.

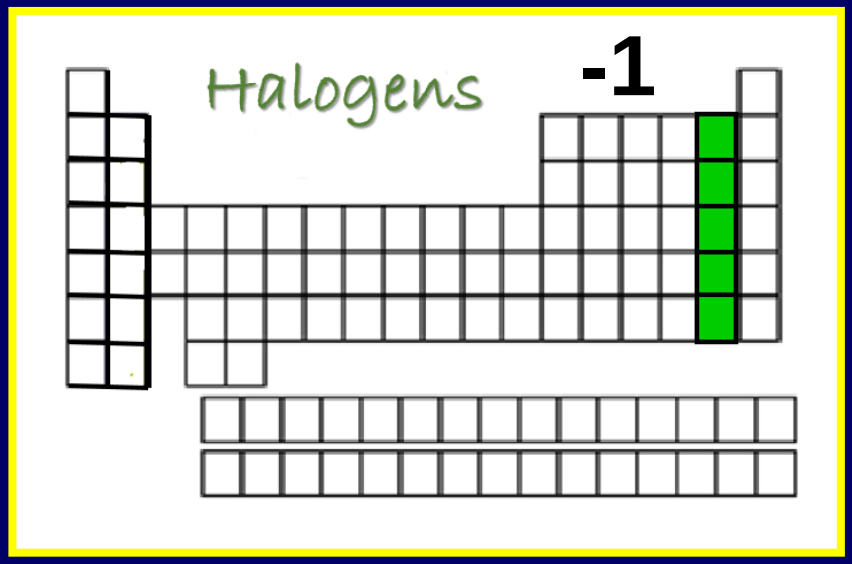


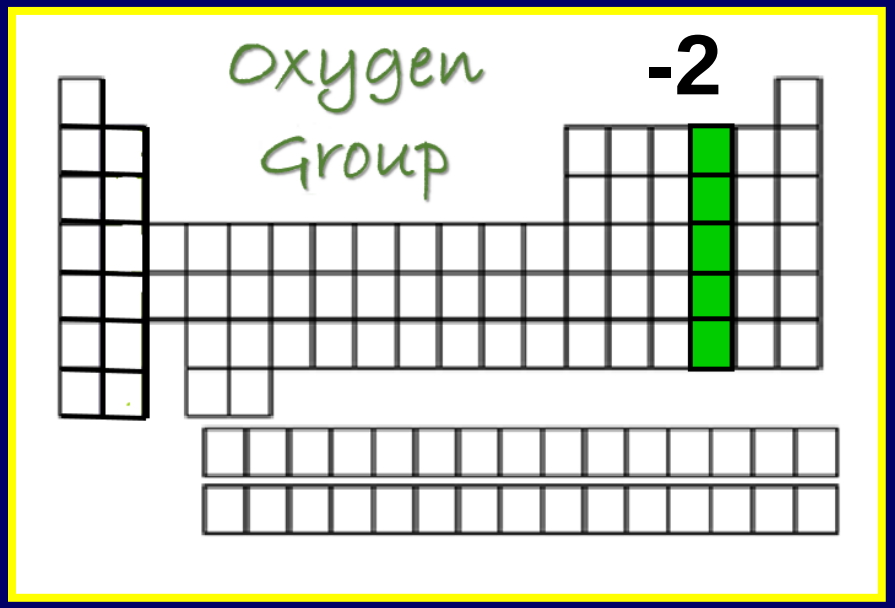


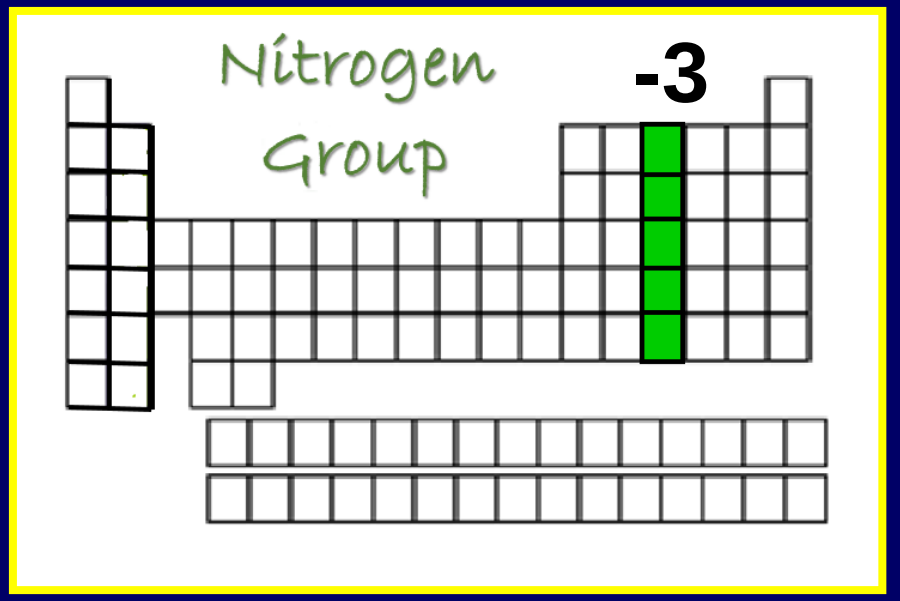


Nonmetals → Negative Ions

Nonmetals gain electrons and develop a negative charge, in the process.

