CHAPTER 2
THE CHEMISTRY OF LIFE
WHAT ARE ATOMS ANYWAY?

Figure 2.1 The hierarchy of biological order from atom to organism

PROPERTIES OF ATOMS

- SOLIDS, LIQUIDS AND GASES
- BASED ON PROTONS IN THE NUCLEUS AND ELECTRONS ON ORBITALS ACTING AS COUNTERBALANCE.
- ATOMS HAVE PROTONS, NEUTRONS AND ELECTRONS
Table 2.1 Naturally Occurring Elements in the Human Body

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Atomic Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>1</td>
<td>1.008</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>12.011</td>
</tr>
<tr>
<td>N</td>
<td>7</td>
<td>14.007</td>
</tr>
<tr>
<td>O</td>
<td>8</td>
<td>15.999</td>
</tr>
<tr>
<td>F</td>
<td>9</td>
<td>18.998</td>
</tr>
<tr>
<td>Ne</td>
<td>10</td>
<td>19.924</td>
</tr>
<tr>
<td>Na</td>
<td>11</td>
<td>22.989</td>
</tr>
<tr>
<td>Mg</td>
<td>12</td>
<td>24.305</td>
</tr>
<tr>
<td>Al</td>
<td>13</td>
<td>26.982</td>
</tr>
<tr>
<td>Si</td>
<td>14</td>
<td>28.086</td>
</tr>
<tr>
<td>P</td>
<td>15</td>
<td>30.974</td>
</tr>
<tr>
<td>S</td>
<td>16</td>
<td>32.060</td>
</tr>
<tr>
<td>Cl</td>
<td>17</td>
<td>35.453</td>
</tr>
<tr>
<td>K</td>
<td>19</td>
<td>39.102</td>
</tr>
</tbody>
</table>

Figure 2.10 Electron configurations of the first 18 elements

**CHARACTERISTICS OF ATOMS**

- Atoms have the same number of protons as electrons
- The atomic number is the number of protons
- The number of protons and neutrons = atomic weight
- Atoms with different number of neutrons are called isotopes
ELECTRON PROPERTIES

- Electrons attracted by the nucleus are repelled by each other.
- Electrons move thru cloud like orbitals.
- Energy levels are the distance from the atomic nucleus: close/low: far/high.

Figure 2.11  Electron orbitals

MORE THINGS ABOUT ELECTRONS

- Electrons fill lowest energy levels first.
- Electrons are 2,8,8,18. etc.
- Energy level filled is more stable, like the inert elements. (He, Ne, Ar, Rn).
- Ions are atoms that have lost or gained electrons.
ISOTOPES

- DIFFERENT FORM OF ATOM
- MORE NEUTRONS
- CARBON 12/CARBON 14
  - C12: 6e,6n,6p/ C14: 6e,8n,6p
  - MEASURES 1/2 LIFE/LOSS OF n
  - ATOMS: DIFFERENT NEUTRON #
  - USE: RADIOACTIVE DATING, MRI'S

FORMS OF BONDING

- IONIC BONDS
- IONS = ELECTRONS GAINED OR LOST.
- A TRANSFER OF ELECTRONS
- SODIUM AND CHLORINE = NaCl
- SODIUM LOOSES 1 ELECTRON
- CHLORINE GAINS 1 ELECTRON
**COVALENT BONDS**

- Pairs of electrons shared
- C-C-C or C-H OR C=C OR C=H
- Can have triple bonds
- Symmetrical charges: non-polar covalent
- Asymmetrical charges: polar covalent such as H2O
CHEMICAL REACTIONS

- **SYNTHESIS (DEHYDRATION)**
- **REMOVES WATER, BUILDS MOLECULES, ASSEMBLES.**
- **ANABOLISM REACTION** \( A + B = AB \)
- **REACTANTS = PRODUCTS**
- **AA + AA = PEPTIDE (- WATER)**
- **PEPTIDE + PEPTIDE = DIPEPTIDE**

Unnumbered Figure (Page 38). Chemical reaction between hydrogen and oxygen

\[ 2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O} \]

**DECOMPOSITION REACTIONS**
- **HYDROLYSIS ADDS WATER**
- **CATABOLISM/SPLITS CMPDS.**
- **AB + WATER = A + B**
- **DIGESTION**
- **PROTEIN + WATER = AA + AA**
- **REDOX REACTIONS**
- **TRANSFER OF ELECTRONS**
- **LOOSE OR GAIN ELECTRONS**
Figure 2.20 Photosynthesis: a solar-powered rearrangement of matter