

Water (H₂O)

A “V” shaped molecule

- Living things are mostly water

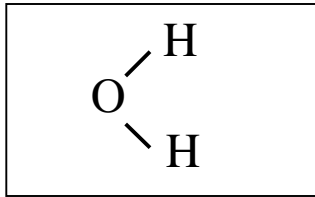


Fig 3.2

Substances are classified as either hydrophilic or hydrophobic, depending on whether they attract water or not

Hydrophilic substance = Any substance that attracts water

- Some typical traits of hydrophilic substances:
 - a) Water spreads out on their surface (example: Paper)
 - or...
 - b) They dissolve in water (example: Table salt)

Hydrophobic substances = Any substance that does not attract water

- Some typical traits of hydrophobic substances:
 - a) Water beads up on their surface (example: Wax)
 - or...
 - b) They do not dissolve in water (example: Oil)

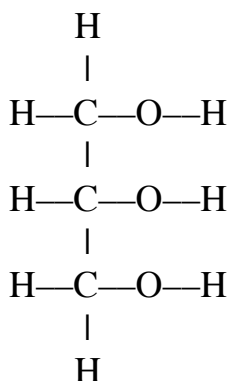
How to predict whether a substance is hydrophobic or hydrophilic by looking at its molecules:

1) Ions are always hydrophilic

✓ Example: Table salt, made of Na^+ and Cl^- ions

2) Molecules where all (or most) of the carbons have partial charges are hydrophilic (“polar molecules”)

✓ Example: Glycerol



3) Molecules where all (or most) of the carbons have don't have partial charges are hydrophobic (“non-polar molecules”)

✓ Example: Octane

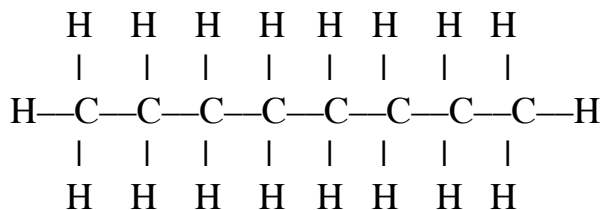
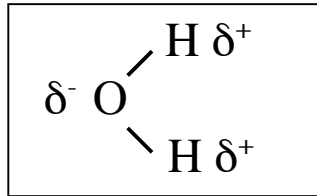


Fig 3.2 and 3.6

Each water molecule has partial charges

- The oxygen is δ^- and the hydrogens are δ^+



- Hydrophilic molecules are hydrophilic because they attract water electrostatically

✓ Water's δ^- oxygen is attracted to any positive charge (such as $+$ ions and δ^+ hydrogen)

✓ Water's δ^+ hydrogen is attracted to any negative charge (such as $-$ ions and δ^- oxygen or nitrogen)

- Hydrophobic molecules are hydrophobic because they have little or no charges to attract water molecules

Fig 3.2

Hydrogen bond

The electrostatic attraction between a δ^+ H and any δ^- atom (such as oxygen or nitrogen)

- Example: Water molecules bond to each other by hydrogen bonds
- Hydrogen bonds are shown as a dashed line

Figs 3.2 and 3.4

Dissolve

When a substance's molecules become evenly spread out in a liquid

- Three important terms related to dissolving a substance in a liquid:

✓ Solvent = The liquid

✓ Solute = The substance that is dissolved

✓ Solution = The liquid and the substance dissolve in it

- When a substance dissolves in water, each molecule of the substance becomes coated with water molecules

Figs 2.14, 3.6, and 3.7

Concentration

The amount of solute per volume of solution

- Concentrations are usually stated as “grams per liter” (grams of solute per one liter of solution)
- A solute written in brackets means the concentration of that solute

✓ Example: [Glucose] = The concentration of glucose

Diffusion

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

- Cell membranes can block diffusion of most solutes

Osmosis

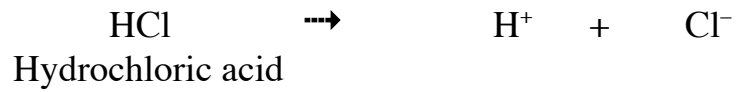
The spontaneous movement of water across a selectively permeable membrane towards the side with the higher total solute concentration

- “Selectively permeable” = Water can cross membrane but solutes cannot
- “Water moves towards solutes” is a way to remember osmosis
- Hypertonic = Higher [solute] than a cell’s cytoplasm
 - ✓ Cells lose water when put in hypertonic solutions
- Hypotonic = Lower [solute] than a cell’s cytoplasm
 - ✓ Cells gain water when put in hypotonic solutions
- Isotonic = Equal [solute] to a cell’s cytoplasm
 - ✓ Cells don’t gain or lose water when put in isotonic solutions

Acid

Any molecule that adds H^+ ions to water

- Examples:

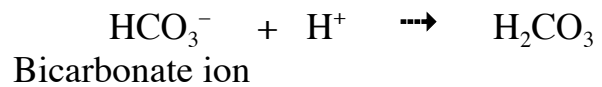
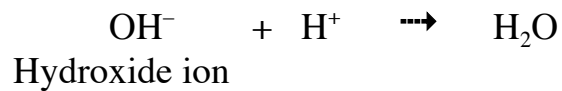


Figs on pages 53 and 54

Base

Any molecule that removes H^+ ions from water

- Examples:



Figs on pages 54

Water molecules can dissociate:



- Only a small number of water molecules are dissociated at any one moment
- In pure water, $[\text{H}^+] = [\text{OH}^-]$

Fig on page 53

pH scale

A number (from 0 to 14) that indicates how acidic or basic a solution is

- $\text{pH} = -\log[\text{H}^+]$

- ✓ Example: $[\text{H}^+] = 0.0001 = 10^{-4} = \text{pH } 4$

- ✓ Example: $[\text{H}^+] = 0.000000001 = 10^{-9} = \text{pH } 9$

- Pure water has a pH of 7 and is called “neutral” (not acidic or basic)

- ✓ $[\text{H}^+] = [\text{OH}^-]$ at pH 7

- Solutions that are acidic have a higher $[\text{H}^+]$ than pure water

- ✓ Acidic solutions have pHs **lower** than 7

- ✓ The higher the $[\text{H}^+]$, the lower the pH

- Solutions that are basic have a lower $[\text{H}^+]$ than pure water

- ✓ Basic solutions have pHs **higher** than 7

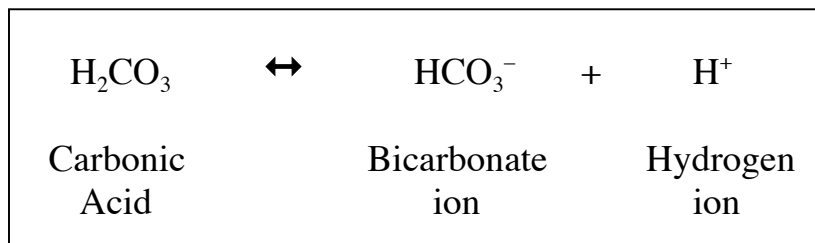
- ✓ The lower the $[\text{H}^+]$, the higher the pH

Fig 3.8

Buffer

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

- Buffers make a solution resistant to acids and bases
- A common buffer in living things is the carbonic acid/bicarbonate ion buffer



- The carbonic acid replaces any lost H^+ by:



- The bicarbonate ion absorbs excess H^+ by:

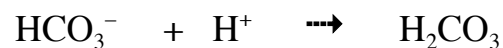


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