Classification of Matter
Chemistry 11

What is an Element?

- **Element:**
  - a substance which cannot be separated into a simpler substance as a result of any chemical change
  - If broken down further, it no longer has the same properties
  - Different elements are classified based on different physical properties

Atoms, Molecules, and Ions

- **Atom:** smallest particle of an element that retains the chemical identity of the element
  - Made up of protons (+ve), electrons (-ve), and neutrons (neutral)
- **Molecule:** a cluster of 2 or more atoms held together by covalent bonds (sharing of electrons)
  - Ex. O₂, CO₂
- **Ion:** an atom or group of atoms that has gained or lost electrons to become positively or negatively charged
  - Ex. Na⁺ (Sodium ion), Br⁻ (Bromide ion)

More Definitions:
so you know what I mean when I say...

- **Particle:** a general term to describe a small bit of matter such as an atom, molecule, or ion
- **Phase:** any part of a system which is uniform in both composition and properties
  - Ex. Oil and water don’t mix, so you get 2 phases
Properties of Matter:
- Matter is classified based on its properties (characteristics)
- What types of matter are there?
  - Elements
  - Compounds
  - Mixtures

...but it is a little more complicated than that!

Classification Scheme:

A. PURE SUBSTANCES
- Pure Substance: one type of particle present & constant set of physical properties
  - can be represented with a single chemical formula
  - example: H₂O

1. Element: simplest form of matter, only has one set of properties
  - can't be decomposed into simpler substances
  - located on the periodic table of ELEMENTS
  - 3 categories: metals, non-metals, metalloids

2. Compound: 2 or more elements joined together by a chemical bond
  - can write a unique chemical formula for each compound
  - properties of compound are different from properties of its component elements
  - example: NaCl (white solid, soluble in H₂O, high m.p.) vs. Na (shiny, explosive in H₂O) and Cl (poisonous green gas)
  - elements present in compound combine in definite proportions by mass ("Law of Definite Composition")
    - water H₂O = 2 atoms H + 1 atom O
      - (11.1% mass) (88.9% mass)
B. Mixtures

**Mixture:** a combination of 2 or more kinds of matter that have separate identities
- components are physically combined (mixed together) and can easily be separated
- the amounts of each substance can vary, thus varying the properties of the mixture
- Represented by 2 or more chemical formulas in varying proportions
  - Ex. \( \text{H}_2\text{O} + \text{NaCl} \)

Two Types:
- **I. Heterogeneous**
  - mechanical mixture: combination of several solids which can be distinguished by eye
    - ex. salad
  - suspension: combination of solid & liquid or 2 liquids which are mixed but not dissolved
    - if left, will separate into layers by settling
    - ex. orange juice, oil & water

- **II. Homogeneous**
  - mixture with uniform composition throughout (only one phase present)
  - will have its own set of physical properties
    - Ex. Boiling point, density, etc.
  - different amounts of the components change the physical properties of a homogeneous mixture

<table>
<thead>
<tr>
<th>Type of solution</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>gas in gas</td>
<td>air ((\text{O}_2/\text{N}_2)/etc.)</td>
</tr>
<tr>
<td>gas in liquid</td>
<td>soda pop</td>
</tr>
<tr>
<td>liquid in liquid</td>
<td>water and alcohol</td>
</tr>
<tr>
<td>solid in liquid</td>
<td>salt water</td>
</tr>
<tr>
<td>solid in solid</td>
<td>metal alloys</td>
</tr>
</tbody>
</table>

A solution is an example of a homogeneous mixture...but not all solutions are a solid dissolved in a liquid (just most of the ones we talk about!)
Solutions:

- There are two components to a solution
  - **Solute**: the component which exists in smaller quantity
  - **Solvent**: the component which exists in larger quantity

- **NOTE**: When water is in the solution, it is *always* called the solvent...it is the **universal solvent**...

...and the solution is called an **aqueous solution**

- Ex. NaCl\(_{\text{(aq)}蜣\)