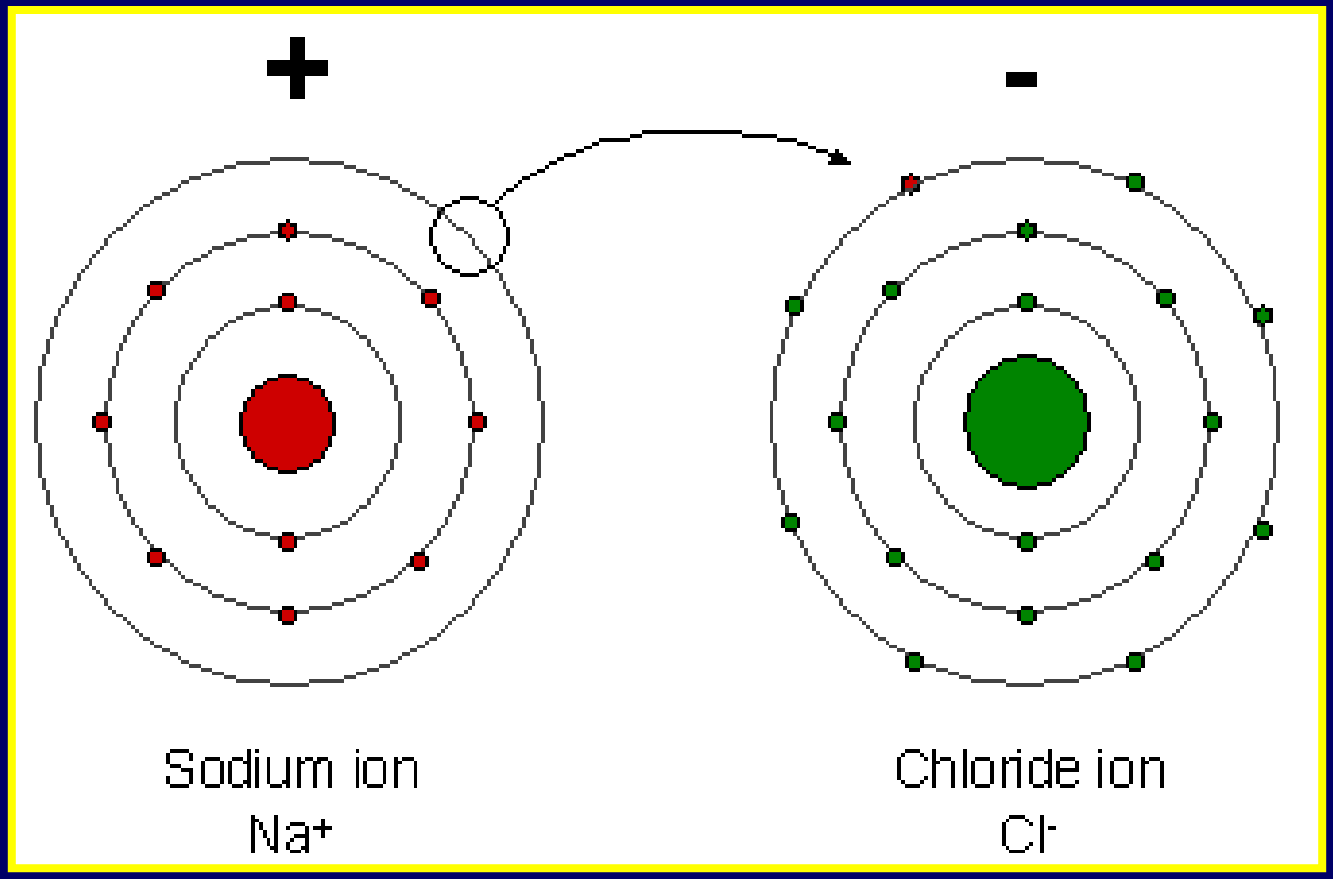






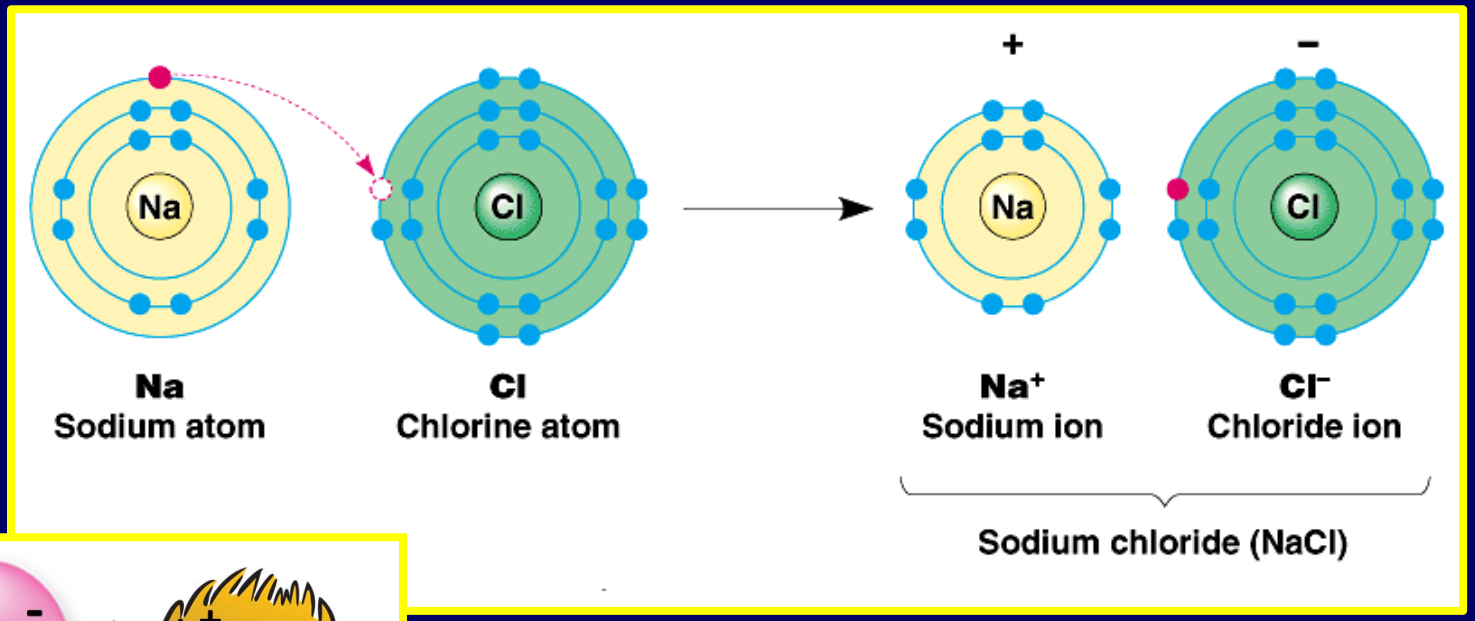
Ion Exchange

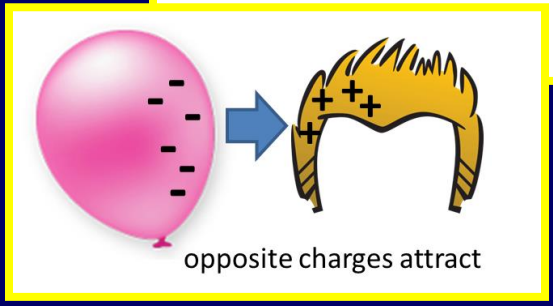
After the electron exchange takes place, the atoms become oppositely charged ions.



