### **Definitions**

- Chemistry: Study of matter
- Organic Chemistry: Study of compounds containing carbon. Chemical symbol of carbon is C
- Chemical symbol: Code for chemical element
- Atom: Is the smallest possible particle that defines a complete chemical element
- Atoms are very small
- Every atom is composed of a nucleus and one or more electrons bound to the nucleus
- Molecules: Discrete (bonded) arrangement of atoms
  - Changing the arrangement or connections changes the molecule and its physical properties
- Compound: Collection of molecules of the same type
  - Water (H<sub>2</sub>O), Cholesterol (27 carbons, white crystalline powder, average male contains 80 g)
- Atomic Number: Number of protons in the nucleus of an atom (Z)
- Atomic Weight: Mass of protons (p<sup>+</sup>) and neutron (N)
  - $\circ {}^{12}C = 6p^+ + 6N$
  - $\circ$  <sup>13</sup>C = 6p<sup>+</sup> + 7N (Isotope of Carbon, Stable, 1.1% abundance)
  - $\circ$  <sup>14</sup>C = 6p<sup>+</sup> + 8N (Radioactive isotope with long half-life, T<sub>1/2</sub> = 5780 yrs)
- Molecular Weight (MW): Mass of atoms in a molecule
  - $H_2O: MW = [(2 \times 1 \text{ g/mol})H + (1 \times 16 \text{ g/mol})O] = 18 \text{ g/mol}$

## Mole Concept

- $1 \text{ mole} = 6.02 \text{ x } 10^{23}$  (Avogadro's number) (can be atoms, molecules etc.)
- 1 mole H = 1 g
- Mole concept relates to MW and Atomic weight
- 18 g of H<sub>2</sub>O is 6.02 x  $10^{23}$  molecules = 1 mole of H<sub>2</sub>O or 6.02 x  $10^{23}$  molecules of water

## **Typical Molecule**

- A few Angstroms (Å) in length: Bond length C-H is 1 Å, C-C is 1.5 Å
- $\circ$  1 Å = 10<sup>-8</sup> cm

Example: Cholesterol is 17 Å across. If you lined all of the cholesterol molecules in an 80 g bottle end to end it would wrap around the earth roughly 5,000,000 times.

## **Physical Properties**

- Defined by chemical structure
- Melting point (mp) and boiling point (bp): Each compound has a characteristic mp and bp.
- Taste, appearance, odour, and biological properties (how it interacts with other molecules).
- Light Absorption
- Density (symbol is  $\rho$ , rho) (unit = g/cm<sup>3</sup>)

- o Absorption of radiation
- Solubility

# **Purity of Compounds**

- 1 mole of H<sub>2</sub>O (6.02 x  $10^{23}$  molecules) = 18 g, then add 1 x  $10^{6}$  other molecules (e.g. sugar) → the purity of the water would be 99.999 999 999 999 999%.
- Purity: A pure compound shows no change in physical properties upon attempts to further purify (purity is a relative term).
- Purity: A pure compound has a discrete and unique physical properties