Unit 1: Nature of Chemistry
Content Outline: Scientific Measurement (1.3)

I. **Quantity**
   A. This term is used to describe something that has *magnitude*, *size, or amount.*
   B. This is <u>not</u> the same thing as measurement.
      1. **Measurement** is a *process* that scientists perform to represent a *specific* unit of some object. For example, you measured the length of a piece of paper to be 11 inches, or you measured out 3 cups of salt.
      2. A measurement nearly always has a number <u>plus</u> a unit.

II. The SI System of measurement used in science
   A. SI stands for the French *Le Système International d'Unités* (International System of Measurement) that was globally accepted in 1960 at the General Conference on Weights and Measures in Sèvres, France.
      1. It is used and recognized by all scientists around the world, despite the reluctance of Americans to adopt the system over the old English system of measurement.
   B. The SI system is based upon 7 Fundamental Units of Measurement. They are:
      1. **Length (l)**
         a. Length is measured in **meters (m)**.
      2. **Mass (m)**
         a. Mass is measured in **grams (g)**.
            i. Mass is measured using a scale or balance.
         b. Mass is different from weight.
            i. **Weight** a measure of the *gravitational pull on matter (an object).*
            ii. Weight is measured on a spring scale and measure in **Newtons** after the great scientist Isaac Newton, who worked with gravity.
         c. Weight can change from location to location (earth vs. moon); but mass does <u>not</u> change.
      3. **Time (t)**
         a. Time is measured in **seconds (s)**.
      4. **Temperature (T)**
         a. It is measured in **Kelvin (K)**.
            i. To convert degrees **Celsius (°C)** to Kelvin:

               273 K + °C ; for example → 273 + 27 °C = 300K

            ii. To convert degrees **Fahrenheit (°F)** to degrees Celsius (°C):

               (°F – 32) X 5/9; for example → (78° F - 32) X 5/9 = 46 X 5/9 = 25.6°C

      5. **Amount of a given substance (n)**
         a. It is measured in **moles (mol)**
         b. A mole is a *quantity* equal to the **Formula Weight** of a molecule <u>but</u> measured out in grams.
      6. **Electric Current (I)**
         a. Electric current is measured in **Amps (A).**
      7. **Luminosity (I_V)**
         a. Luminosity is measured in **candelas (cd)** Sounds like candles.
         b. You can see this one on light bulb packages in stores. The more…the brighter.
   C. *Prefixes* (Additions at the front of a word) for **Magnitude** (greater than 1): →*getting larger*
      1. Deka (da) = 10; therefore 1 dekameter = 10 meters
      2. Hector (h) = 100; therefore 1 hectometer = 100 meters
      3. Kilo (k) = 1,000; 1therefore 1 kilometer = 1,000 meters
      4. Mega (M) = 1,000,000 (1 million); therefore 1 Megameter = 1,000,000 meters
      5. Giga (G) = 1,000,000,000 (1 billion); therefore 1 Gigameter = 1,000,000,000 meters
      6. Tera (T) = 1,000,000,000,000 (1 Trillion); therefore 1 Terameter = 1 Trillion meters

D. *Prefixes* for *portions* (pieces) of a whole: → *getting smaller*
   1. deci (d) = 1/10; therefore 1 decimeter is 1/10 of 1 meter.
   2. Centi (c) = 1/100; therefore 1 centimeter is 1/100 of 1 meter.
   3. Milli (m) = 1/1,000; therefore 1 millimeter is 1/1,000 of 1 meter.
   4. Micro (μ) = 1/1,000,000 (millionth); therefore 1 micrometer is 1/1,000,000 of 1 meter
   5. Nano (n) = 1/1,000,000,000 (billionth); 1 nanometer is 1 billionth of 1 meter.

E. *Derived*(made from the Fundamental) *units:*
   1. **Area (A)**
      a. Derived by Length (m) X Width (m).
      b. Area is measured in **square meters (m^2).**
   2. **Volume (V)**
      a. Derived by Length X Width X Height
      b. Volume is measured in **cubic meters (m^3)**.
   3. **Density (D)**
      a. Derived by Mass divided by Volume (m/m^3)
      b. Density is measured in **Grams per Meter cubed (g/m^3)**
   4. **Molar Mass (M)**
      a. Derived by Mass divided by amount of a substance (mole) → m/mol
      b. Molar mass is measured in **Grams per Mole (g/mol)**
   5. **Molar Volume (V_M)**
      a. Derived by Volume divided by the amount of a substance (mole) → v/mol
      b. Molar Volume is measured in **cubic Meters per Mole (m^3/mol)**
   6. **Energy (E)**
      a. Derived from Force X length (m)
      b. Energy is measured in Joules **(J)**
   7. **Pressure (P)**
      a. Derived from mass divided by meter/second squared → $m/m \bullet s^2$ ($\bullet$ = multiplied by)
      b. Pressure is measured in **Pascals (Pa)** or **Atmospheres (Atm.)**