Ionic Bonds

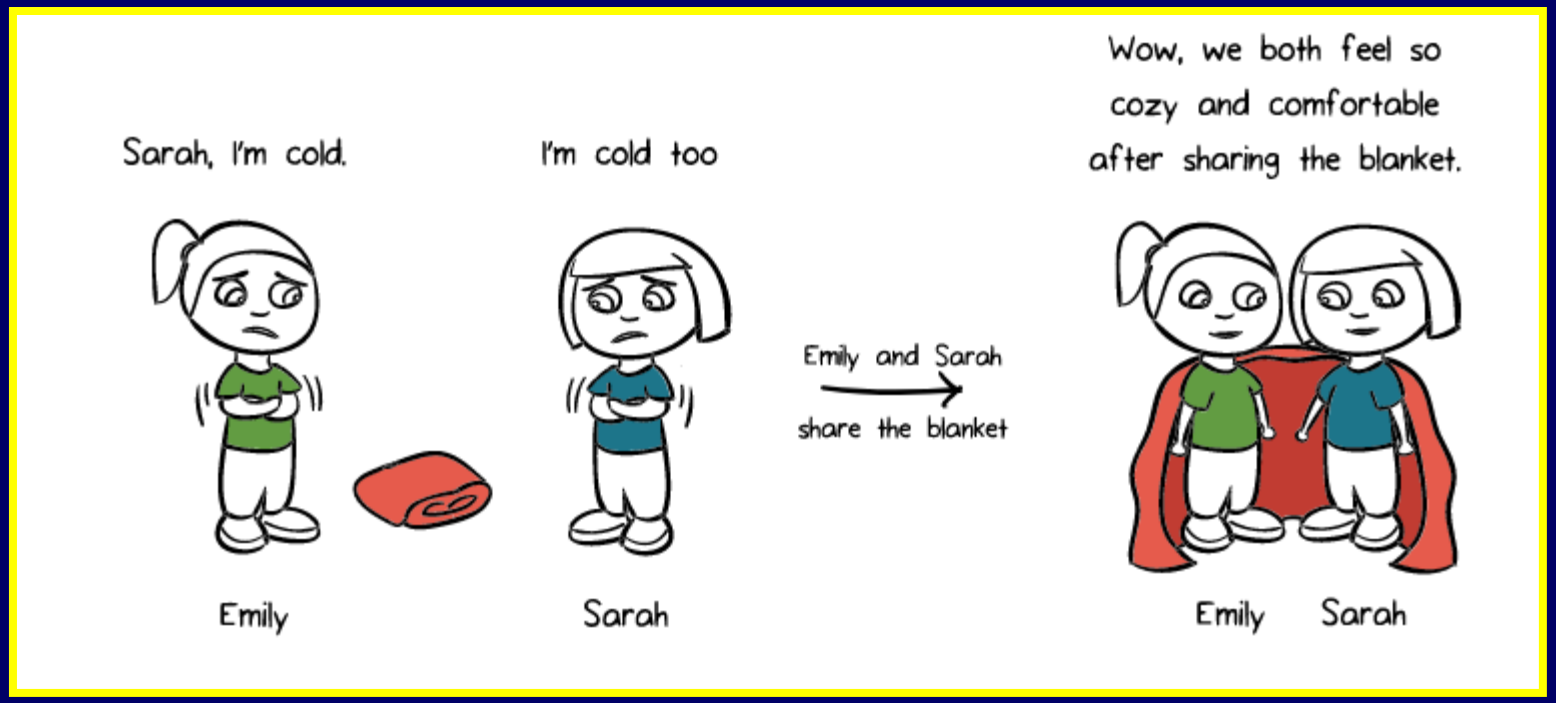
Ions with opposite charges attract each other and join together by an electrostatic attraction to form an ionic compound.





