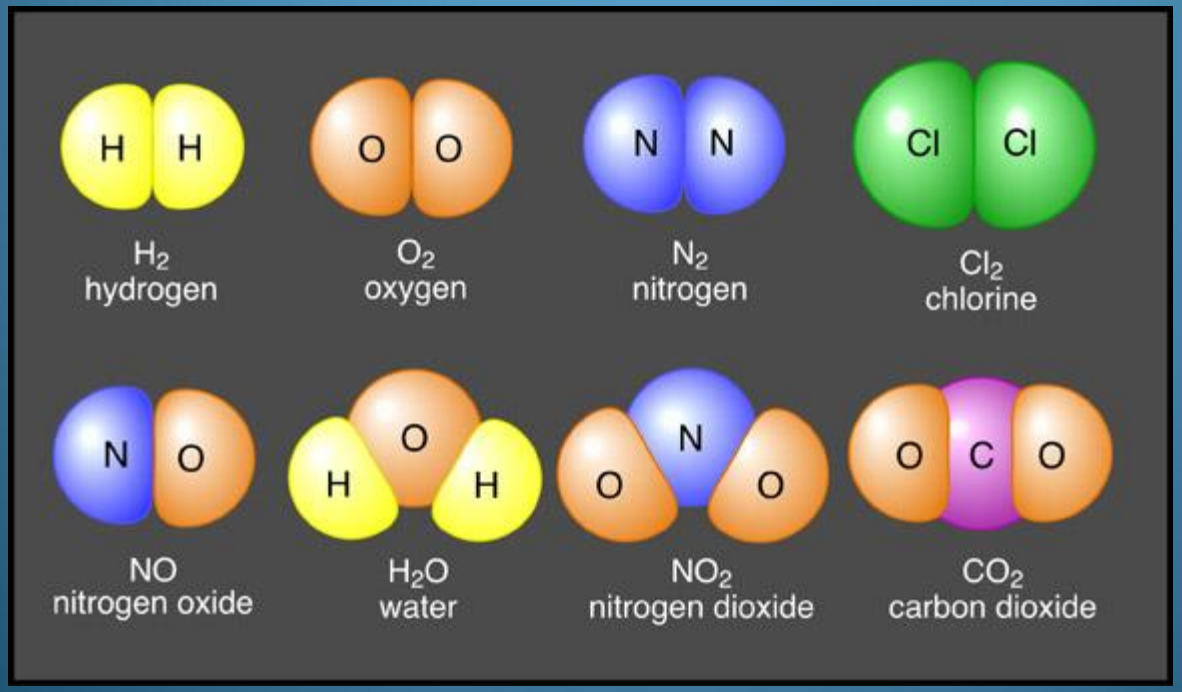
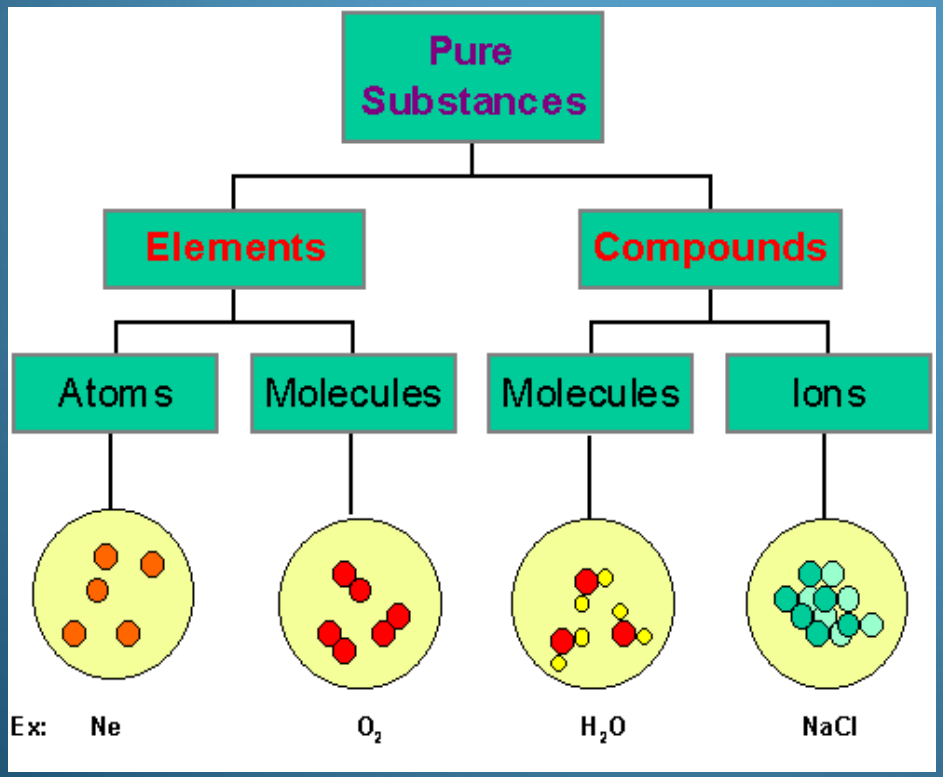
Ch 6 CHEMICAL BONDS

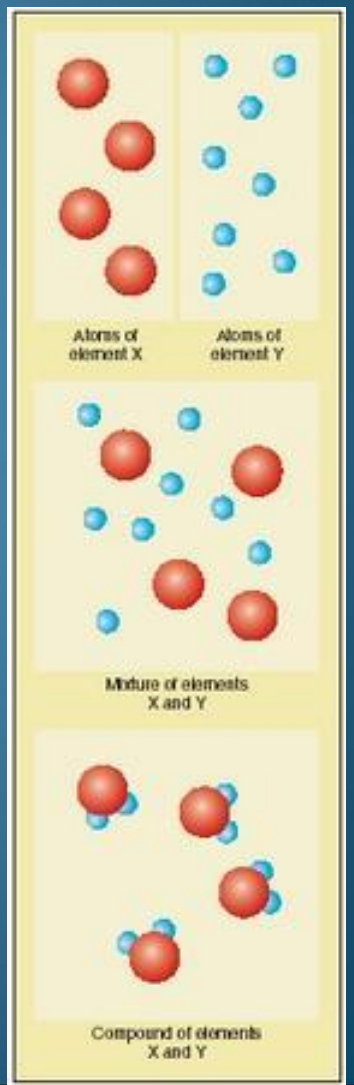
- 6.1 Compounds have different properties from the elements that make them

