Biological Importance of Water

Standard SB1 - Students will analyze the nature of the relationships between structures and functions in living cells.

(d) Explain the impact of water on life processes (i.e., osmosis, diffusion).
Water (H₂O)

- Most abundant compound in organisms
- Many unique properties that make water so versatile & so important to life

Earth is ~70% water and 96% of it is in the oceans
Water (H₂O)

Water’s Polarity

- **Polar molecules** have a positive (+) charge on 1 side and a negative (-) charge on the other.

- **Non-polar molecules** have no charge and are not attracted to polar molecules.
Water (H$_2$O)

- Polarity
  - Makes it possible for other compounds to dissolve in water
- Water has hydrogen bonds
  - Adhesion
    - H$_2$O sticking to other substances
  - Cohesion
    - H$_2$O molecules sticking to other H$_2$O molecules
- Surface tension
  - Measure of how difficult it is to stretch or break the surface of a liquid
Capillary action

- Combination of cohesion & adhesion (used in the uptake of water in plants)
van der Waals Forces

- the attractive forces between slightly positive and negative regions of molecules
- “pull” on the molecules and hold them together.

van der Waals forces give water its “sticky” properties and creates surface tension
Water (H\(_2\)O)

- **Solvent abilities**
  - Occur because of its polarity
  - **Hydrophobic** (water-fearing)
    - Non-polar compounds that are NOT water soluble
  - **Hydrophilic** (water-loving)
    - Polar & Ionic compounds that are water soluble
  - Most biochemical reactions involve solutes dissolved in water

**Figure 2.14**

![Ions in solution](image.png)
pH scale & buffers

- The measure of concentration of H+ in a solution is called pH.

- The pH of substances ranges from 0-14
  - 0-6.9 = acid
    - Substances that release hydrogen ions (H+) when dissolved in water are called acids.
  - 7 = neutral
  - 7.1-14 = base
    - Substances that release hydroxide ions (OH-) when dissolved in water are called bases.
Buffers

- Prevent sharp, sudden changes in pH so that the body can maintain homeostasis
- pH of most fluids in the body = 6.5-7.5
**pH scale**

- **0-6.9 = acid**
- **7 = neutral**
- **7.1-14 = base**

<table>
<thead>
<tr>
<th>pH Value</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Battery acid</td>
</tr>
<tr>
<td>1</td>
<td>Stomach acid</td>
</tr>
<tr>
<td>2</td>
<td>Lemon juice, vinegar</td>
</tr>
<tr>
<td>3</td>
<td>Orange juice, cola</td>
</tr>
<tr>
<td>4</td>
<td>Tomatoes</td>
</tr>
<tr>
<td>5</td>
<td>Bananas</td>
</tr>
<tr>
<td>6</td>
<td>Normal rainwater</td>
</tr>
<tr>
<td>7</td>
<td>Urine, healthy lake</td>
</tr>
<tr>
<td>8</td>
<td>Pure water</td>
</tr>
<tr>
<td>9</td>
<td>Blood, tears</td>
</tr>
<tr>
<td>10</td>
<td>Seawater</td>
</tr>
<tr>
<td>11</td>
<td>Baking soda</td>
</tr>
<tr>
<td>12</td>
<td>Great Salt Lake</td>
</tr>
<tr>
<td>13</td>
<td>Household ammonia</td>
</tr>
<tr>
<td>14</td>
<td>Soapy water</td>
</tr>
<tr>
<td>14</td>
<td>Oven cleaner</td>
</tr>
<tr>
<td>14</td>
<td>Sodium hydroxide (NaOH)</td>
</tr>
</tbody>
</table>

*Strong Acid* pH 0  *Weak Acid* pH 6.9  *Neutral* pH 7  *Weak Base* pH 7.1  *Strong Base* pH 14