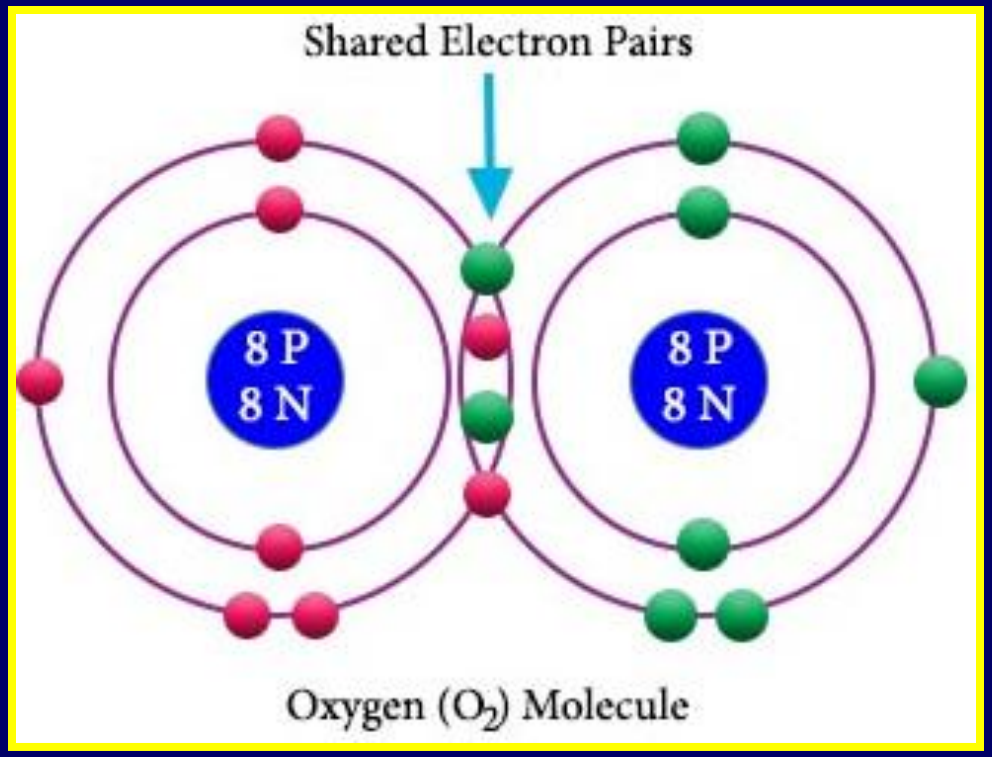
Covalent Bonds

Covalent bonds are formed when non-metals share electrons.



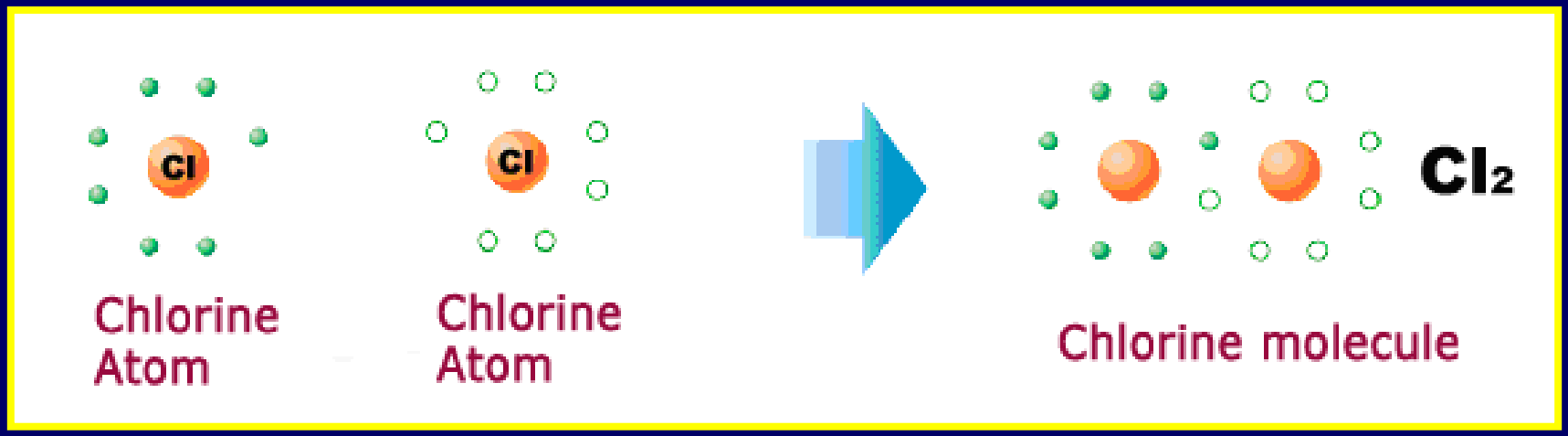
Sharing Electrons

When non-metals share electrons, they don't lose or gain electrons, so they don't develop a charge.



Covalent Bonds

When atoms join together by sharing valence electrons they form covalent bonds.