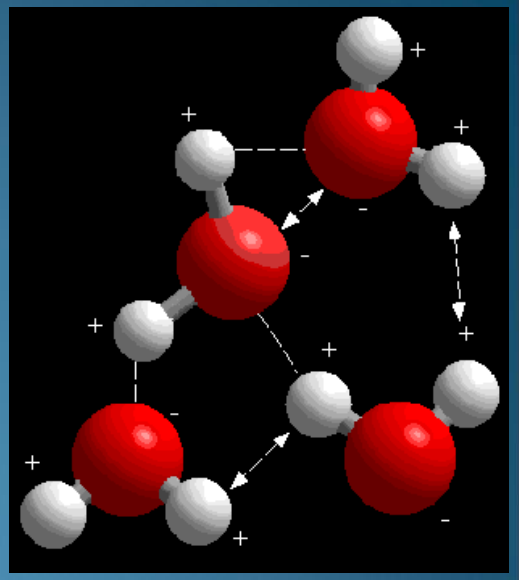


Compounds

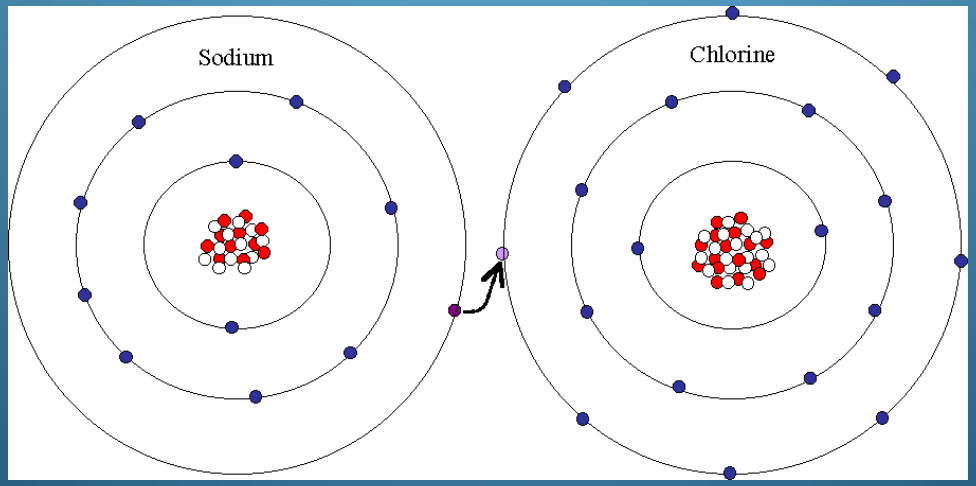
- Compound—combination of 2 or more different elements bonded





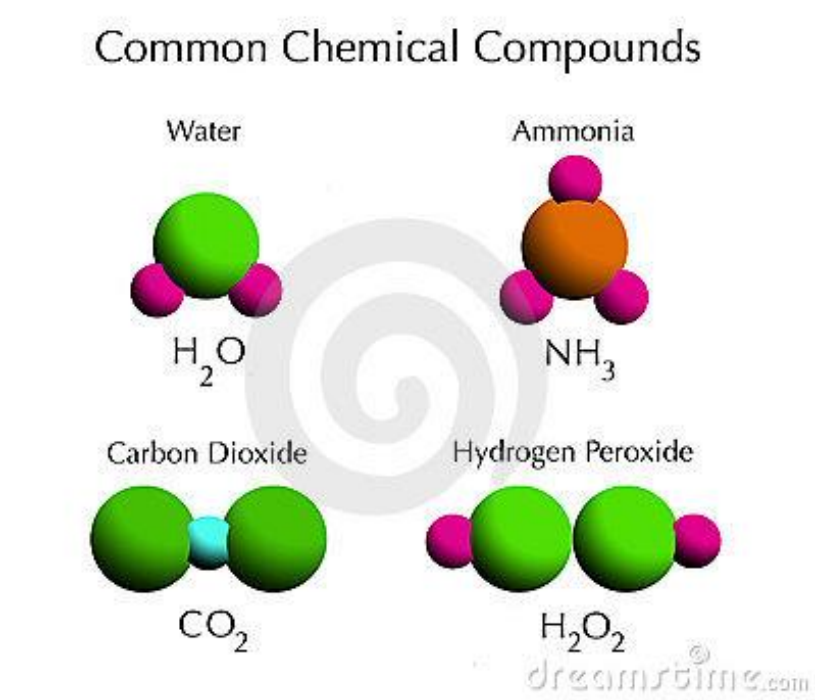


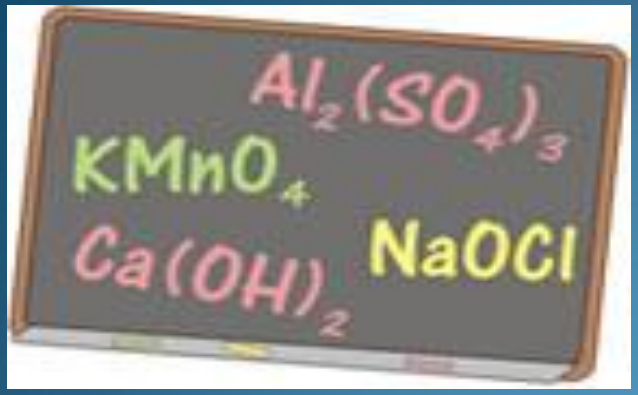
- Chemical bonds—hold elements together
- Compound's properties are different from the elements that comprise it



