WATER AND SOLUTIONS

Section 6.3

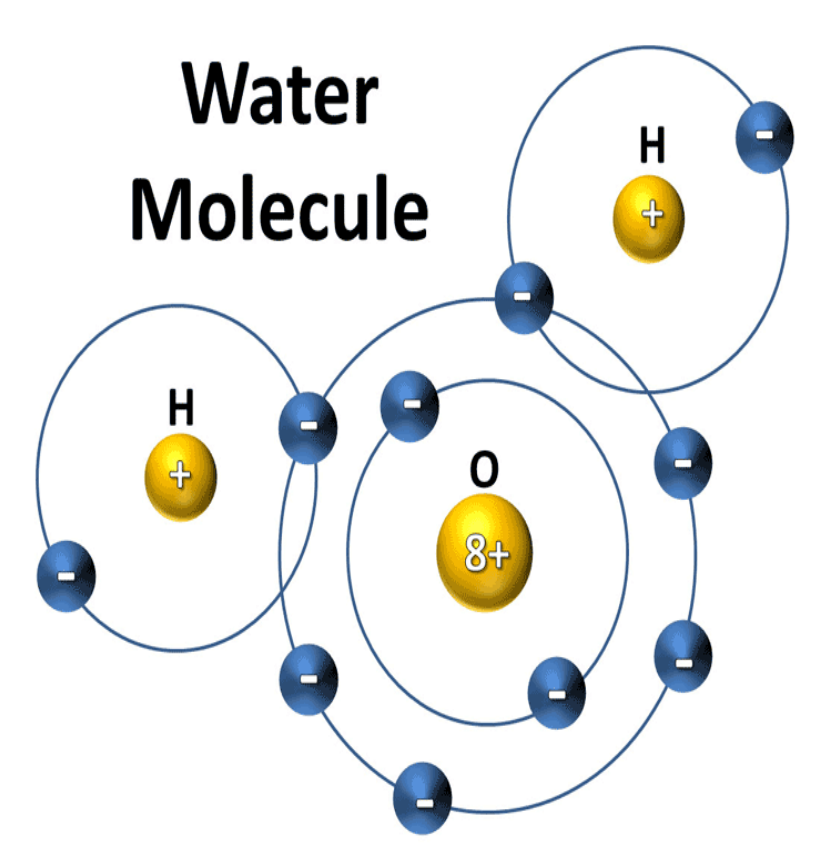
SB1a,d,e

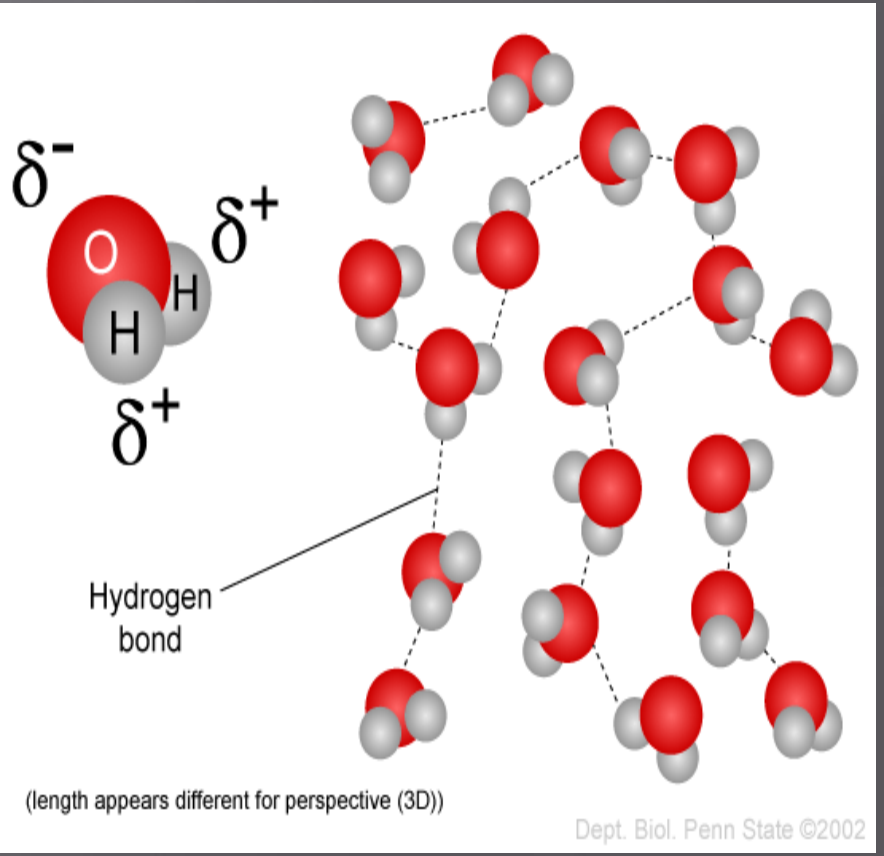
? What properties of Water make it INVALUABLE to Living Things?

