

Today's topics: WATER (Chapter 3)

1. Importance of water to living things
2. Special properties of water
3. Molarity and solutions
4. Acids and bases
5. Buffers and electrolytes
6. Hydrophobic and hydrophilic compounds

Water is essential to life



- Life originated in the sea
- All life processes still take place in watery solutions
- We are about 65% water
- Water has several special properties that help make life possible

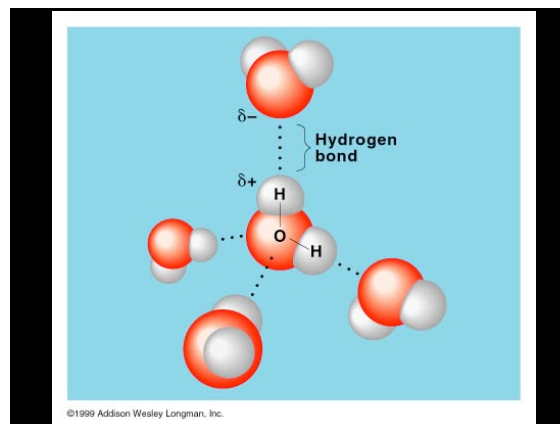
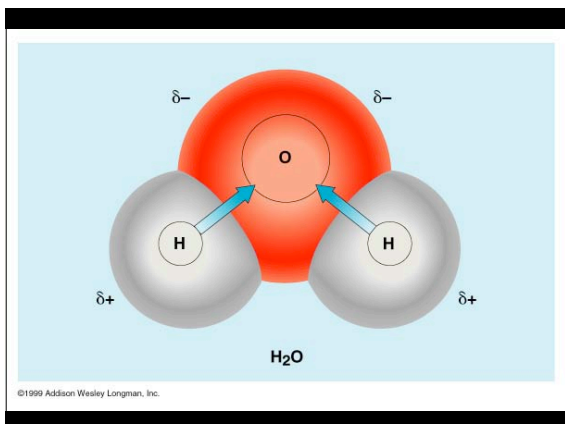
The special properties of water include:

- Water is cohesive/adhesive
- Water is an excellent solvent of ionic and polar compounds
- Water has a high specific heat
- Water has a high heat of evaporation
- Ice is less dense than liquid water

Why does water have these special properties?

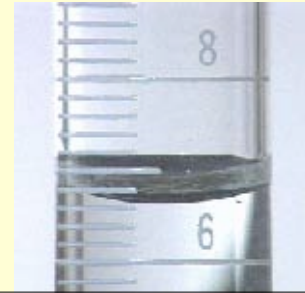
Recall: water is a very polar molecule (slight electrical charge on each end)

- Because it is polar, water makes hydrogen bonds
- Hydrogen bonds and polarity contribute to many of water's properties



Water is cohesive

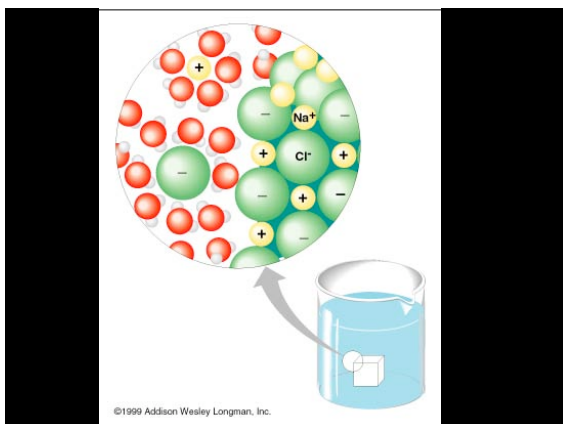
Water adheres to some substances



What do polarity and hydrogen bonds have to do with cohesion and adhesion?

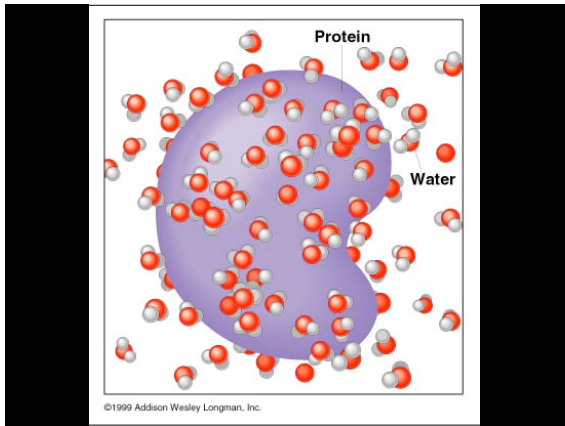
- Why is cohesion important to living things?
- Adhesion?