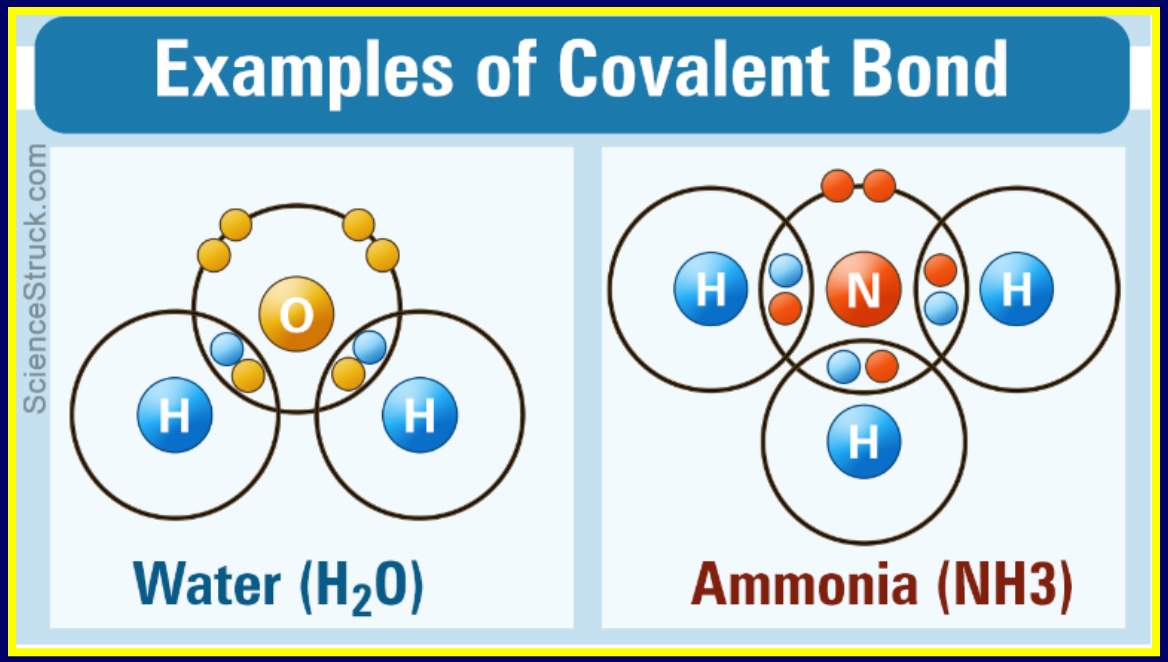


Co-workers share the work

Co-valent compounds share valence electrons

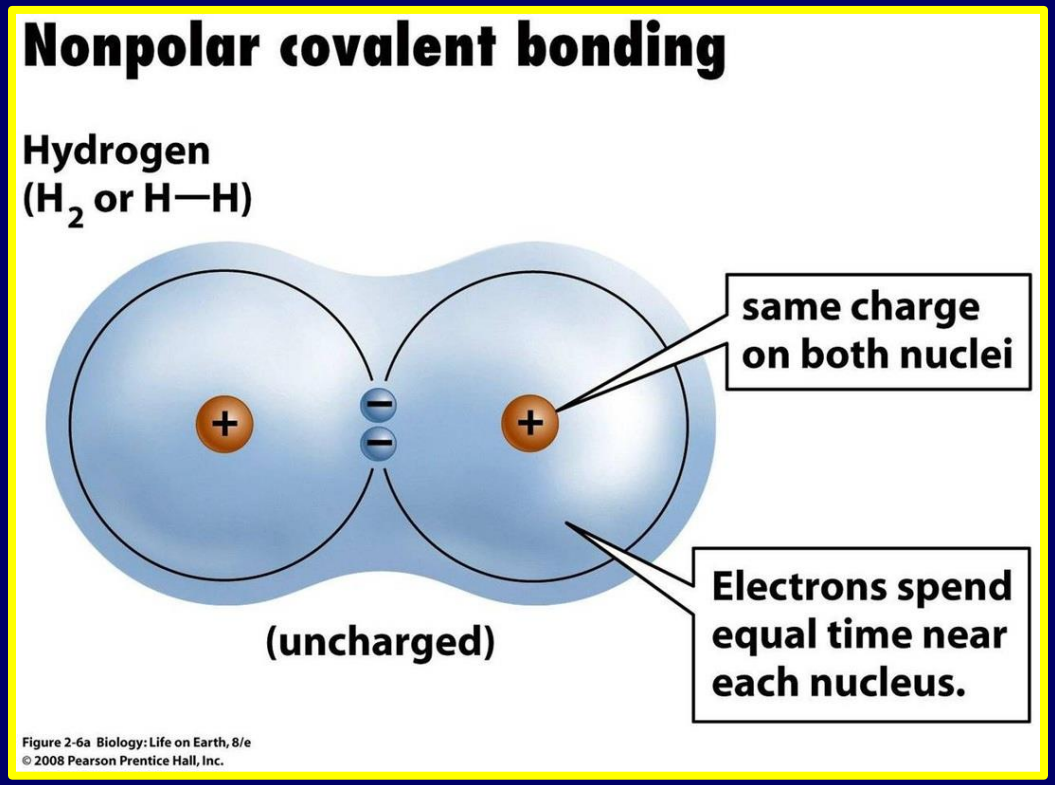
Covalent Bonds

When atoms share valence electrons, those electrons will orbit around each of the atom's nuclei, so each atom can meet the octet rule.



Equal Sharing

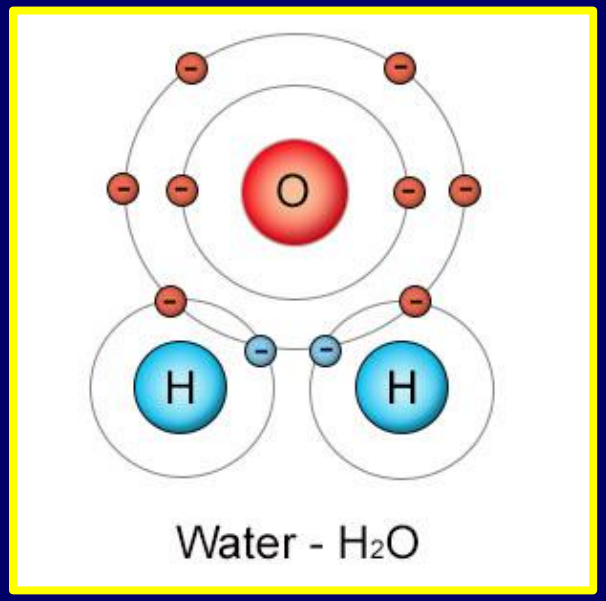
When the atoms in a covalent molecule are the same or of similar size, the valence electrons are shared equally.



