- smallest particle of an element that still retains the properties of that element

- Composed of:
  - Protons - positively (+) charged particles
  - Neutrons - neutrally (0) charged particles
  - Protons and Neutrons are located in the Nucleus - the center of the atom
  - Electrons - negatively (-) charged particles
    - sometimes written as $e^-$
    - $e^-$ surround the nucleus
  - Opposite charges attract
  - The number of protons is equal to the number of electrons
  - The total charge of the atom is zero

Models of the Atom

1898    1911    1913 present
Bohr    Energy levels or shells = Electron cloud model
- electrons “travel” in energy levels
  - known as l, m, n, o, p, q
  - can only hold a certain # of $e^-$

$$s = 2s^2$$
$$2 \cdot (1^2) = 2$$
$$2 \cdot (2^2) = 8$$

- a stable level is either full or holds 8 electrons

**The Doghouse Model of the Atom**

= protons (+)  = attraction
= electrons (-)  = electron cloud
= neutron (0)
Atomic Number- The number of protons in an atom
- the number of protons determines the element
- a change in the number of protons produces a different element

Atomic Mass (Weight)- The number of protons PLUS the number of neutrons

Ion- An atom of an element that has gained or lost electrons
- the atom has a positive (lose e\(^-\)) or negative charge (gain e\(^-\))
- written as \(H^+\), \(Ca^{++}\) or \(Ca^{2+}\), \(Cl^-\)

Isotope- an atom of an element with a different number of neutrons
- since the number of protons determines the element, a change in the neutrons doesn’t change the element

Note:
- the atomic mass is the average of the isotopes of an element
  = relative abundance (weighted average)

- example: Chlorine

\[
\begin{align*}
\text{Cl}^{35} & \quad + \quad \text{Cl}^{37} \\
75\% & \quad 25\% \\
35 \times 0.75 & \quad 37 \times 0.25 \\
26.25 & \quad 9.25 \\
\text{35.5}
\end{align*}
\]
Compound- a pure substance made up of elements which are chemically combined

- water
- methane
- sugar
- salt

Molecule- smallest unit of a compound that still retains the properties of the compound

Molecular formula- tells what elements are bonded together to make a compound

\[
\begin{align*}
H_2O & \quad 2 \text{ H, 1 O} \\
CH_4 & \quad 1 \text{ C, 4 H} \\
C_6H_{12}O_6 & \quad 6 \text{ C, 12 H, 6 O} \\
NaCl & \quad 1 \text{ Na, 1 Cl}
\end{align*}
\]

Physical Change- an alteration of the properties of a substance without affecting the substance itself
= size, shape, state (solid, liquid, gas), hardness, color, etc.
Chemical Change- a thorough change in a substance so that an entirely new substance is formed
  - the new substance has its own properties

example:

\[ 2H + O \rightarrow H_2O \]

explosive gases puts out fire

\[ Na + Cl \rightarrow NaCl \]

poisonous gases edible crystal

- happens because of a chemical reaction
- chemical reactions usually involve heat
  - exothermic- give off heat
  - endothermic- absorbing heat