Water

- 70% of the body
  - Major component of cells
  - Helps maintain homeostasis
    - Maintains body temperature
    - Moves nutrients and waste
- 70% of the earth
  - Regulates earth's temperature
  - Solid water floats!

Structure


Water Molecule
H
+
H
+
O
8+


δ-
δ+
O
H
H
δ+
Hydrogen bond
(length appears different for perspective (3D))
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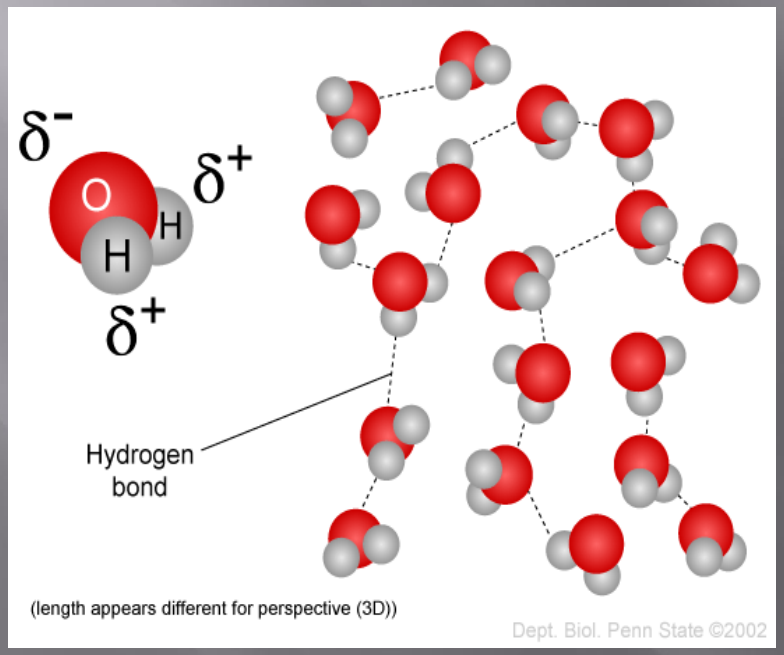
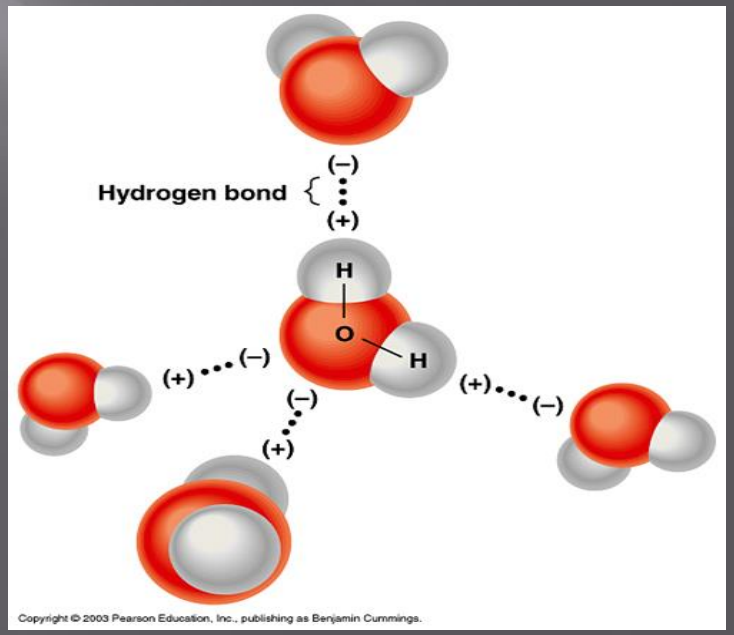
Bonding & Polarity

