Control of Blood Volume

Regulation of Body Water

- Kept constant by regulating intake and output
- The more water you need, the less you will excrete
- Minimum amount of fluid necessary to dissolve metabolic wastes and provide for their excretion in urine.

Details of Intake Regulation

- Thirst is finely adjusted to meet body’s needs for water
- When water lost from blood, the blood becomes hypertonic, causing:
  - Withdrawal of water from salivary glands, causing dry mouth
  - Stimulation of hypothalamus, increasing drinking
## Details of Output Regulation

- Excretion controlled by kidneys
- High osmotic pressure in blood causes secretion of **ADH** (antidiuretic hormone) from pituitary gland
- Stimulates water retention by kidney reabsorption

## Electrolyte Balance

## What are electrolytes?

- Electrically charged particles (i.e. Na\(^+\) and Cl\(^-\)), formed when a compound dissociates in water
- **Cation** = positively charged particle
- **Anion** = negatively charged particle
In an electrolyte solution, water molecules are attracted to both anions and cations. Notice that the negative oxygen atoms of the water molecules are drawn to the sodium cation (Na\(^+\)), whereas the positive hydrogen atoms of the water molecules are drawn to the chloride ions (Cl\(^-\)).

**Fluid And Electrolyte Balance**

- Proteins regulate flow of fluids and ions
- Transport proteins in cell membranes regulate the passage of positive ions

**Fluid And Electrolyte Balance (2)**

- Negative ions follow
- Water flows toward the more concentrated solution
- Sodium/potassium pump exchanges minerals across cell membrane
### Table 12.4

<table>
<thead>
<tr>
<th>Electrolytes</th>
<th>Intracellular (inside cells)</th>
<th>Extracellular (outside cells)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cations (positively charged ions)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium (Na⁺)</td>
<td>142</td>
<td>142</td>
</tr>
<tr>
<td>Potassium (K⁺)</td>
<td>156</td>
<td>5</td>
</tr>
<tr>
<td>Calcium (Ca²⁺)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Magnesium (Mg²⁺)</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Anions (negatively charged ions)</td>
<td>180</td>
<td>103</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Phosphate (HPO₄²⁻)</td>
<td>103</td>
<td>2</td>
</tr>
<tr>
<td>Sulfate (SO₄²⁻)</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Organic acids (urate, pyruvate)</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Proteins</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>

**Key:**
- **Cations**
- **Anions**

*Chemical symbols:*
- K = potassium
- P = phosphorus
- Mg = magnesium
- S = sulfate
- Na = sodium
- Cl = chloride

**Fluid And Electrolyte Imbalance**

Sodium and chloride most easily lost:
- Extracellular: lost in sweat
- Need to be replaced

Different solutes lost by different routes:
- Vomiting and/or diarrhea loses sodium
- Potassium may be lost in the kidneys
- Uncontrolled diabetics may lose sugar and electrolytes through the kidneys
Acid-Base Regulation by the Lungs

- Carbon dioxide forms carbonic acid in the blood, which dissociates into hydrogen ions and bicarbonate ions
- Carbonic acid and bicarbonate work as buffers to neutralize acids and bases

Acid-Base Regulation by the Lungs (2)

- Respirations slow down or speed up to maintain homeostasis
Acid-Base Regulation by the Kidneys

- The kidneys select which ions to excrete and which to retain
- The urine’s acidity level fluctuates as needed to keep the body’s total acid content balanced.

To learn more about the newer types of water available, please visit the following website.

http://www.webmd.com/diet/guide/super-waters-health-or-hype