Chemistry:

MATTER:

92 Elements that occur in nature.

ELEMENT:
   Ex. oxygen, gold, copper, carbon

COMPOUND:
   Ex. salt (NaCl), H₂O

ELEMENTS ESSENTIAL TO LIFE: (Table 2.2 on p. 19)
25 of all elements are essential to life:
   4 of these make up 96% of all living matter:
      1.
      2.
      3.
      4.
The remaining 4% include:
   1. Phosphorus (P)
   2. Sulfur (S)
   3. Calcium (Ca)
   4. Potassium (K)
The human body:
  O, C, H, N, Ca, P, K, S, Na, Cl, Mg.

Trace elements:
   Ex. Iron (Fe)

ATOMS (p. 20; Fig. 2.4A)

Atoms consists of subatomic particles:

<table>
<thead>
<tr>
<th>Particle</th>
<th>Found</th>
<th>~ Weight (Daltons)</th>
<th>Charge</th>
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Atomic Number:

Atomic weight (or mass number):
   Ex. \( ^{12}_6 \text{C} = \text{At. wt} \Rightarrow 12 = 6p + 6n \)

Isotope:
   Ex. Carbon: 12, 13, 14
   \( ^{13}_6 \text{C} \Rightarrow \text{How many neutrons?} \\
   \text{Proton?} \\
   \text{Electrons?} \)
Radioactive isotope:

\[ ^{14}_{6}\text{C} \rightarrow 14 = 6\text{p} + 8\text{n} \rightarrow \text{Radioactive isotope} \]

Usefulness in science?

Electrons are found in **orbitals** around the nucleus.

- SHELLS: 1st = up to 2e⁻
- 2nd and subsequent shells = up to 8e⁻

**OCTET Rule:**

**Noble Gases:**

**How do the elements stay together?**

**Chemical bonds:**

Three types of chemical bonds:
1. **Covalent Bond** (between elements)
2. **Ionic Bond** (between elements)
3. **Hydrogen Bond** (between molecules)

**COVALENT BOND:** (p. 23, Figure 2.8)

Types of covalents bonds:
- H-H => single covalent bond
- O=O => double covalent bond
- N \equiv N => triple covalent bond
- H₂O => compound

How are electrons attracted to another?

**Electronegativity:**

**Non-Polar covalent bond:**

- Ex. Oxygen (O₂), Methane (CH₄)

**Polar covalent bond:**

- Occurs when:
  - Ex. Water (H₂O)  (p. 24; Figure 2.9)

**IONIC BOND** (p. 23, Fig. 2.7)

**ION:**
- **cation:**
- **anion:**

Ex. table salt (NaCl)

\[ \text{Na}^+ \quad + \quad \text{Cl}^- \quad \longleftrightarrow \quad \text{NaCl} \]
HYDROGEN BOND (p. 24; Figures 2.10A)

Living cells: electronegative atom => O or N

Are weak bonds, therefore easy to break

IMPORTANCE:

WATER AND ITS UNUSUAL PROPERTIES:
Note: Understand these 5 properties & their significance to life.

Water:
- Polar molecule
  - Hydrogen bonding BETWEEN each water molecule

  a) Cohesiveness
    - cohesion:
      - adhesion:
      - surface tension (p. 25, fig. 2.11)

  b) High specific heat

  c) High heat of vaporization
    - Evaporative cooling:

  d) Density of water (p. 26; Fig. 2.13)

  e) Versatile solvent (p. 26; Fig. 2.14)

  **pH, acids, bases & buffers**

Terms:
- Solution:
- Solvent:
- Solute:
- aqueous solution:
  - Ex. kool aid

Dissociation of H₂O (refers to the separation of H₂O)

\[ \text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^- \quad \text{or} \quad \text{H}_2\text{O} + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{OH}^- \]

Chemical equilibrium = the amount of H+ is equal to the amount of OH.
pH scale:

range:

log based scale \( \text{pH} = -\log[H^+] \) = - log \([10^{-5}]\)

\[ = - (-5) \]

\[ = 5 \]

When (p. 27; Fig. 2.15)

- pH = 7
- pH < 7
- pH > 7

Most biological systems:

Exception:

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<th>(a)</th>
<th>(b)</th>
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<td>_------</td>
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<td>(c)</td>
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1. pH values of acidic solutions
2. pH values of basic (alkaline) solutions
3. Point at which \( H^+ \) equal \( OH^- \).
4. Progressing from a weak to strong acid
5. Progressing from a weak to a strong base
6. Results of adding more hydrogen to a solution

- ACIDS:

- BASES:

- BUFFERS:

Ex. Carbonic acid - bicarbonate buffer system (2nd most important body buffering system)

If pH rises ...

\[ \text{H}_2\text{CO}_3 \_---------> \text{HCO}_3^- + \text{H}^+ \]. releases \( \text{H}^+ \).

(acid) (base)

\( \text{H}^+ \) donor \( \text{H}^+ \) acceptor

If pH drops ...

\[ \text{H}_2\text{CO}_3 <-------- \text{HCO}_3^- + \text{H}^+ \]. absorbs \( \text{H}^+ \).

helps to maintain your blood pH at ~ 7.35 - 7.45
If blood pH: falls below 7.35 => acidosis => needs to absorb \( \text{H}^+ \).

rises above 7.45 => alkalosis => needs to release \( \text{H}^+ \).