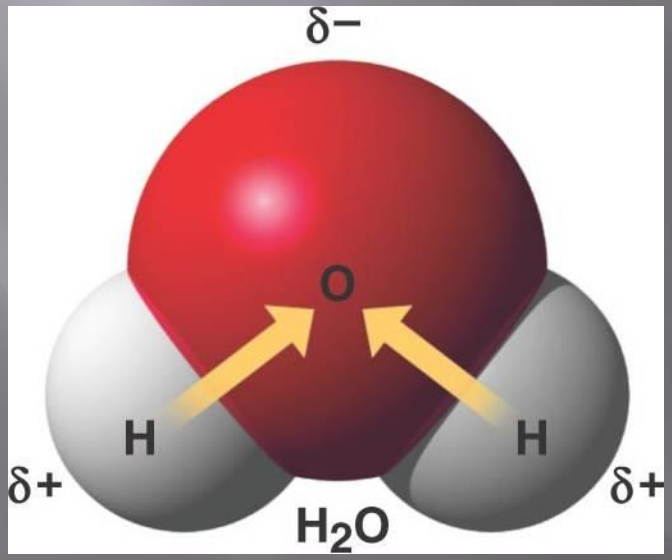
- A single water molecule is composed of 1 oxygen atom attached to 2 hydrogen atoms with covalent bonds—*this is a tiny molecule!*
- Water molecules are polar because the electrons (e-) that are shared in the covalent bond are not shared equally
  - The e- spend more time around the oxygen atom giving it a partially negative charge and less time around the hydrogen atoms giving them a partially positive charge

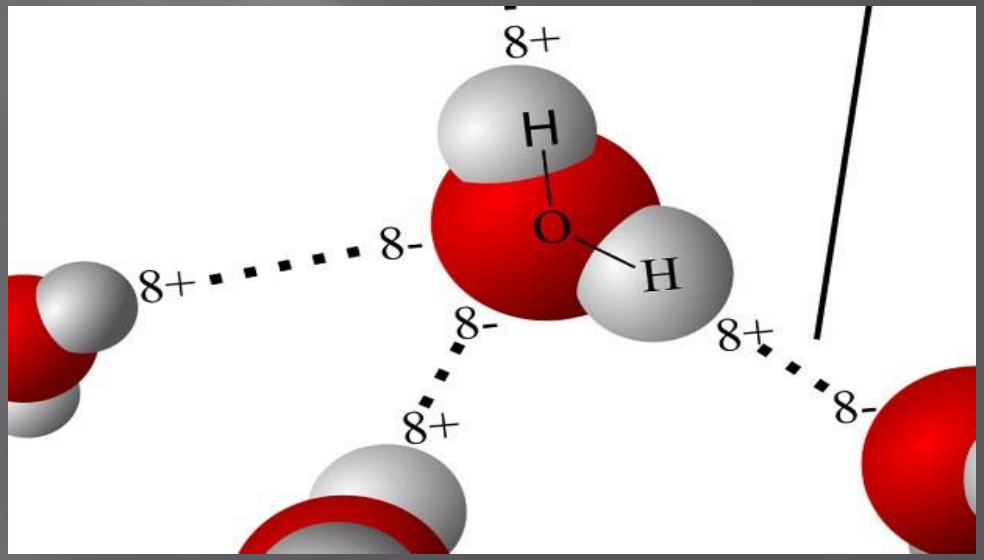
- Bonds form between water molecules as a result of their polarity. Water molecules form hydrogen bonds between the positive pole of one molecule (hydrogen atoms) and the negative pole of another molecule (oxygen atom).