Atoms combine in predictable numbers

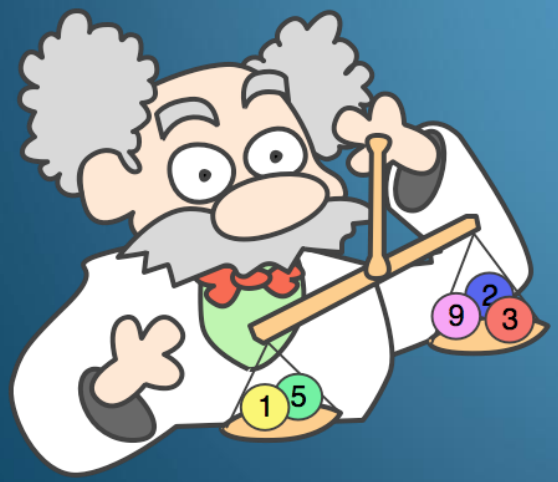
- compounds have a definite composition
- Each contains a specific ratio of atoms





Chemical Formulas

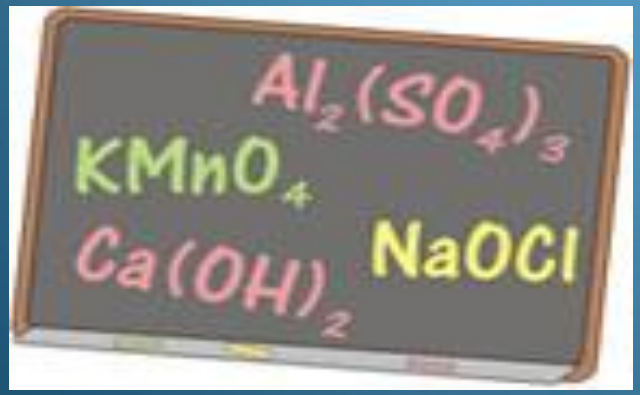
- Chemical formulas—represent compounds
- They contain symbols & #s to show the ratio of atoms

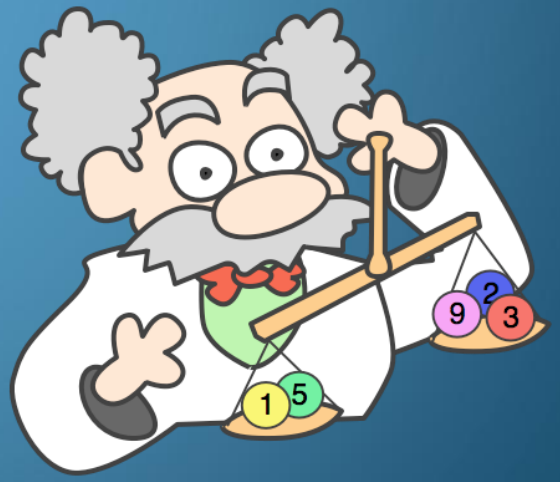


Subscripts--# written to the right of the chemical symbol and slightly below the line

Writing Subscripts

1. Note the oxidation # of each element
2. This oxidation # becomes the subscript for the other element in the formula (unless they are the same or #1)





