

**Vocabulary:**

**Atoms-** the smallest representative particle of an element.

**Subatomic Particles-** particles such as protons, neutrons, and electrons that are smaller than an atom

**Law of Electrostatic Attraction** – unlike charges attract each other, whereas like charges repel each other

**Radioactivity** – the spontaneous disintegration of an unstable atomic nucleus with accompanying emission of radiation

**Electronic Charge-** the negative charge carried by an electron; it shows has a magnitude of  $1.602 \times 10^{-19}$

**Angstroms-** a common non-SI unit of length that is used to measure atomic dimensions

**Isotopes-** atoms of the same element containing different numbers of neutrons and therefore having different masses

**Nuclide-** a nucleus of a specific isotope of an element

**Chemical formula-** a notation that uses chemical symbols with numerical subscripts to convey the relative proportions of atoms of the different elements in a substance

**Empirical formula-** a chemical formula that shows the kinds of atoms and their relative numbers in a substance

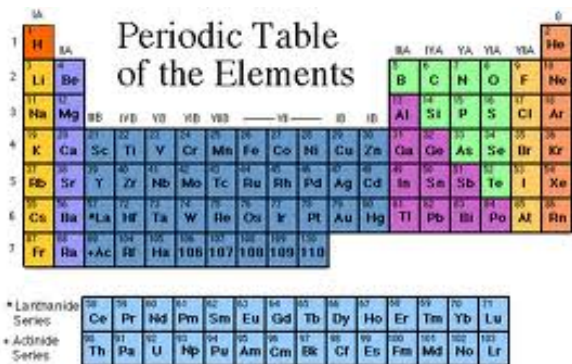
**Molecular formula-** a chemical formula that indicates the actual number of atoms of each element in one molecule of a substance

**Ions-** electrically charged atoms or group of atoms, they can be positively or negatively charged depending on whether electrons are lost or gained. (Positively charged ion = **cations**; negatively charged ion = **anion**)

**Compounds-** a substance composed of two or more elements united chemically in definite proportions

**Polyatomic ions-** an electrically charged group of two or more atoms

**Periodic Table:**



**Periodic Table:** the arrangement of elements in order of increasing atomic number, with elements having similar properties placed in vertical columns.

- Elements in each column is known as groups
- **Metallic Elements-** all elements on the left side and in the middle of the periodic table (except for hydrogen)
- **Nonmetallic Elements-** separated by a diagonal step like line that runs from boron (B) to astatine (At)
- **Metalloids-** elements that properties that fall between metals and nonmetals.

Names of Some of the Groups of the Periodic Table		
Group	Name	Elements
1A	Alkali Metals	Li,Na,K,Rb,Cs,Fr
2A	Alkaline earth Metals	Be,Mg,Ca,Sr,Ba,Ra
6A	Chalcogens	O,S,Se,Te,Po
7A	Halogens	F,Cl,Br,I,At
8A	Noble Gases	He,Ne,Ar,Kr,Xe,Rn

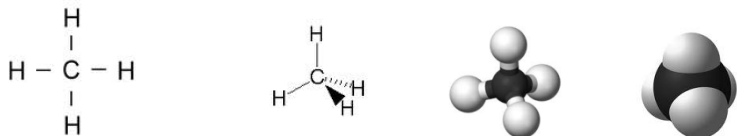
### Visual Structure of Molecules: (Images shown respectively)

**Structural formula** – a formula that shows the number and kinds of atoms in a molecule and the arrangement of the atoms; does not show geometry of molecules.

**Perspective Drawing:** similar to the structural formula but shows a sense of geometry to the molecule.

**Ball-and-Stick Model:** shows atoms as spheres and the bonds as sticks.

**Space filling model-** a depiction of what the molecule would look like if it were scaled up in size.



### Naming Inorganic Compounds:

#### Positive Ions (Cations)

- Cations formed from metal atoms have the same name as the metal  
Ex:  $\text{Na}^+$  sodium ion
- If a metal can form cations of differing charged, the positive charge is given by a Roman numeral in parentheses following the name of the metal  
Ex:  $\text{Fe}^{+2}$  iron (II) ion
- Cations formed from a nonmetal atoms have names that end in **-ium**  
Ex:  $\text{NH}_4^+$  ammonium ion

#### Negative Ions (Anions)

- Monatomic anions have named formed by dropping the ending of the name of the element and adding the ending **-ide**  
Ex:  $\text{H}^-$  hydride ion
- Polyatomic anions containing oxygen have names ending in **-ate** or **-ite**  
Ex:  $\text{NO}_3^-$  nitrate       $\text{NO}_2^-$  nitrite
- Anions derived by adding  $\text{H}^+$  to an oxyanion are named by adding as a prefix the word hydrogen or dihydrogen, as appropriate

