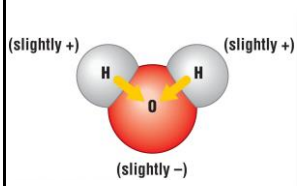
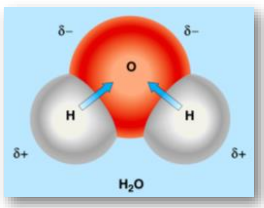
# Water – The Elixir of Life

## Chemistry of water

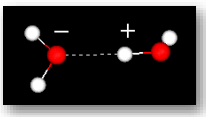
- Water is polar molecule
  - remember polar covalent bonds
  - + & – poles

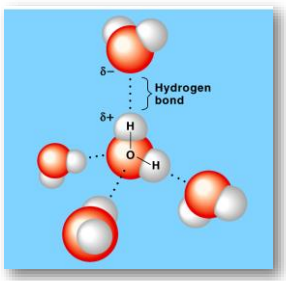



## Chemistry of water

- $H_2O$ molecules form H bonds with each other
  - + attracted to –
  - creates a sticky molecule




## Cohesion

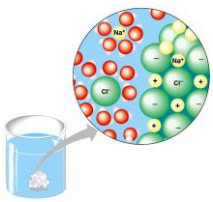
- H bonding between $H_2O$ creates cohesion
  - water is "sticky"
  - surface tension
  - drinking straw
    - can you suck sugar up a straw?

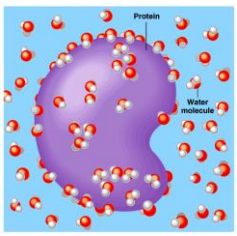
## Adhesion

- $H_2O$ molecules form H bonds with other substances
  - capillary action
  - meniscus
  - water climbs up fiber
    - ex. paper towel
  - water sticking to the side of a microtube

## Water is the solvent of life

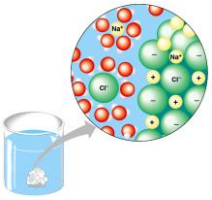
- $H_2O$ is a good solvent due to its polarity
  - polar $H_2O$ molecules surround + & – ions
  - solvents dissolve solutes creating aqueous solutions

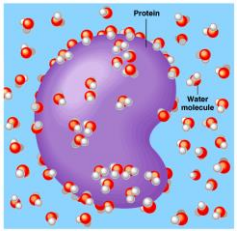


## Hydrophilic

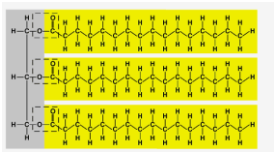
- Hydrophilic
  - substances have affinity for $H_2O$
  - polar or non-polar?
  - ionic






## Hydrophobic

- Hydrophobic
  - substances do not have affinity for $H_2O$
  - polar or non-polar?
  - non-ionic



fat (triglycerol)


## Water forms ions

- Hydrogen ion ($H^+$) splits off from water to leave a hydroxide ion ($^-OH$)

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

- If concentration of 2 ions is equal, water is neutral
- If $[H^+] > [^-OH]$, water is acidic
- If $[^-OH] > [H^+]$, water is basic
- pH scale = how acidic or basic a solution is

## pH Scale

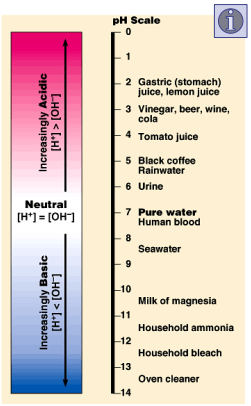
- In pure water only 1 water molecule in every 554 million is dissociated.
  - very small amount of ions
  - $[H^+]$ and $[OH^-]$ is $10^{-7}$ M

$$K_w = [H^+]\,[OH^-] = 10^{-14}\ M$$

- pH scale is based on this equation

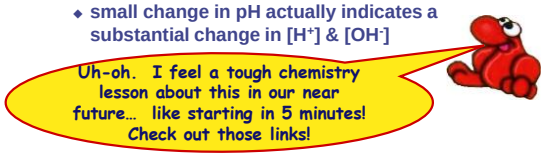
## pH Scale

- In neutral solution $[H^+] = 10^{-7} \rightarrow pH = 7$
- Values for pH *decline* as $[H^+]$ *increase*
- Acids
  - adding acid increases $[H^+]$
- Bases
  - adding base increases $[OH^-]$



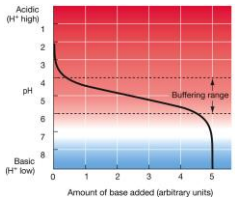

## pH & Biology

- pH of a neutral solution = 7
- Acidic solutions = pH < 7
  Basic solutions = pH > 7
- Most biological fluids have pH 6 – 8
  - pH values in human stomach can reach 2
- Each pH unit represents a 10-fold difference in $H^+$ & $OH^-$ concentrations.
  - small change in pH actually indicates a substantial change in $[H^+]$ & $[OH^-]$



## Buffers

- Resist pH change
- Is a solution of weak acid and its corresponding base
- works best when ratio of whole acid to "dissociated" acid is 1:1
- ex. $H_2CO_3 \leftrightarrow HCO_3^- + H^+$
- staying in the buffering range limits pH swings





## Any Questions??