Oxidation #s

Family 1 = +1

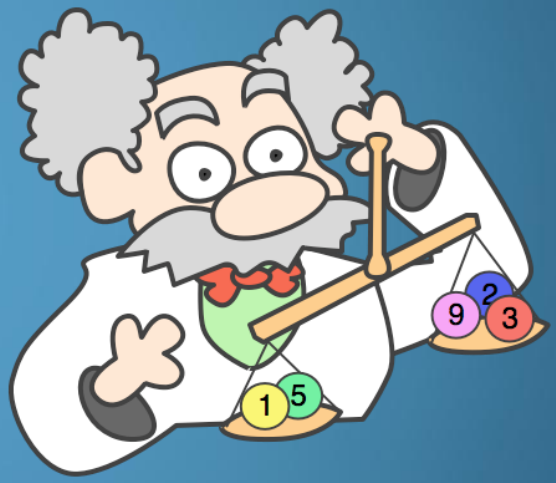
Family 2 = +2

Family 13 = +3

Family 15 = -3

Family 16 = -2

Family 17 = -1



Words with Suffixes

Phosphide

Oxide

Sulfide

Selenide

Fluoride

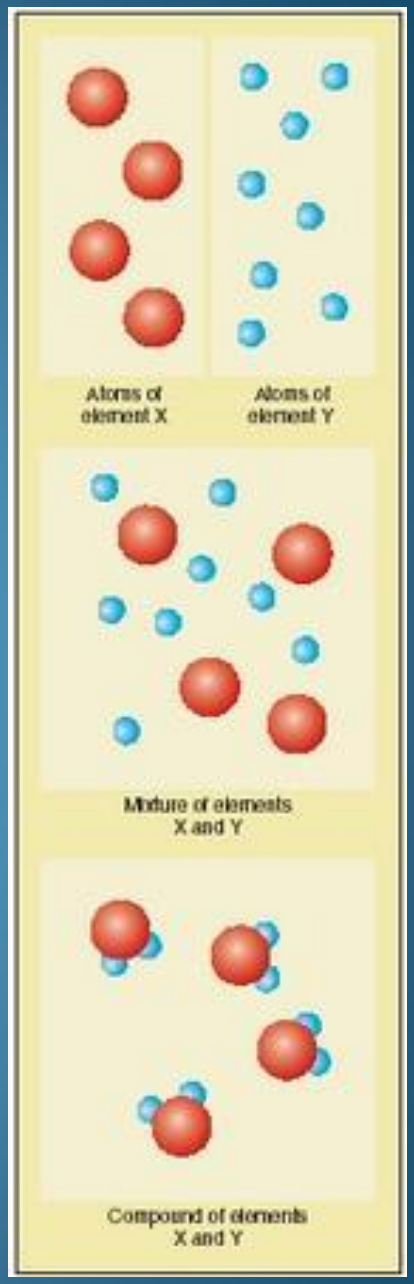
Chloride

Bromide

Iodide

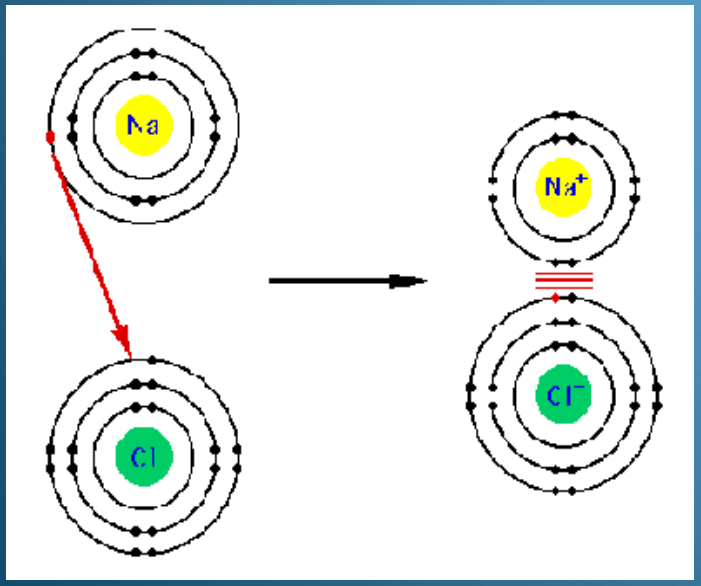
Nitride

- Compounds are not mixtures
  - 2 hydrogens bonded to 1 oxygen is water
  - 2 hydrogens bonded to 2 oxygens is hydrogen peroxide
  - Water + hydrogen peroxide is a mixture of the 2 substances



6.2 Chemical bonds hold compounds together

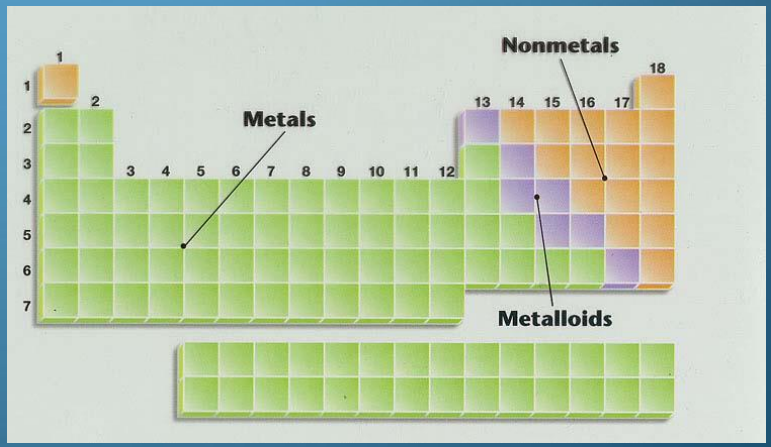
- Chemical bonds between atoms involve valence electrons (electron cloud)



-Result from interactions between the electron clouds of 2 or more atoms

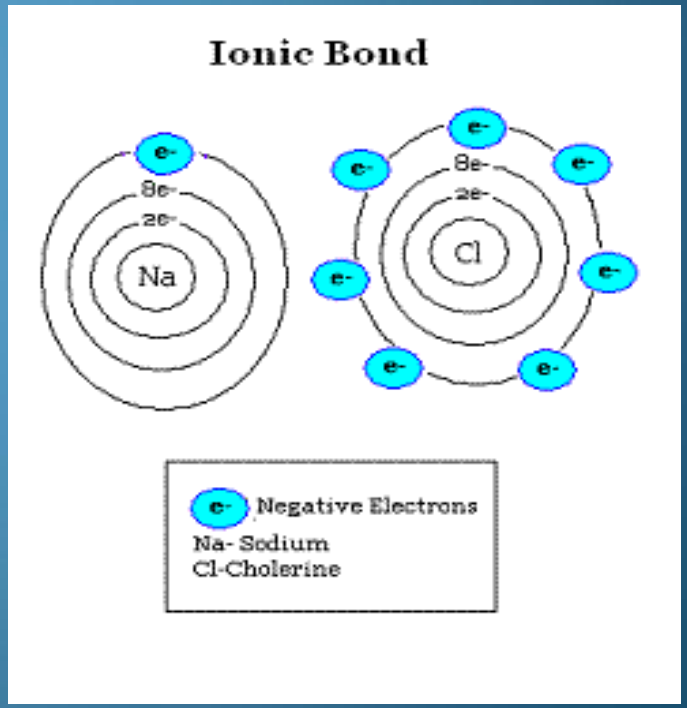
3 Types of Chemical Bonds

1. Ionic—metals + nonmetals (electrons are transferred)
2. Covalent—2 nonmetals (electrons are shared)
3. Metallic—2 metals (electrons are shared equally in all directions)