#### Ionic Compounds

- Names of ionic compounds are the cation name followed by the anion name

### Names and Formulas of Acids

Anions		Acid
<div style="border: 1px solid black; padding: 5px; width: fit-content;">_____ide (chloride, <math>\text{Cl}^-</math>)</div>	Add $\text{H}^+$ ion →	<div style="border: 1px solid black; padding: 5px; width: fit-content;">Hydro_____ic acid (hydrochloric acid, <math>\text{HCl}</math>)</div>
<div style="border: 1px solid black; padding: 5px; width: fit-content;">_____ate (chlorate, <math>\text{Cl}_3^-</math>)</div>	Add $\text{H}^+$ ion →	<div style="border: 1px solid black; padding: 5px; width: fit-content;">_____ic acid (Chloric acid, <math>\text{HClO}_3</math>)</div>
<div style="border: 1px solid black; padding: 5px; width: fit-content;">_____ite (chlorite, <math>\text{Cl}_2^-</math>)</div>	Add $\text{H}^+$ ion →	<div style="border: 1px solid black; padding: 5px; width: fit-content;">_____ous acid (Chlorous acid, <math>\text{HClO}_2</math>)</div>

**Vocabulary:**

**Polarizability-** the ease with which the electron cloud of an atom or molecule is distorted by an outside influence, thereby inducing a dipole moment.

**Heat of Fusion-** the enthalpy change for vaporizing a liquid

**Heat of Vaporization-** the enthalpy change for vaporizing a liquid

**Dynamic Equilibrium-** a state of balance in which opposing processes occur at the same rate

**Volatile-** tending to evaporate readily

**Triple Point-** the temperature at which solid, liquid and gas phases coexist in equilibrium.

**Crystalline Solid-** a solid whose internal arrangement of atoms, molecule or ions show a regular repetition in any direction through the solid

**Amorphous Solid** – a solid whose molecule arrangement lacks a regular, long range pattern

**Unit Cell-** the smallest portion of a crystal that reproduces the structure of the entire crystal when repeated in different directions in space.

**Crystal Lattice-** an imaginary network of points on which the repeating unit of the structure of a solid may be imagined to be laid down so that the structure of the crystal is obtained.

**Primitive Cubic cell** – a cubic unit cell in which the lattice points are at the corners only

**Body-Centered Cubic cell** – a cubic cell in which the lattice points occur at the corners and at the center

**Face-Centered Cubic cell-** a cubic unit cell that has lattice points at each corner as well as at the center of each face

**Cubic close packing-** a close packing arrangement in which the atoms of the third layer of a solid are not directly over those in the first layer

**Hexagonal close packing-** a close packing arrangement in which the atoms of the third layer of a solid lie directly over those in the first layer.

**Coordination number-** the number of adjacent atoms to which an atom is directly bonded.

**Molecular solids-** solids that are composed of molecules

**Covalent-network solids-** solids in which the units that make up the three-dimensional network are joined by covalent bonds.

**Ionic solids-** solids that are composed of ions.

**Metallic solid-** solids made up of metal atoms.

**Characteristic Properties of the States of Matter**

**Gas-** Assumes both the volume and the shape of container, compressible, Diffusion within a gas occurs rapidly, flows readily

**Liquid-** Assumes the shape of the portion of the container it occupies, does not expand to fill container, is virtually incompressible, flows readily

**Solid-** Retains its own shape and volume, is virtually incompressible, diffusion within a solid occurs extremely slowly, does not flow

**Intermolecular Forces:**

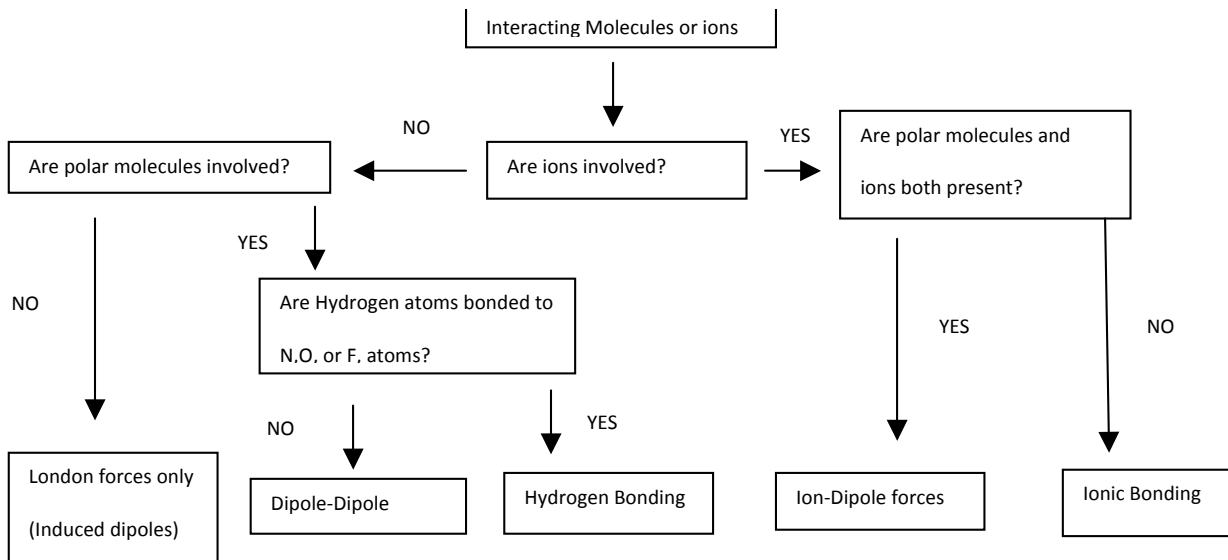
**Intermolecular Forces:** the short range attractive forces operating between the particles that make up the unit of a liquid or solid substance.

