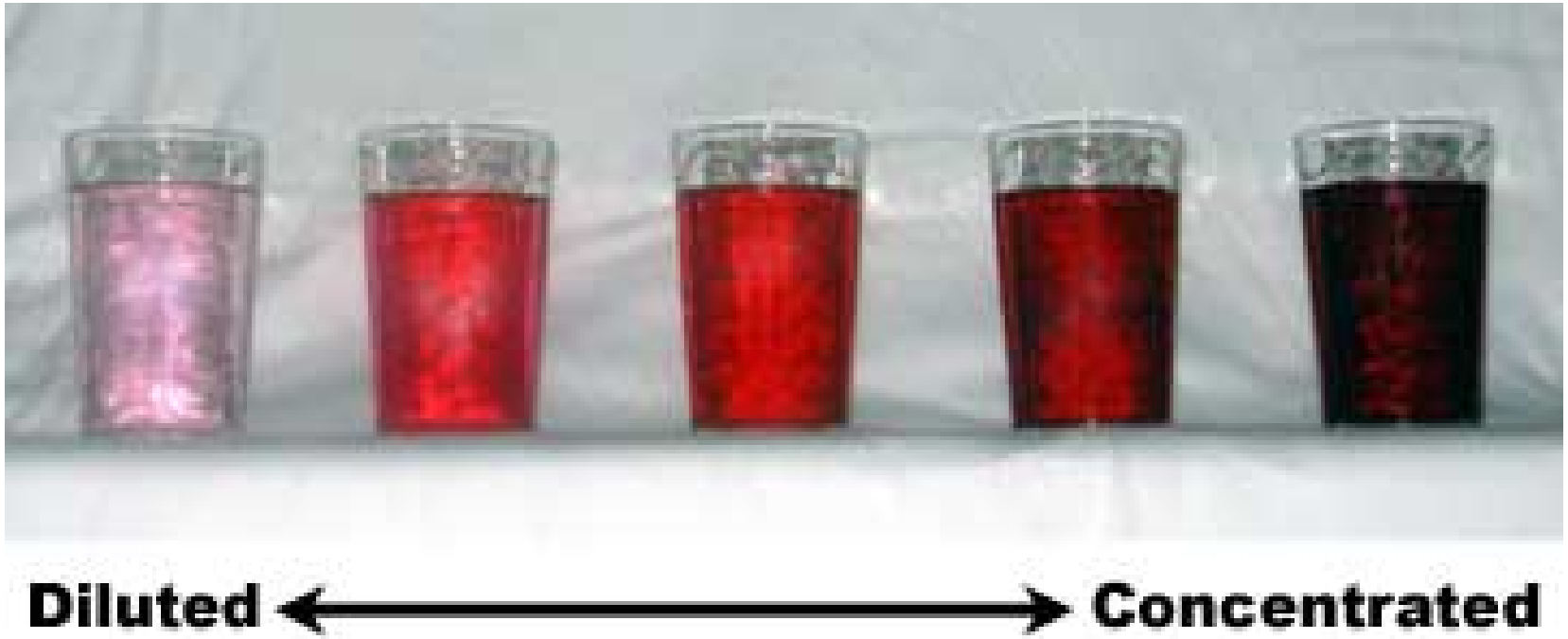
Concentration



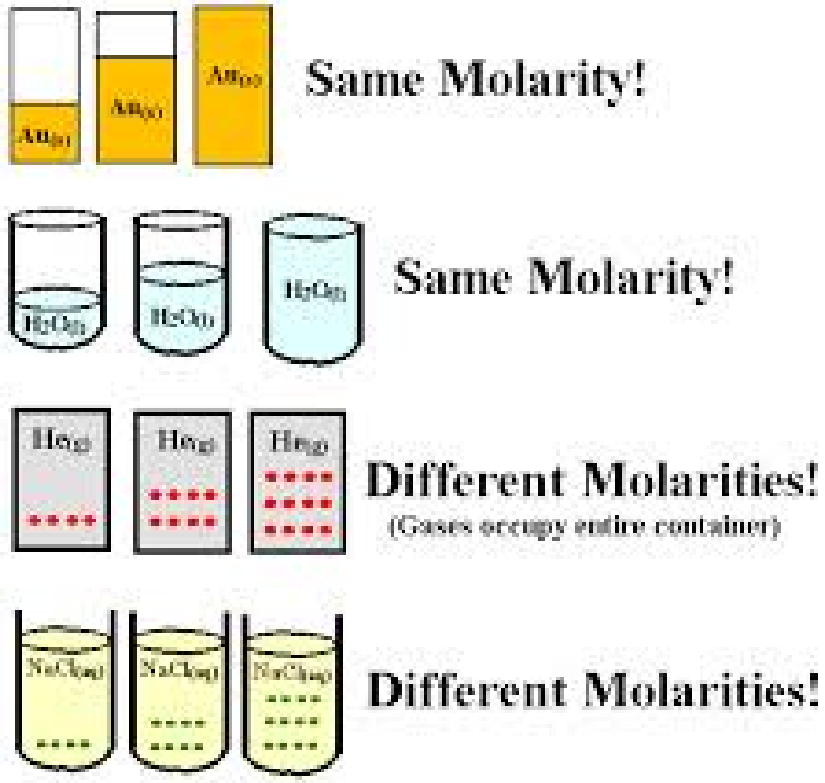
Outcomes:

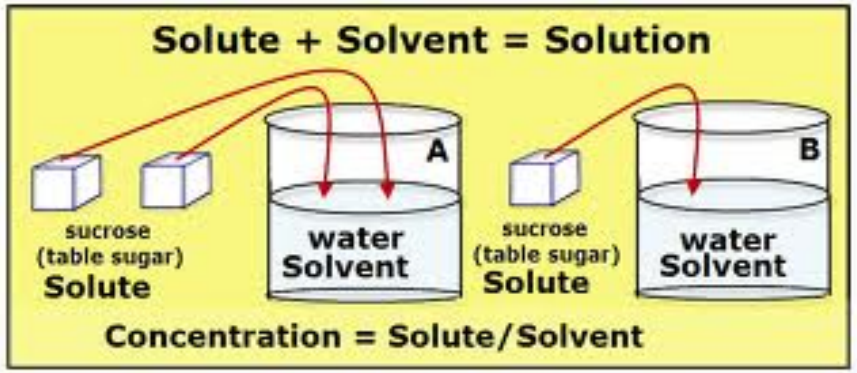
- Differentiate among, and give examples of the use of various representations of concentration. Include: g/L, %W/W, %W/V, %V/V, ppm, ppb, mol/L
- Solve problems involving calculation for concentration, moles, mass and volume.

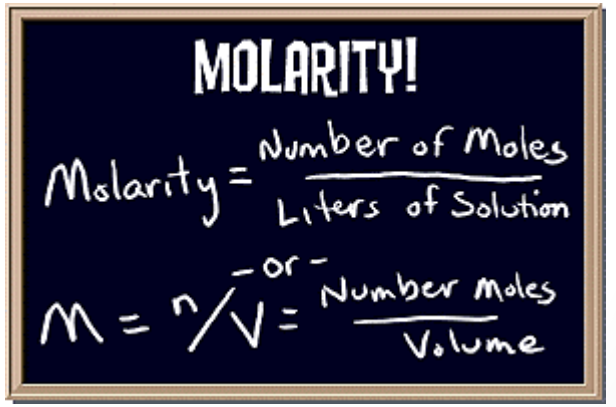
Concentration:

The **AMOUNT** of **SOLUTE** in a given **AMOUNT** of **SOLVENT** or **SOLUTION**.

- We usually see concentration measured in **g/L** or **mol/L** (**MOLARITY**)