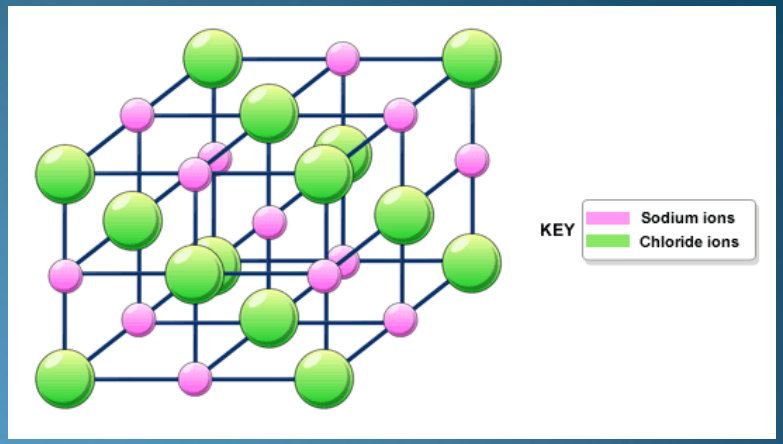


Atoms can transfer electrons

- Ions—formed when atoms gain or lose electrons
- Ionic bond—positive ions are attracted to negative ions
  - 1 atom gains electrons while the other loses electrons



Ionic Compounds Form Crystals



- Crystal networks—

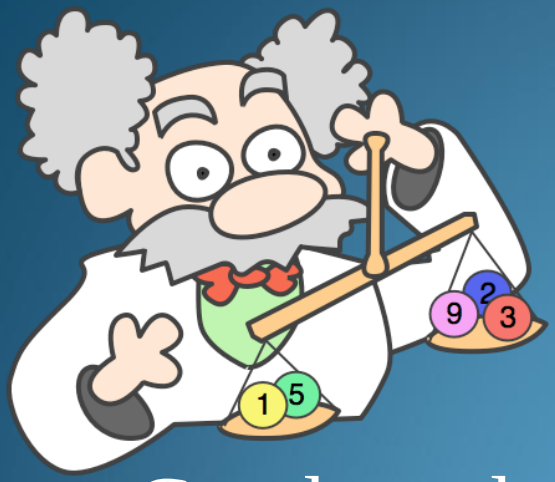
  produced by ionic bonds

  +/- attraction between the

  2 ions acts in all directions

- Ionic compounds bear the name of the positive ion, followed by the name of the negative ion (with the suffix *ide)*

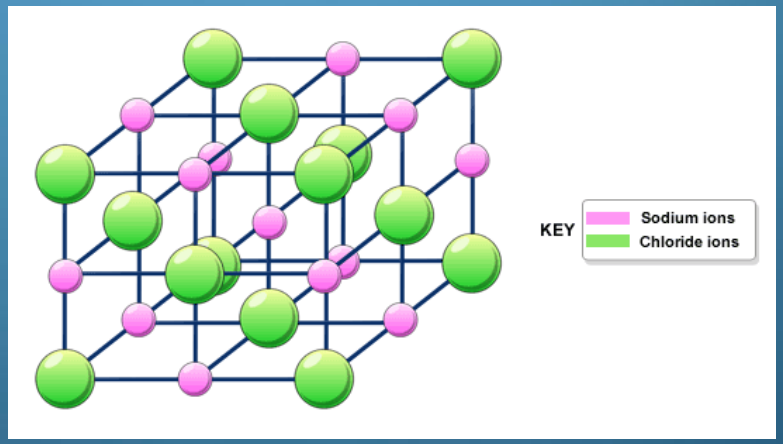
  – *Sodium + Chlorine → Sodium Chloride*



Properties of Crystals

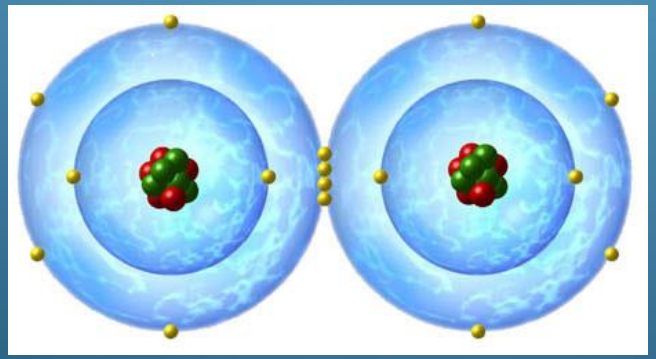
--Good conductors of electricity in the liquid phase but not in the solid phase

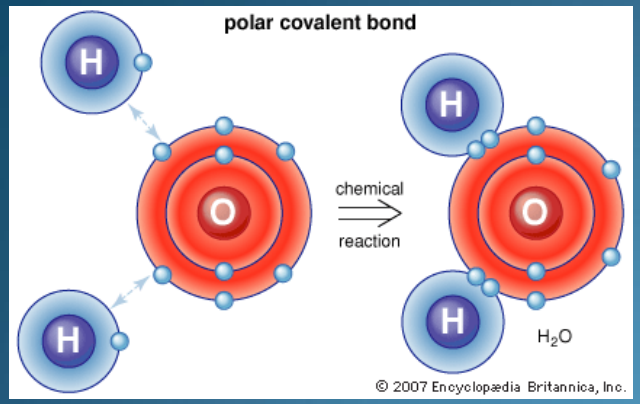
--Shatter when they break



Covalent Bonds

- Covalent Bonds—exist between atoms that SHARE electrons (2 nonmetals)
- Sharing electrons makes them more energetically stable because they have 8 valence electrons (except for H)



