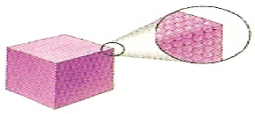
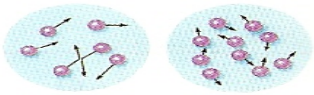
Particle Theory

Developed by a philosopher named Democritus who said all substances were made of particles too small to be seen.

- All matter is made of tiny particles.
- All particles of one substance are the same. Different substances are made of different particles.
- The particles are always moving.
- There are attractive forces between the particles.

Table 1 **The Particle Theory of Matter**

Principle	Illustration
1. All matter is made up of tiny particles.	
2. All particles of one substance are the same. Different substances are made of different particles.	substance A  substance B 
3. The particles are always moving. The more energy the particles have, the faster they move.	 hot cold
4. There are attractive forces between the particles. These forces are stronger when the particles are closer together.	particles far apart—force weak  particles close together—force strong

Pure Substance: all the particles are the same
Two types: **Elements** and **Compounds**

Atom: building blocks of matter. The smallest particles.

Elements: are pure substances that **cannot be broken down** into simpler substances.
Ex. oxygen, hydrogen, iron, and mercury

Compounds: are pure substances that contain **2 or more different elements** in a fixed proportion.

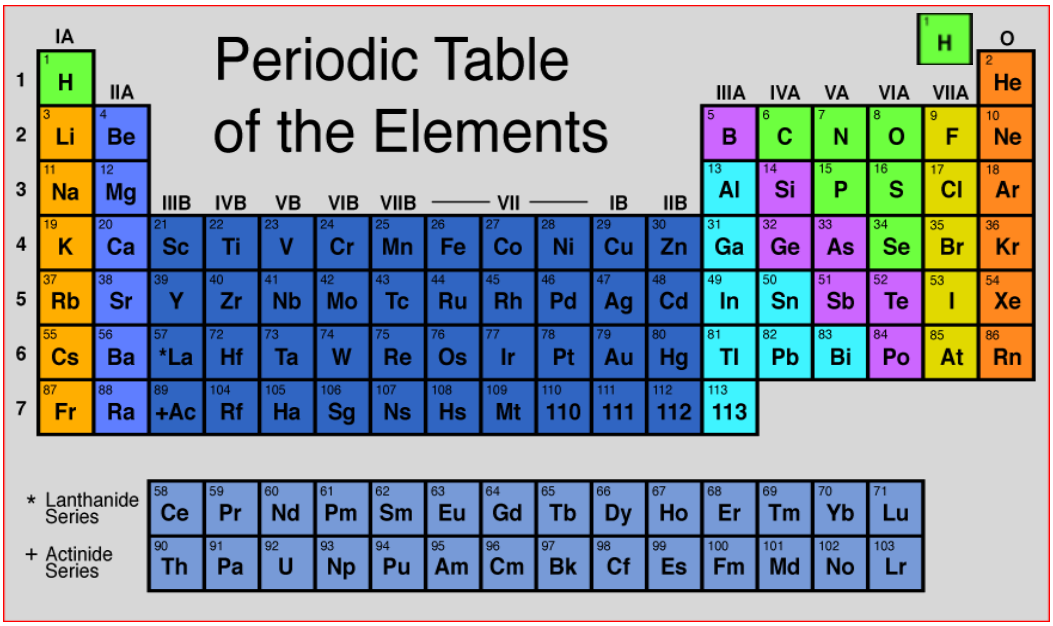
Ex. H_2O, CO_2, etc.

Molecules: made of at least two atoms

Review of the Periodic Table

Periodic table - a structured arrangement of elements that help us explain and predict physical and chemical proerties.

Metals are generally located on the left, while the non-metals are located on the right side of the table.
(staircase line)



Hydrogen, the lightest element, is the exception to almost every rule in chemistry. Although it is located on the left side of the staircase, it behaves mostly as a **nonmetal**.

Metals are normally shiny,malleable , conductors, react with acid, and are mostly solids at room temperature.

