

WATER, ACIDS, BASES, BUFFERS

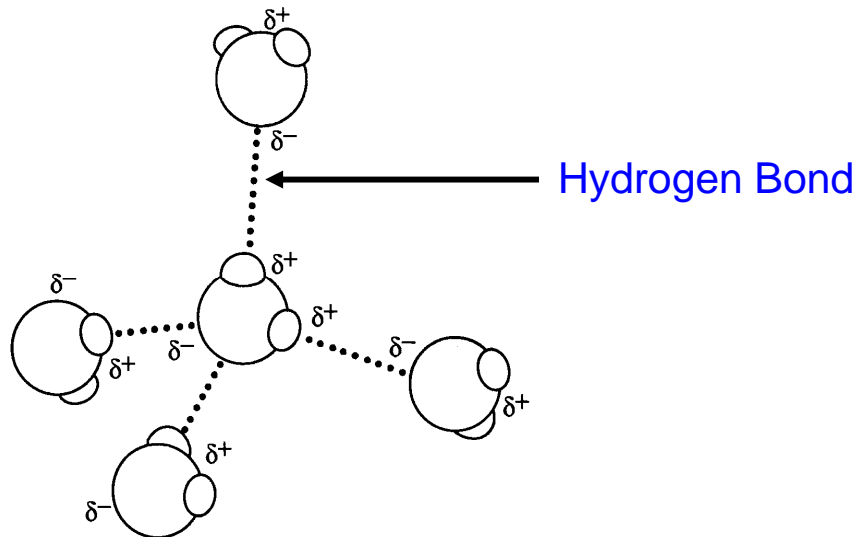
STRUCTURE & GEOMETRY OF WATER:

Water is polar



Maximum number of H bonds = 4

Each water molecule can form a max. of 4 hydrogen bonds with 4 other water molecules



PROPERTIES OF WATER:

Liquid water is cohesive

Cohesion = H bonds between water molecules; H₂O molecules tend to stick tog.

Importance = Transport H₂O against gravity in plants
Higher surface tension

Water has a high specific heat

Takes a lot of energy to raise 1 gram of H₂O 1 °C

Why? Must break H bonds

Liquid H₂O can absorb large amounts of heat with small changes in temperature

Water has a high heat of vaporization

Takes a lot of energy to convert liquid H₂O into vapor

Why? Must break H bonds

Keeps water in liquid state

Water expands with it freezes

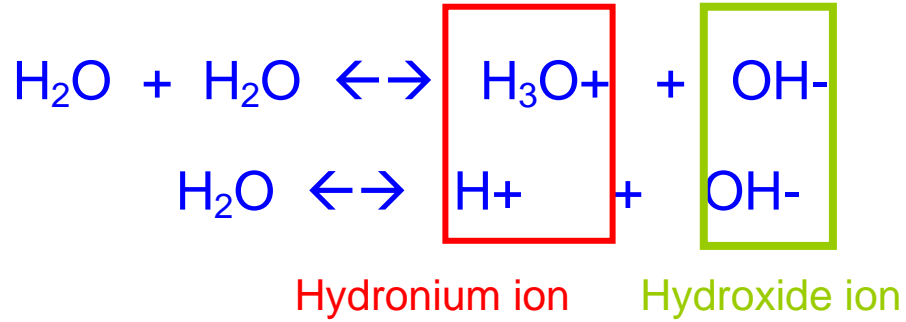
Solid H₂O is less dense than liquid H₂O

Why? In solid state H₂O locked into max. number of H bonds; takes up more space

Water is a versatile solvent

Will dissolve polar covalent and ionic compounds

DISSOCIATION OF WATER:



1 out of 554,000,000 water molecules dissociates

At equilibrium in pure water at 25°C

$$[\text{H}^+] = [\text{OH}^-] = 1.0 \times 10^{-7} \text{ M}$$

If add $[\text{H}^+]$ to pure water
water

Removes OH^-
Equilibrium shifts left
 $[\text{H}^+] > [\text{OH}^-]$

If add $[\text{OH}^-]$ to pure

Removes H^+
Equilibrium shifts left
 $[\text{OH}^-] > [\text{H}^+]$
reduces H^+ indirectly
If add NH_3
 $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$
Reduces H^+ directly

PH SCALE:

$$\text{pH} = -\log_{10}[\text{H}^+]$$

$$\text{if } [\text{H}^+] = 10^{-7}$$

$$\text{then pH} = 7$$

$$[\text{H}^+] \times [\text{OH}^-] = 10^{-14}$$

$$\text{If } [\text{H}^+] = 10^{-9}$$

$$\text{Then } [\text{OH}^-] = 10^{-5}$$

$$\text{pOH} = 5$$

$$\text{pH} = 9$$

BUFFERS:		
Description	Function	Importance
Weak acids or bases	Minimize changes in pH	Controls chemical reactions Maintains homeostasis
BICARBONATE BUFFER SYSTEM:		
$\text{H}_2\text{O} + \text{CO}_2 \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{HCO}_3^- + \text{H}^+$		
<p>HCO₃⁻ = Bicarbonate (weak base) H₂CO₃ = Carbonic acid (weak acid)</p> <p>Major buffer system in blood Maintains blood pH between 7.38 and 7.42</p>		
Action:	Effect:	
Increase [H ⁺] How? Fat metabolism OD on acidic drug	Increase [H ⁺] Equilibrium shifts left $\text{H}^+ + \text{HCO}_3^- \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ Increase [CO ₂] Increase rate and depth of respiration	
Increase Rate & Depth of Respiration Hyperventilate	Decrease [CO ₂] Equilibrium shifts left $\text{H}^+ + \text{HCO}_3^- \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ Blood pH increases	