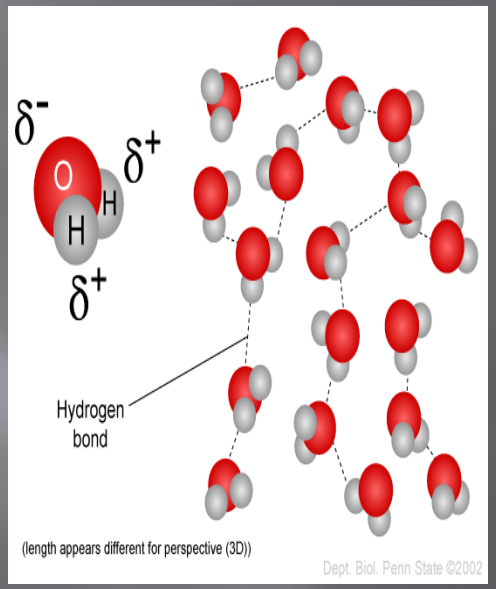
- Polarity
  - Molecules that have an unequal distribution of charges are called polar molecules
  - Polarity is the property of having two opposite poles
- Hydrogen Bond
  - A hydrogen bond is a weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom

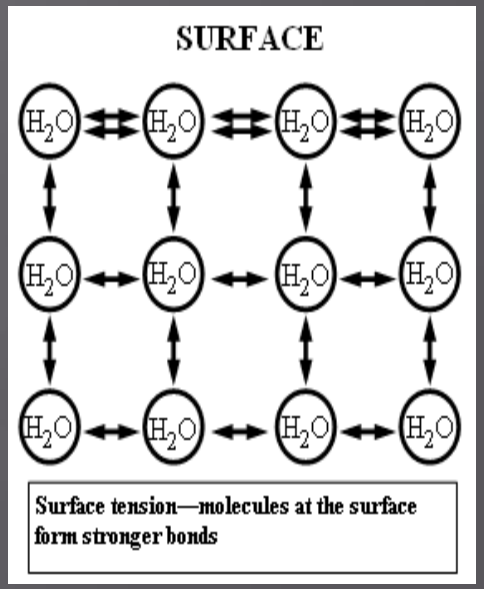




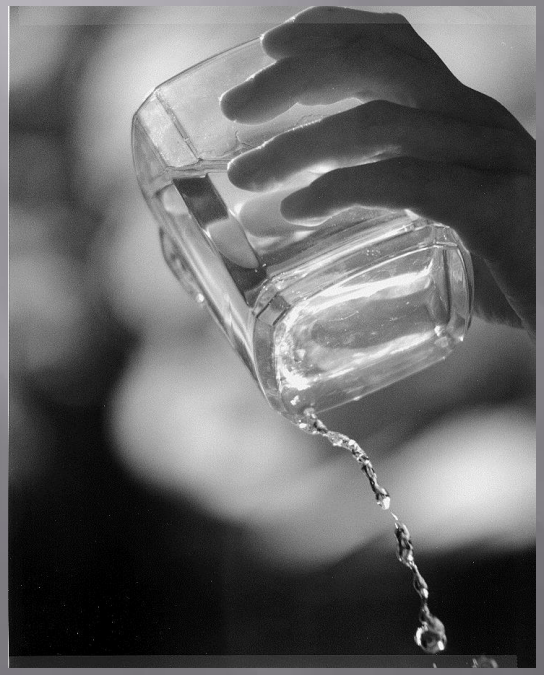
Properties of Water

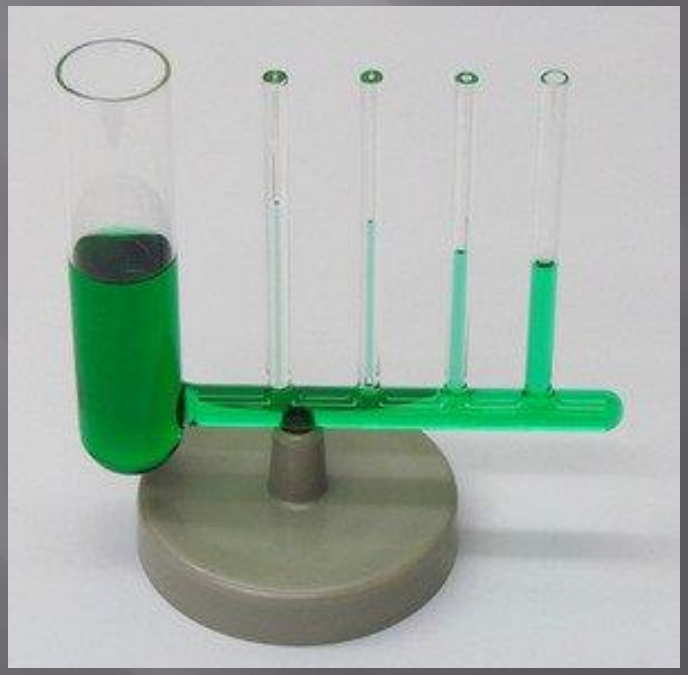
- Cohesion
  - The attraction of water molecules to one another
- Surface Tension
  - The enhanced attraction of water molecules to one another at the surface





- Adhesion