These molecules are said to be nonpolar.

Unequal Sharing

When one of the atoms in a covalent molecule is larger than the other(s), the electrons feel more attraction to the larger atom and spend more time around the larger atom.

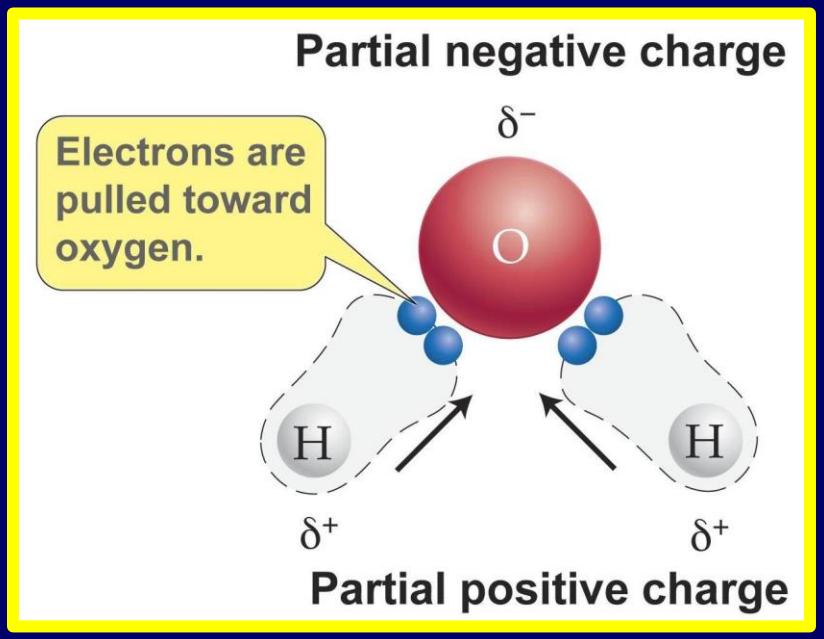


Water - H_2O

This results in an unequal sharing of the electrons.

Polar Molecule

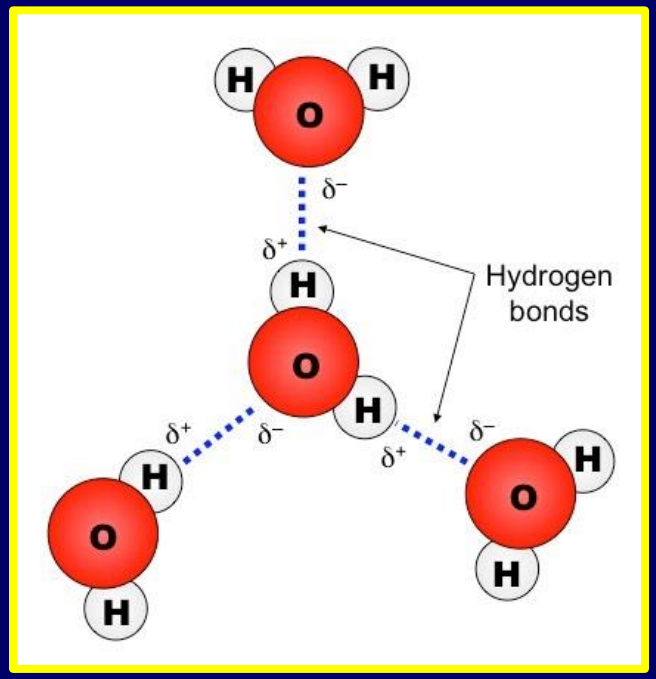
The large atom, which the electrons tend to be around, develops a partial negative charge, while the smaller atom develops a partial positive charge.



Because each pole of the molecule has an opposite charge, they are said to be polar.

Hydrogen Bonds

Hydrogen bonds form between a hydrogen atom on one polar molecule and an oxygen, nitrogen, or fluorine atom on another polar molecule.



These are weak bonds based on an electrostatic attraction.