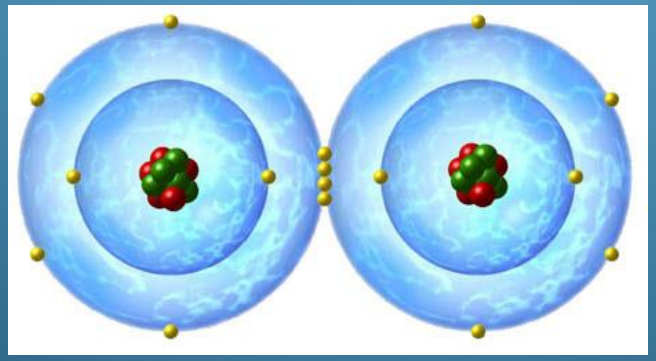


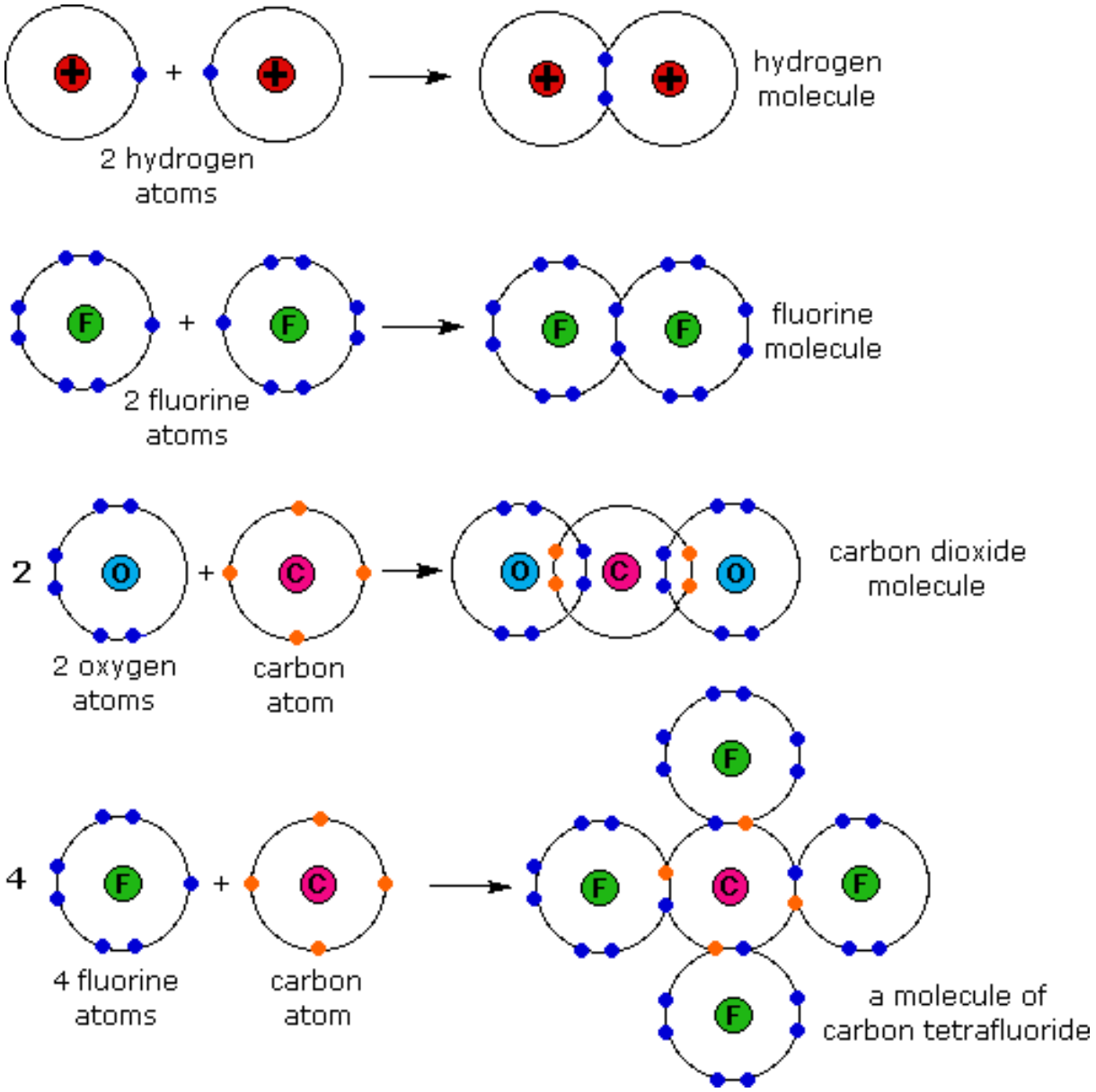
Covalent Bonds Form Molecules

- Can form between 2 atoms of the same element (diatomic molecules)
- Can form between 2 atoms of different elements (non-metals)
- Molecule—group of atoms held together by covalent bonds
  - Molecules have no electrical charge (unless they are polar covalent)

Diatomic Molecules

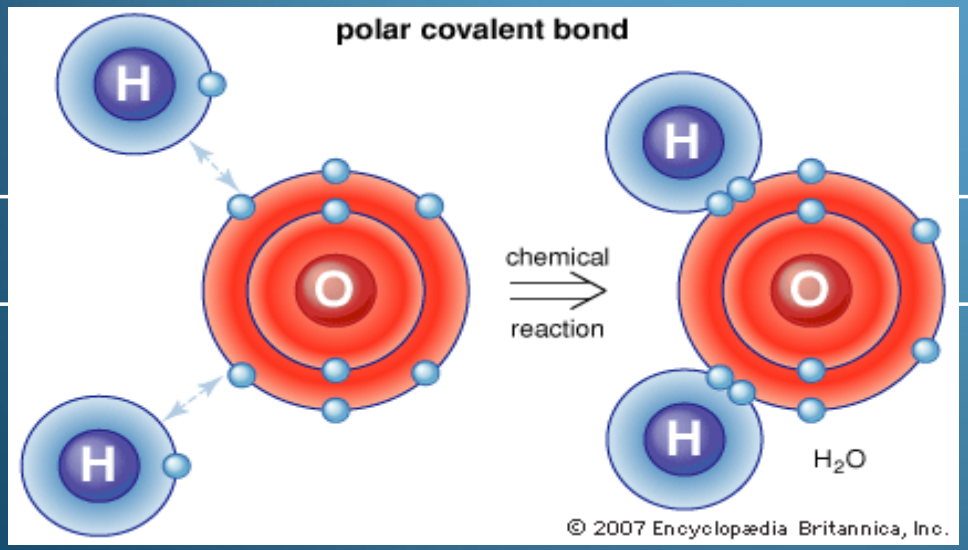
- Bond to another like atom in order to achieve stability
- H, N, O, F, Cl, Br, & I