  - The attraction of water molecules to a solid like glass or a cell wall.
- Capillary Action
  - Water moving up a tube or stem





- High Heat Capacity
  - It requires a lot of energy to change water's temperature. It "resists" temperature change.
    - Regulates the earth's temperature
    - Regulates the body's temperature
- High Heat of Vaporization
  - It requires a lot of energy to move water from the liquid phase to the gas phase
    - Again, this helps to regulate temperature
    - For example, sweating helps to cool the body

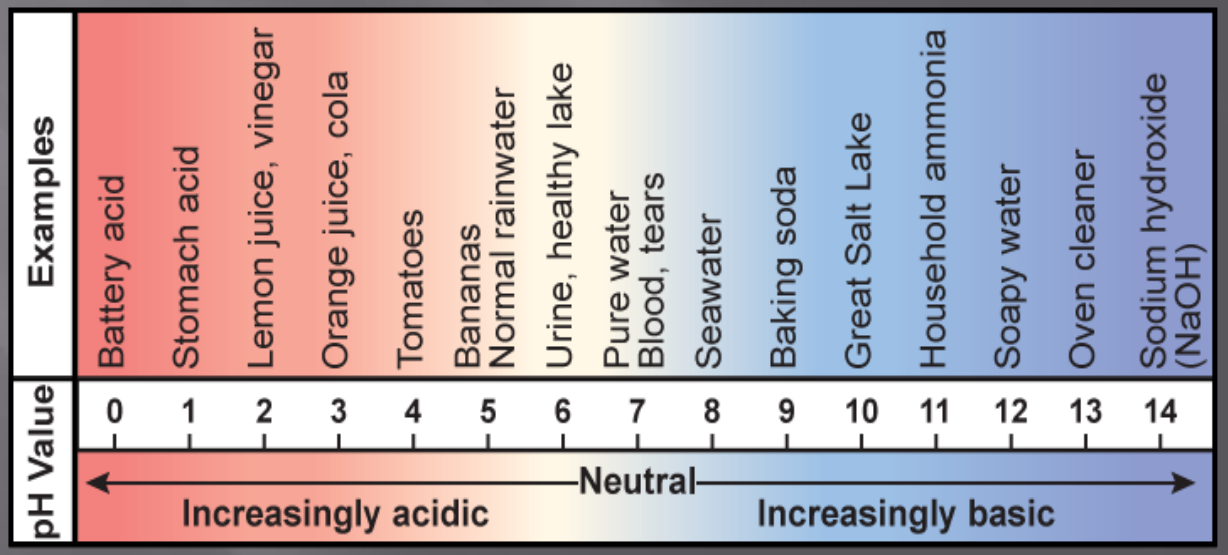
Water Expands When It Freezes!