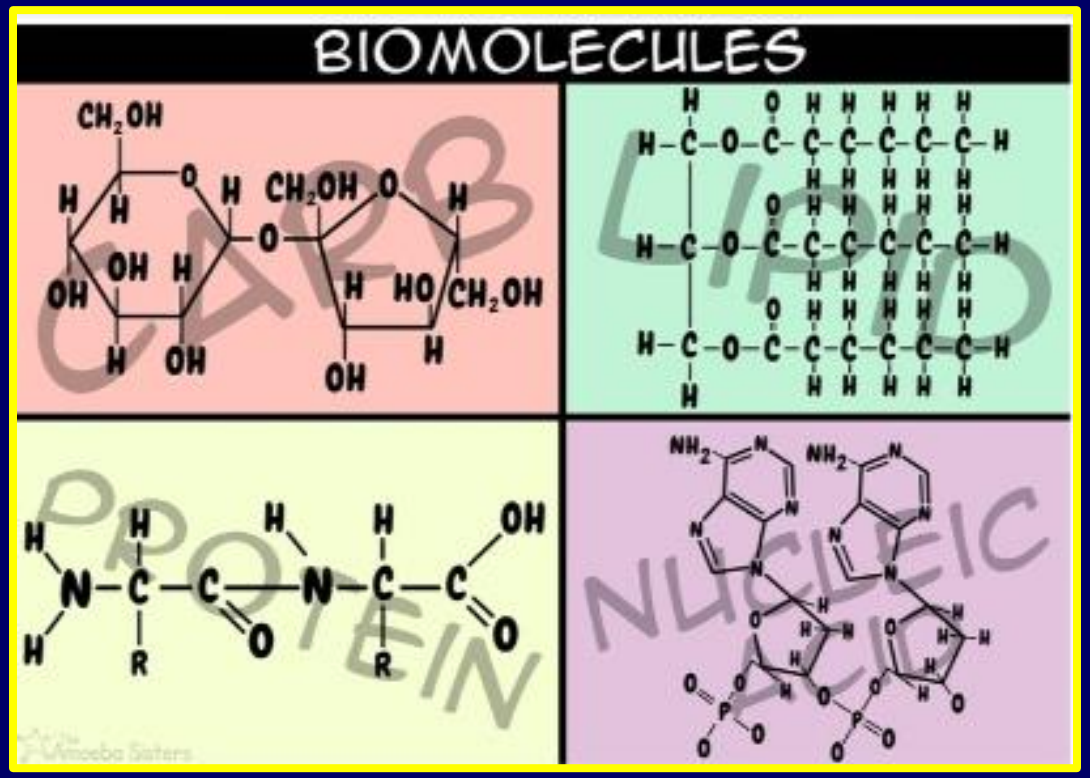
Organic Molecules

Organic molecules consist of carbon atoms covalently bonded to other carbon atoms, along with hydrogen, oxygen, nitrogen, phosphorus, and sulfur atoms.

CHNOPS

Biomolecules

Organic molecules are often called biomolecules because they are found in living organisms.



Carbohydrates

Lipids

Proteins

Nucleic Acids

Metallic Bonds

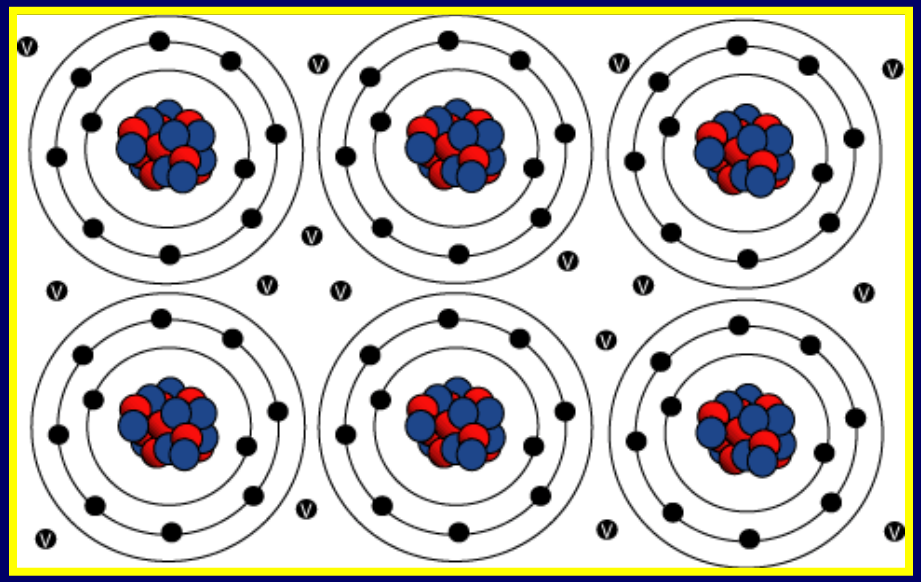
Metallic bonds are formed when two metals share electrons with every atom present, giving metals the properties for which they are known.

Metallic Properties

Conductors
Malleable
Ductile
Shiny

Metal Valence Electrons

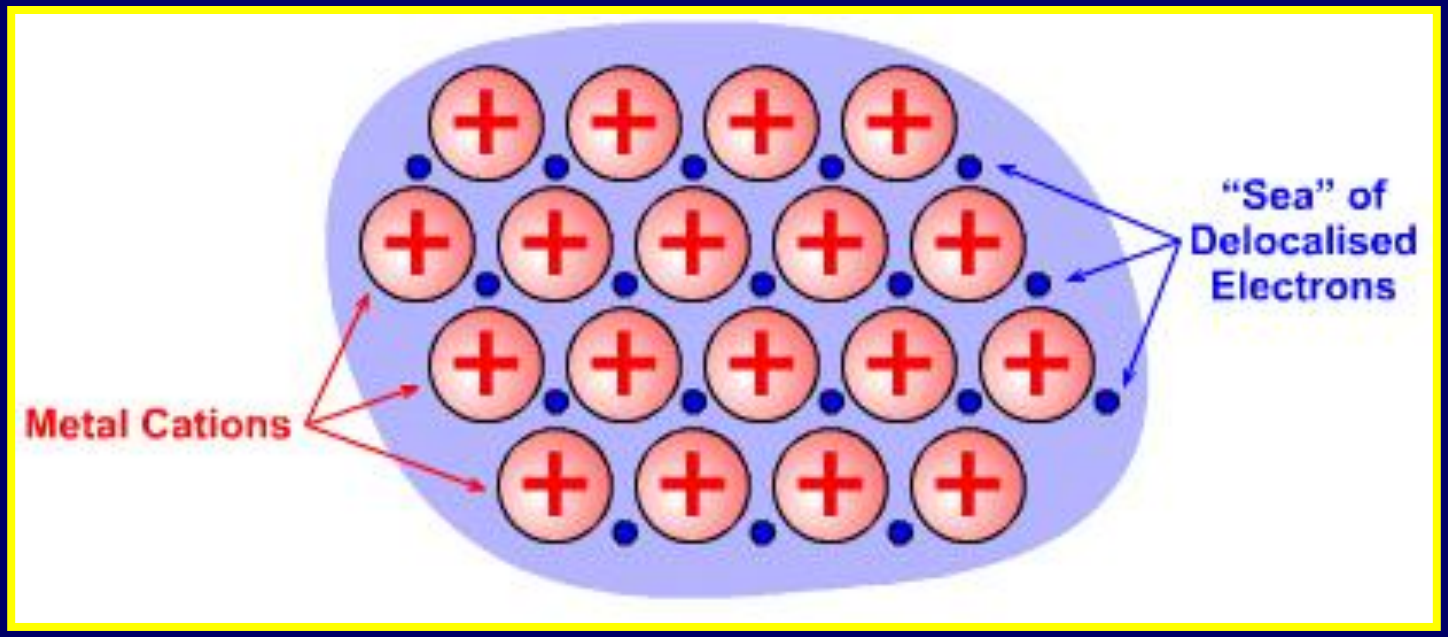
When metals atoms are grouped together, the valence electrons feel just as much attraction to the nuclei of other metals as they do their own nucleus.



