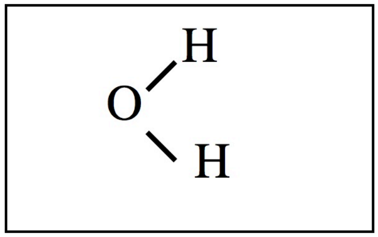
Water chemistry (chapters 2 and 3)

Water (H_2O)



- The most abundant molecule in living things

  √ Our bodies are about half water by weight

Figs 2.10 and 26.2

Water has many properties that are essential to sustaining life

- Water dissolves many substances

  √ This allows substances to be easily transported in body fluids

- Water cools when it evaporates

  √ We can lower body temperature through sweating

Hydrophilic molecules (also called polar or lipophobic molecules)

Molecules that dissolve in water

√ Ex: Ions (salts), carbohydrates, proteins

Fig 2.15

Hydrophobic molecules (also called non-polar or lipophilic molecules)

Molecules that do not dissolve in water

√ Ex: Fats, oils, waxes

- Molecules that are hydrophobic usually have large regions made of only carbon and hydrogen atoms

The "like mixes with like" principle:

Hydrophilic molecules mix with other hydrophilic molecules, not with hydrophobic molecules

Hydrophobic molecules mix with other hydrophobic molecules, not with hydrophilic molecules

Dissolve

When molecules become evenly spread out with a liquid

- Solute = The substance that is dissolved in the liquid
- Solvent = The liquid that does the dissolving
    - √ Water is the solvent in all body fluids
- Solution = The liquid with the solute dissolved in it

Diffusion

The movement of a solute from an area of its high concentration to an area of its low concentration

- Cell membranes are barriers that prevent most solutes from diffusing through them
    - √ Water can pass through cell membranes

Fig 3.3

Osmosis

The movement of water across a cell membrane towards whichever side has the highest solute concentration

- "Water moves towards solutes"

- Hypertonic = A solution with a higher solute concentration than a cell

  - √ Cells lose water by osmosis in hypertonic solutions

  - √ The cell will shrink and crenate (shrivel)

- Hypotonic = A solution with a lower solute concentration than a cell

  - √ Cells gain water by osmosis in hypotonic solutions

  - √ The cell will enlarge and may lyse (burst)

- Isotonic = A solution with an equal solute concentration to a cell

  - √ Cells stay the same size in isotonic solutions because they don't gain or lose water through osmosis

  - √ Blood and other body fluids are isotonic solutions

  - √ Most hospital IV solutions are also isotonic solutions

Figs 3.7 and 3.8

Acid

Any molecule that adds H^+ ions to a solution

- Examples:

$HCl \rightarrow H^+ + Cl^-$

Hydrochloric acid

$H_2CO_3 \rightarrow H^+ + HCO_3^-$

Carbonic acid

Fig 2.16

Base

Any molecule that removes H^+ ions from a solution

- Examples:

$OH^- + H^+ \rightarrow H_2O$

Hydroxide ion

$HCO_3^- + H^+ \rightarrow H_2CO_3$

Bicarbonate ion

Fig 2.16

pH scale

A number (from 0 to 14) that indicates the H^+ concentration of a solution

• The pH is how acidic or how basic the solution is

• Pure water has a pH of 7 and is called "neutral" (not acidic or basic)

• Solutions that are acidic have a higher $[H^+]$ than pure water

√ Acidic solutions have pHs **lower** than 7

√ The higher the $[H^+]$, the lower the pH

• Solutions that are basic have a lower $[H^+]$ than pure water

√ Basic solutions have pHs **higher** than 7

√ The lower the $[H^+]$, the higher the pH

Fig 2.17

Buffer

Substances that (when added to a solution) minimize changes in the solution's pH

• Buffers make a solution resistant to acids and bases

• Blood is buffered by the carbonic acid and bicarbonate ions in the blood

• The carbonic acid replaces any lost H^+

$$H_2CO_3 \rightarrow HCO_3^- + H^+$$

• The bicarbonate ion absorbs any excess H^+

$$HCO_3^- + H^+ \rightarrow H_2CO_3$$