- Solid water is less dense than liquid water
- This is why ice floats!

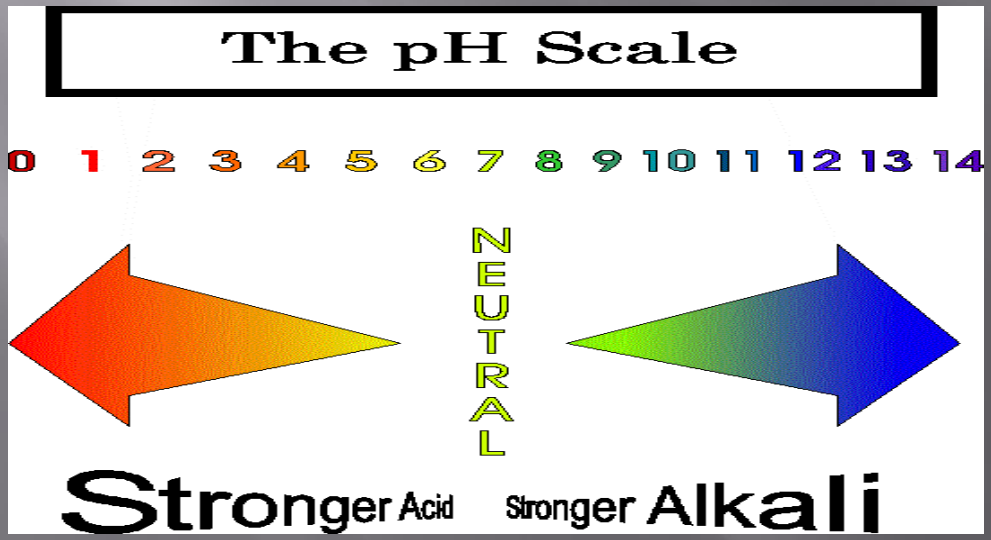
- Water is the "Universal Solvent!"
  - Because of its small size and polarity it is capable of dissolving many substances
- Solutions
  - Solvent + solute = solution
  - In a solution the solute is dissolved in—and evenly distributed throughout—the solvent.

Acids & Bases

- An acid is a substance that gives away H+ ions in a solution
- A base is a substance that gives away OH- ions in a solution
- The acidity of a solution can be measured on a pH scale



- The pH scale measures the concentration of H+ in a solution
- Acidic solutions have a pH less than 7
- Basic solutions have a pH greater than 7
- A pH of 7 is neutral



pH Value	Examples
0	Battery acid
1	Stomach acid
2	Lemon juice, vinegar
3	Orange juice, cola
4	Tomatoes
5	Bananas Normal rainwater
6	Urine, healthy lake
7	Pure water Blood, tears
8	Seawater
9	Baking soda
10	Great Salt Lake
11	Household ammonia
12	Soapy water
13	Oven cleaner
14	Sodium hydroxide (NaOH)

Increasingly acidic — Neutral — Increasingly basic

- Buffers
  - Substances that can react with acids or bases to resist changes in pH
  - Our bodies contain buffers that help maintain our pH within an acceptable range
    - For example, the carbonic-acid-bicarbonate helps to maintain our blood pH at 7.4
    - If our blood pH rises above 7.8 or below 6.8 we could die!