Non-metals are generally dull, brittle, good insulators, do not react with acid, and can be solid, liquids or gas at room temperature.

Chemical Families (groups) are vertical columns in the periodic table. They tend to have similar physical and chemical properties.

Alkali metals (group 1) are shiny, silvery metals and form compounds that are mostly white solids and soluble in water.

Alkaline earth metals (group 2) are shiny, silvery metals, but they form compounds that are not soluble in water.

The *halogens* (group 17) generally react with alkali metals.

Noble gases (group 18) generally do not form compounds.

Parts of an Atom

The smallest part of an element is called the atom.

The atom is comprised of three types of subatomic particles:
protons, neutrons and electrons .

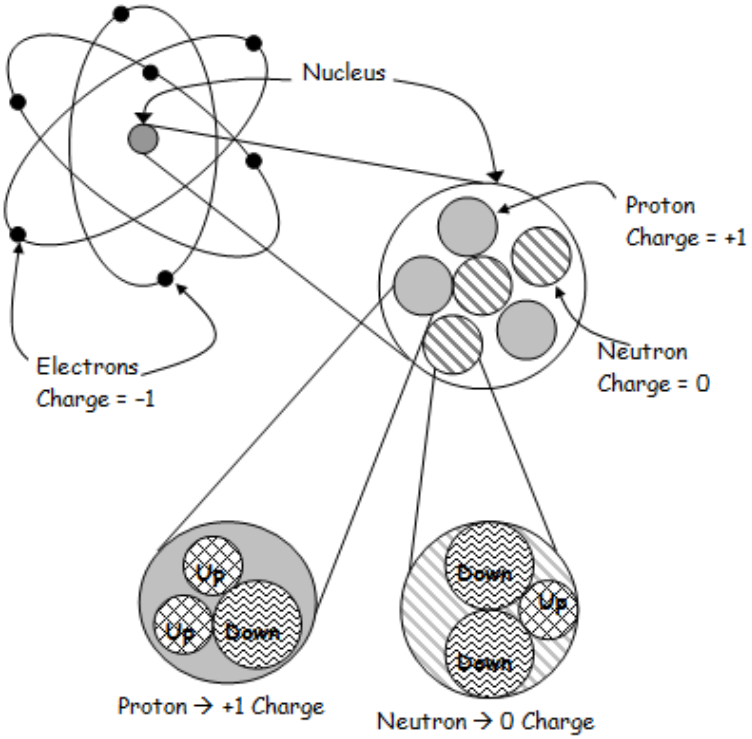
Protons: are 'heavy', positively charged (p^+) particles found in the nucleus
• the number of protons is equal to the atomic number

Neutrons: are neutral particles that have the same mass as a proton and are found in the nucleus.
What does neutral mean??

Electrons: are negatively charged (e^-) particles that circle or orbit the nucleus at different energy levels.
• The particles have almost no mass.
• The farther away from the nucleus an electron is, the higher the energy level.
• atoms are electrically neutral, so the number of p^+ equals the number of e^-

- Bohr diagrams can be drawn to represent the arrangement of electrons in various levels or orbits
- each orbit has a definite number of electrons

the first level can have two
the second can have eight
the third can have eight



Up Quark = $+\frac{2}{3}$ Charge

Down Quark = $-\frac{1}{3}$ Charge

Atomic Models

Draw a Bohr diagram for:

a) C

b) Cl

c) Be

d) N

Ions

- elements are willing to give up or gain e^- in order to have the appearance of a filled outermost orbital
- when e^- are gained or lost, an atom is then called an **ion**
- **an ion is an atom with a positive or negative charge**
- the ionic charge is the numerical value of the electric charge with a plus or minus sign

  Ex. Li atom has $3p^+$ and $3e^-$
  Li ion has $3p^+$ and $2e^-$ and is written Li^{1+}

Which groups would tend to lose electrons? Gain electrons?

- metals lose electrons to become stable
  Ex. magnesium will lose two e- and become positively charged
  Mg atom → Mg^{2+}

- nonmetals gain electrons to become stable
  Ex. oxygen will gain two e- and become
  O atom → O^{2-}