Water as a solvent



Water as a solvent

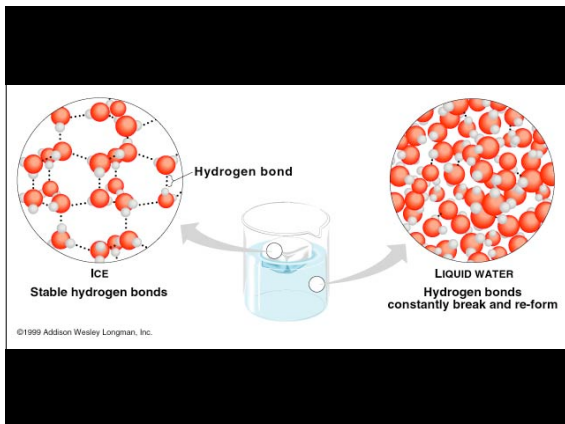
- Polar water molecules surround ions
- Water efficiently dissolves ionic compounds
- Even large molecules can be dissolved in water if there are charges on their surface



Water has a high specific heat and a high heat of evaporation

- Can you explain what polarity or hydrogen bonds have to do with water's high heat of evaporation?
- Why are these properties important to living things?

Ice floats - solid water is less dense than liquid water



- Why is it important to life that ice floats?
- Can you explain what hydrogen bonds or polarity have to do with ice being less dense than water?

Moles



- A mole is a big number: 6.02×10^{23}
- Why that number?
- Convenience. If the atomic mass of an atom or molecule is X atomic mass units, then one mole of that substance weighs X grams.
- For example, one mole of ^{12}C weighs 12g

Molarity

- The concentration of aqueous solutions is usually expressed in molarity
- A one molar solution is one mole of solute dissolved in enough water to make one liter of solution

Acids, Bases, pH

- Acids release hydrogen ions (H^+) into aqueous solutions. Acids are "proton donors."
- Acids usually have formulas that start with "H"
- Examples...
- Acids increase the concentration of H^+ ions in water

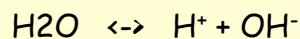
A Hydrogen ion is a Proton

- The nucleus of a hydrogen atom (atomic number =1, atomic mass = 1) consists of one proton.
- Hydrogen atoms can lose their electron to become an ion (H^+)
- Stripped of its electron, a hydrogen ion is simply a proton

Bases are Proton Acceptors

- Bases either directly accept protons, or the bases dissociate in water, releasing OH^- , and OH^- then accepts protons
- Many bases have formulas that end in "OH"
- Examples...
- Bases decrease the concentration of H^+ ions in water

A small portion of water molecules in any solution dissociate on their own:



(total concentration of H^+ in pure water at *equilibrium*: 1×10^{-7} Molar)

The pH Scale

- Measures acidity/alkalinity
- pH = negative logarithm of H⁺ concentration
- Runs from 0 to 14
- Each unit = tenfold change in H⁺ concentration
- 1 = most acid; 7 = neutral; 14 = most basic

Buffers

- Buffers minimize pH change
- Buffers are often weak acids or weak bases
- A "weak acid" is an acid that dissociates *incompletely* in water
- Buffers are very important in maintaining *homeostasis* (constant pH)

Electrolytes

- Acids and bases can react, forming a salt
- Dissolved ionic substances, including salts, acids and bases, conduct electricity and are called *electrolytes* because they can carry electric current

Hydrophilic or Hydrophobic?

- Hydrophilic - "waterloving" - polar and ionic molecules are hydrophilic. Hydrophilic molecules dissolve in water and attract water.
- Hydrophobic - "scared of water" - electrically neutral molecules without charge or polarity are hydrophobic - they dissolve poorly and do not attract water.

Rehash

- Water is important because all the chemical reactions of life take place dissolved in water
- The water molecules's polarity gives water unique properties, which basically allow life as we know it to exist.
- Living things regulate their pH via buffer systems.
- Hydrophilic and hydrophobic interactions often determine how molecules interact in and around water

For next time,
read Chapters 4 and 5