+
hydrogen molecule
2 hydrogen atoms
F
+
F
F
F
fluorine molecule
2 fluorine atoms
2
O
+
C
O
C
O
carbon dioxide molecule
2 oxygen atoms
carbon atom
4
F
+
C
F
F
C
F
F
4 fluorine atoms
carbon atom
a molecule of carbon tetrafluoride

Polar Covalent Bonds

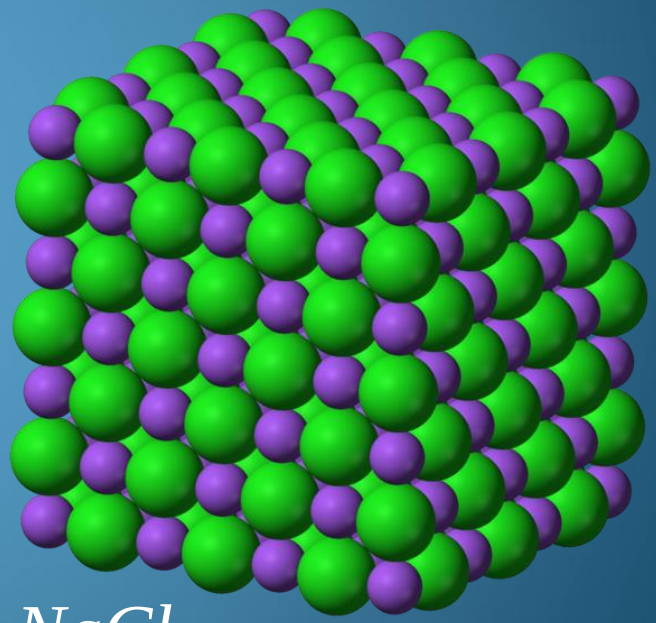
- Exist when there is a size difference between elements that make up a molecule
- Polar covalent bonds—form when the electrons shared in covalent bonds spend more time closer to only 1 of the nuclei



**Each element has a slight positive or negative charge

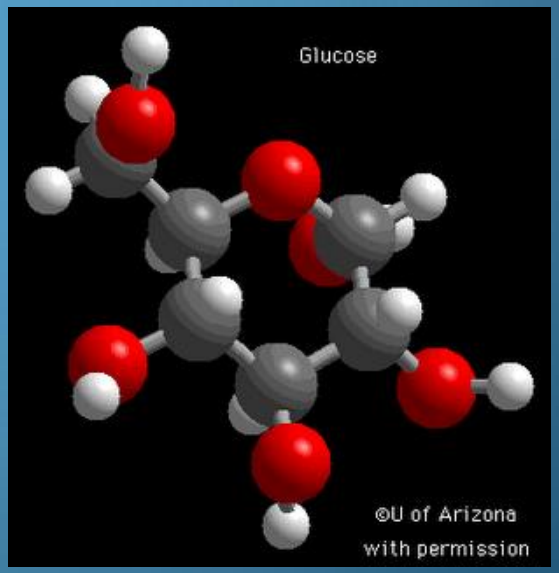
Chemical Bonds give all materials their structures

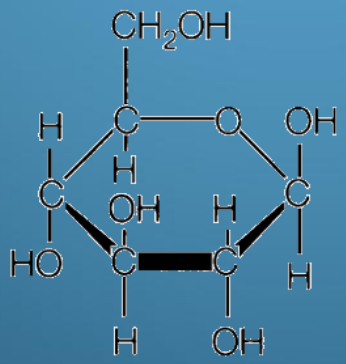
- The shape of a crystal (formed by ionic compounds) depends on:
  - Shape or size of ion
  - Ratio of elements/ions
  - Na & Cl come apart in Solution (liquid phase) & conduct electricity -shatter when broken



NaCl

- Covalent compounds form molecules, NOT CRYSTALS
- Molecules have characteristic shapes, or molecular structures
  - These structures affect the properties of the compound

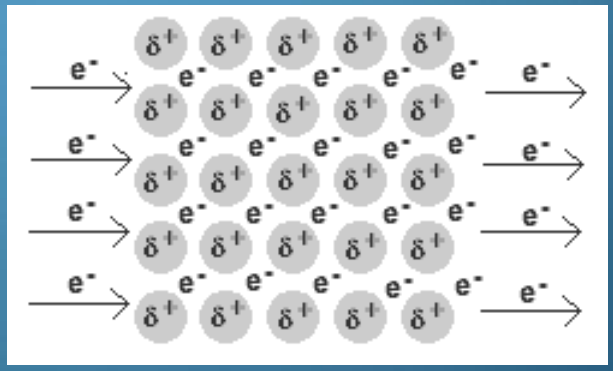




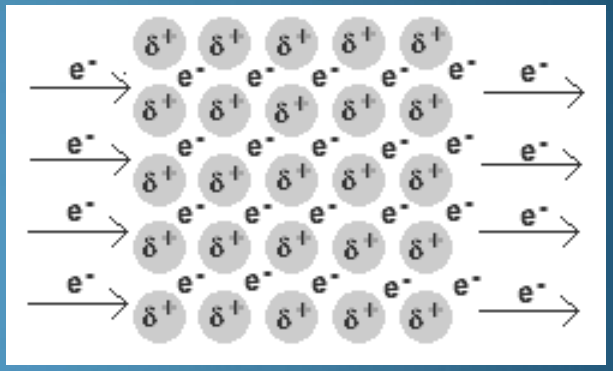
glucose

6.3 Substances' properties depend on their bonds

1. 2 or more metals form metallic bonds
2. Metal atoms share electrons equally in all directions with other metal atoms
3. Electrons move freely between the metals (like a "sea" of electrons)