As a result, all valence electrons leave their individual atoms.

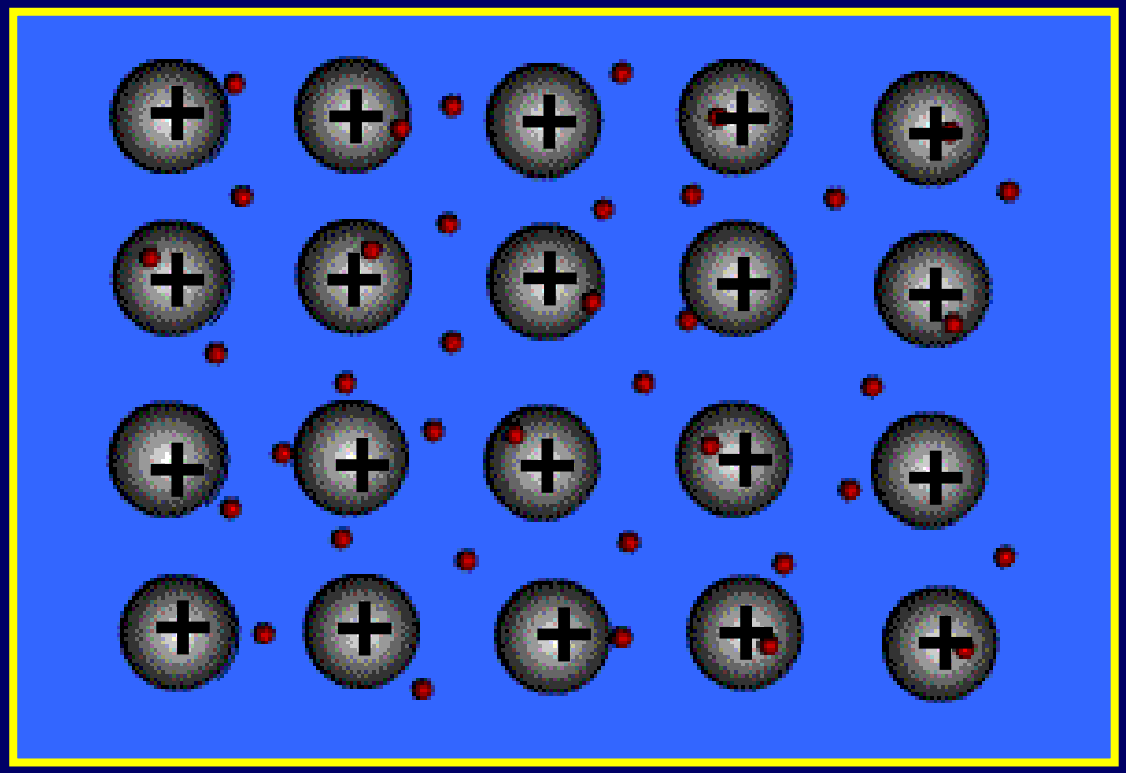
Delocalized Electrons

When the valence electrons leave their individual atoms, it results in a group of positive metal atoms surrounded by a sea of “delocalized” electrons.



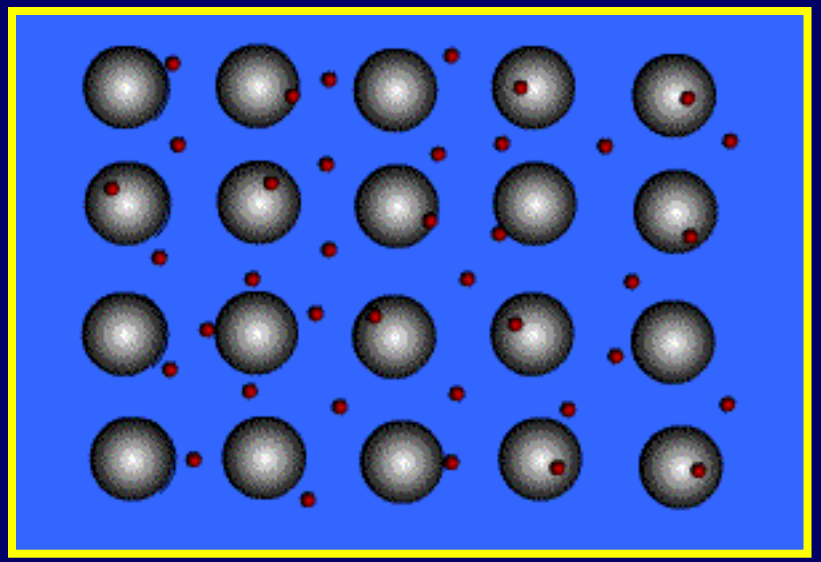
Sea of Electrons

Delocalized electrons no longer belong to any one metal atom, instead they float freely between all the metal atoms forming what is called a “sea of electrons”.



Metallic Compounds

The sea of electrons allows metal compounds to be malleable, ductile, and shiny, along with being able to conduct heat and electricity easily.



The End