**Dipole Dipole Forces:** the force that exists between polar molecules

**London Dispersion Forces-** intermolecular forces resulting from attractions between induced dipoles

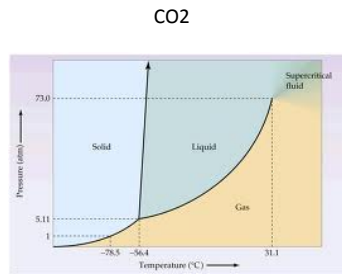
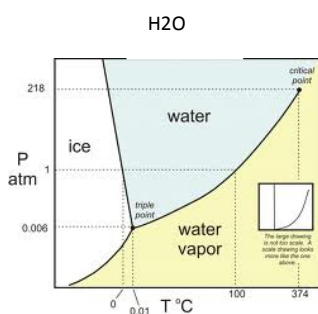
**Hydrogen Bonding** – bonding that results from intermolecular attractions between molecules containing hydrogen bonded to an electronegative element.

**Ion-Dipole Forces** – the force that exists between an ion and its neutral polar molecule that possesses a permanent dipole moment.



### Phase Diagrams:

The phase diagram for CO<sub>2</sub> follows the typical behavior. The melting point increases with increasing pressure. In contrast, the melting point of H<sub>2</sub>O decreases with increasing pressure. \*Water is among the very few substances whose liquid form is more compact than its solid form.



### Structures of Solids:

#### Finding Density

The geometric arrangement of ions in crystals of LiF is the same as that in NaCl. The unit cell of LiF is 4.02 Å on an edge. Calculate the density of LiF.

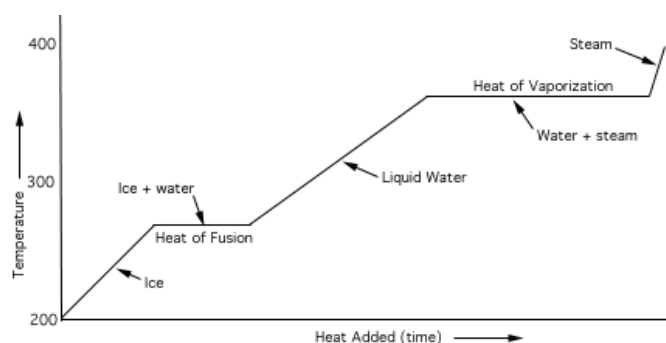
**Solution** Because the arrangement of ions in LiF is the same as NaCl, as unit cell of LiF will contain four Li<sup>+</sup> and four F<sup>-</sup> ions. Density is a measurement of mass per unit volume. Thus, we can calculate the density of LiF from the mass contained in a unit cell and the volume of the unit cell. The mass contained in one unit cell is

$$4(6.94 \text{ amu}) + 4(19.0 \text{ amu}) = 103.8 \text{ amu}$$

The volume of a cube of length  $a$  on an edge is  $a^3$ , so the volume of the unit cell is  $(4.02 \text{ Å})^3$

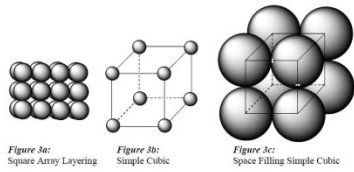
$$\text{Density} = (103.8 \text{ amu}) / (4.02 \text{ Å})^3 \cdot (1 \text{ g}) / (6.02 \times 10^{23} \text{ amu}) \cdot (1 \text{ Å} / 10^{-8} \text{ cm}) = 2.65 \text{ g/cm}^3$$

**Heating Curve :** A heating curve is a graph of temperature of a system versus the amount of heat added.

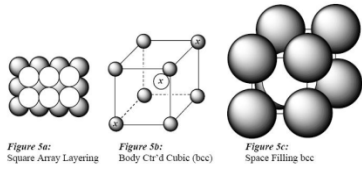


## Structures of Solids

**Primitive (simple) Cubic cell** – a cubic unit cell in which the lattice points are at the corners only



**Body-Centered Cubic cell** – a cubic cell in which the lattice points occur at the corners and at the center



**Face-Centered Cubic cell** – a cubic unit cell that has lattice points at each corner as well as at the center of each face

