

Background concepts reviewed online

- Logarithms and exponentials
- Atoms and the periodic table
- Concentration notation
- Chemical bond types
- Metric/SI notation
- Unit conversions

Moles and molarity

Most recipes involve a very large number of molecules ($\gg 10^{20}$): a convenient unit for counting molecules at this scale is the mole (abbreviated “mol”). Avogadro’s constant, $N_A \approx 6.022 \cdot 10^{23} \text{mol}^{-1}$, gives the number of molecules in one mole of molecules:

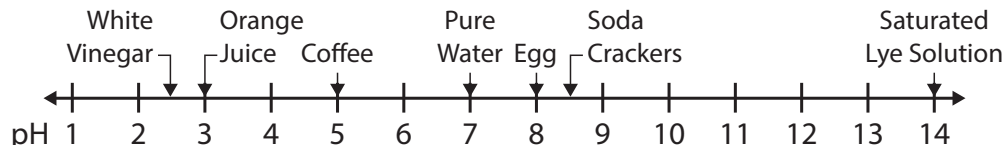
$$1 \text{ mole of molecules} = 6.022 \cdot 10^{23} \text{ molecules} \quad (1)$$

Molarity (with units of mol/L, or simply M) is the standard concentration unit in this course. Molar molecular weight (given in g/mol) varies between molecules and must be looked up or calculated.

Acids and bases, pH

Acidic solutions have higher free proton concentrations than pure water ($[\text{H}^+_{\text{water}}] = 10^{-7} \text{ M}$), while basic solutions have lower proton concentrations. Many sour foods and drinks are highly acidic, while just a few common ingredients (including lye and baking soda) are strongly basic. Because proton concentrations can vary over many orders of magnitude, a logarithmic scale called the pH scale (for “power of H^+ ”) is commonly used:

$$\text{pH} = -\log_{10} [\text{H}^+] \quad (2)$$



Major macromolecules in food: carbohydrates, proteins, and fats

Carbohydrates can exist as long covalently-bound chains (polymers) of sugars, and are therefore categorized according to their length. Single sugars, such as glucose and fructose, are monosaccharides; two linked sugars form disaccharides like sucrose (table sugar); and polysaccharides are longer polymers such as starch and agar. Many carbohydrates used in cooking (i) contain only C, H, and O, (ii) are uncharged, (iii) don’t adopt ordered conformations, and (iv) have names ending in “ose” or “-an.”

Proteins are long polymers made of amino acids, which come in about twenty types of varying shape, charge, and polarity. Proteins fold into specific conformations stabilized by non-covalent interactions between amino acids. While some proteins are mainly structural, a subset called “enzymes” can speed up chemical reactions. Many protein names end in “-ase,” “-in,” or “-gen.”

Fats, also called triglycerides, contain three fatty acids linked together by a glycerol molecule. The fatty acid tails contain only hydrogen and carbon and are thus nonpolar (immiscible in water).

Advanced materials available online

- Reading molecular diagrams
- Charge neutralization/ pK_a
- pH and protein denaturation