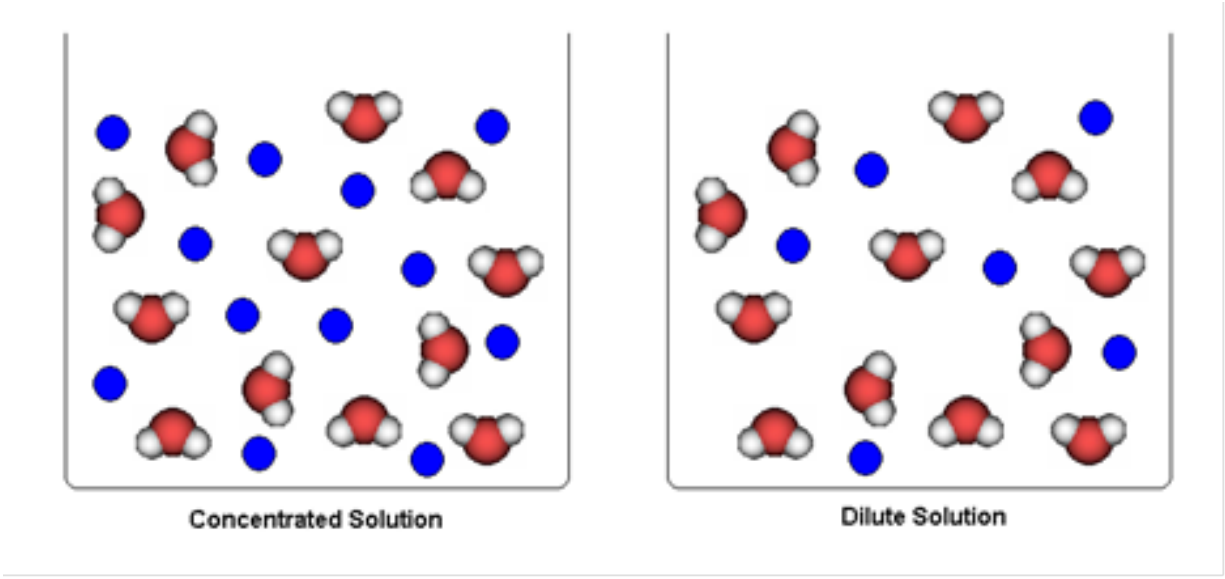
Concentrated & Dilute Solutions:

Concentrated Solutions:

- Solutions that contains a **LARGE AMOUNT** of **SOLUTE** for the **AMOUNT** of **SOLVENT**.
- **PANCAKE SYRUP** is a concentrated solution of sugar and water.

Dilute Solution:

- Solutions that have a **SMALL AMOUNT** of **SOLUTE** for the **AMOUNT** of **SOLVENT**.
- **LEMONADE** is a dilute solution of lemon juice, sugar and water.



Units for Concentration:

g/L = Grams of **SOLUTE** in 1L of **SOLUTION**

$$\%\,W/_{W} = \frac{Mass_{solute}}{100 g Solution} x100$$

$$\%\,W/_{V} = \frac{Mass_{solute}}{100 mL Solution} x100$$

$$\%\,V/_{V} = \frac{Volume_{solute}}{100 mL Solution} x100$$

ppm = **PARTS PER MILLION**

ex. 10 ppm sodium ions in water = 10 sodium ions in 1 million particles of water

ppb = **PARTS PER BILLION** (same idea as above)

Examples of Concentration Units

Molarity (mol/L):

- The number of **MOLES** of solute dissolved in each liter of solution.
- It is expressed as "**M**", "**C**", or square brackets "[ ]"
- Units: **moles/L**

[NaCl] = 5 mol/L

"Concentration of NaCl"

Molarity = moles of solute / Litres of solution

$$M = \frac{mol}{L}$$

Examples:

1. What is the molarity if 5.00mol of $CoCl_2$ is dissolved in 0.1L of solution?

mol/L

$$\frac{5.00\,mol}{0.1\,L} = 50\,\frac{mol}{L} = [CoCl_2]$$

Examples (Con't):

2. What is the molarity of a solution formed by mixing 10.0g H_2SO_4 with enough water to make 100.0 ml of solution?

$$10.0\,g \times \frac{1\,mol}{98.12\,g} = \frac{0.1\,mol}{0.1\,L} = 1\,\frac{mol}{L} = [H_2SO_4]$$

0.1L

3. What is the number of moles and mass of NaCl needed to make 1.0L of a 0.1 mol/L solution?

$$1.0\,L \times \frac{0.1\,mol}{1\,L} = 0.1\,mol\,NaCl \times \frac{58.5\,g}{1\,mol} = \boxed{5.85\,g\,NaCl}$$

$\frac{0.1\,mol}{1\,L}$ or $\frac{1\,L}{0.1\,mol}$

4. ~~How would we make the solution in #3?~~

What volume of $0.5\,\frac{mol}{L}$ NaCl would contain 1.5 mol.

$$1.5\,mol \times \frac{1\,L}{0.5\,mol} = 3\,L$$

$0.5\,mol/L$

$\frac{0.5\,mol}{1\,L}$ or $\frac{1\,L}{0.5\,mol}$