4. Properties of metals are determined by the mobility of the electrons in the bond
   - Most have high melting points
   - Conductivity (able to conduct heat or electricity)



   - Ductility (able to be shaped into a wire)
   - Malleability (able to be hammered or pounded into a certain shape)

Ionic bonds give compounds certain properties

1. Ions are tightly locked into place in the structure of a crystal so they are <u>difficult to break</u> (when they do break, they shatter)
2. High melting points
3. Hard & brittle
4. Dissolve easily &

Separate into ions in

Solution (electrolytes)

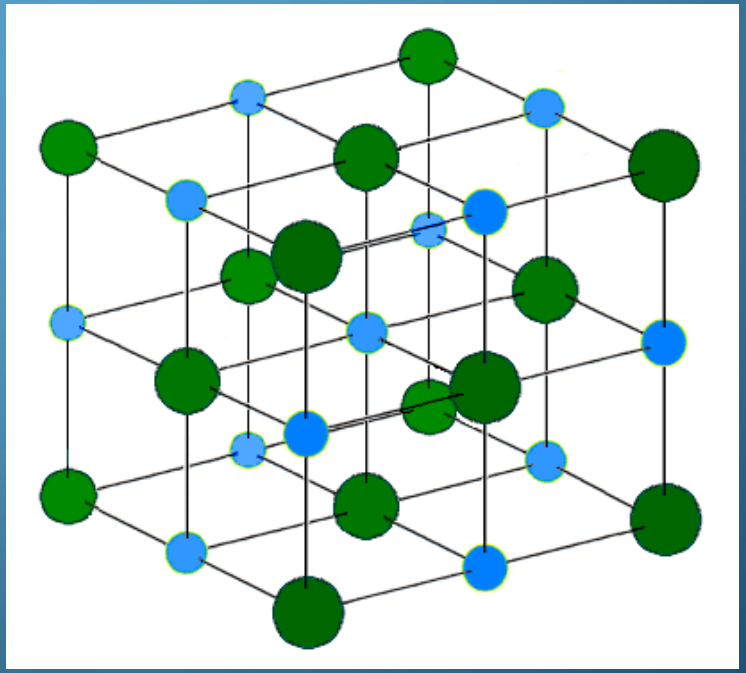
Ionic compounds (continued)

5. Not good conductors of electricity in the solid phase
6. Break up into + & - ions when dissolved & can conduct

electrical currents

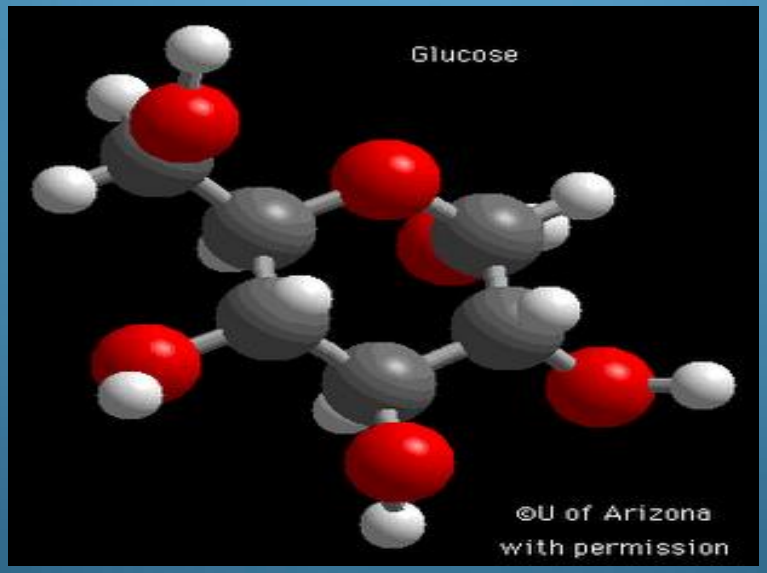
in a solution

(liquid phase)

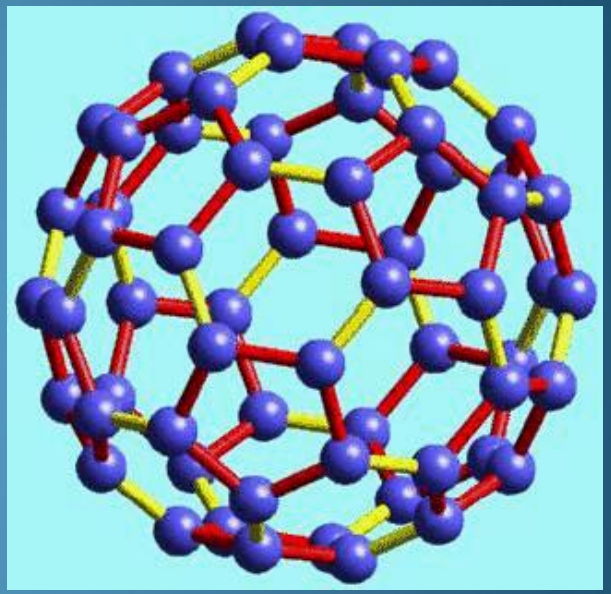


Molecules of covalent compounds are not held together very tightly

- Low boiling & melting points
- Stay intact when dissolved in water
- Properties affected by size & shape



Bonds can make the same element look different



Allotropes—different forms of the same element

- Can result from different arrangements of covalent bonds
- Carbon forms 3 different allotropes:

1. Diamond (hardest natural substance)
2. Graphite (what we call *pencil lead*)
3. Fullerene (used in making polymers like plastic, nylon, vinyl)