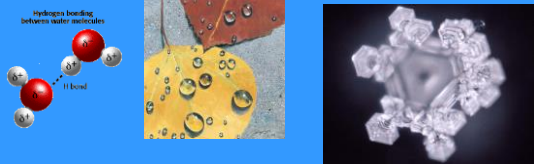




1.1 Structure of Water and Hydrogen Bonding



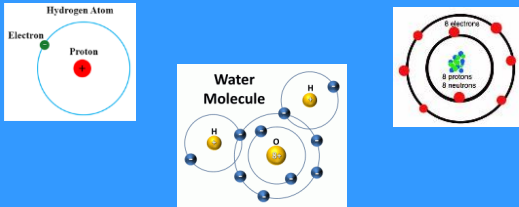
ENDURING UNDERSTANDING

SYI-1 Living systems are organized in a hierarchy of structural levels that interact.

atom
molecule
macromolecule
organelle
cell
tissue
organ
system
organism
population
community
ecosystem
biosphere

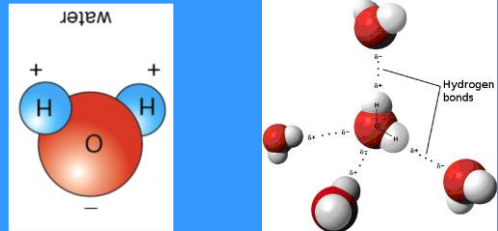
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- The subcomponents of biological molecules and their sequence determine the properties of that molecule.



SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Living systems depend on properties of water that result from its polarity and hydrogen bonding.

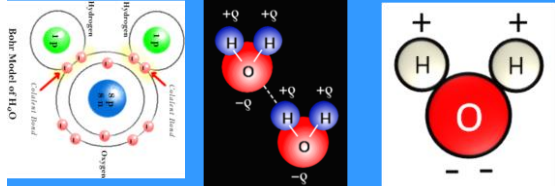


SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Polarity
 - Oxygen more electronegative than hydrogen
 - Electrons spend more time closer to Oxygen
 - Uneven charge on molecule makes it polar.
 - Polarity creates hydrogen bonds
 - H-bonds are responsible for emergent properties of water

Electronegativity of Some Elements

H	Li	Be	B	C	N	O	F	Cl	Br	I	S	Se	Te	Pb	Bi	Po
2.1	1.0	1.5	2.0	2.5	3.0	3.5	4.0	3.0	2.8	2.5	2.5	2.4	2.1	2.0	2.0	2.0



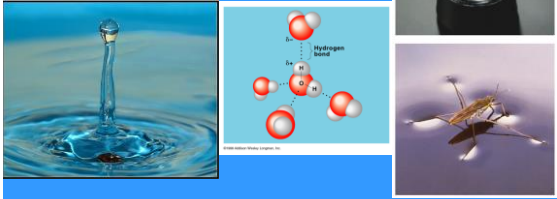
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- The hydrogen bonds between water molecules result in cohesion, adhesion, and surface tension.



SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Cohesion
 - Hydrogen bonds hold water molecules together
 - Creates Surface tension
 - Measurement of the difficulty to break or stretch the surface of a liquid
 - Must break the H-bonds to break the tension



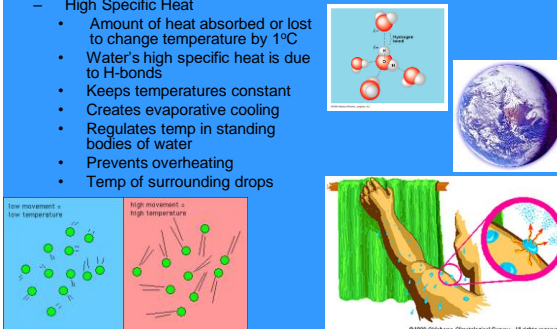
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Adhesion
 - H-bonds hold water molecules to another substance
 - Adhesion to solid surfaces creates capillarity
 - Capillarity allows water to move against gravity
 - Plants can grow tall



SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- High Specific Heat
 - Amount of heat absorbed or lost to change temperature by 1°C
 - Water's high specific heat is due to H-bonds
 - Keeps temperatures constant
 - Creates evaporative cooling
 - Regulates temp in standing bodies of water
 - Prevents overheating
 - Temp of surrounding drops



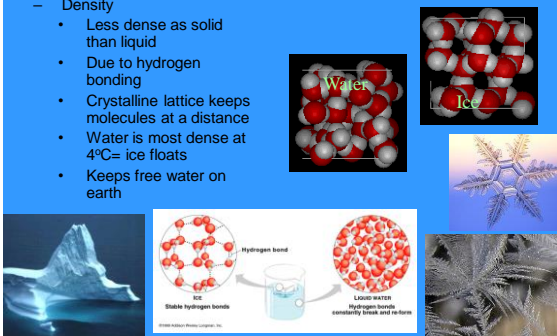
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Heat of Fusion
 - Quantity of heat required to convert unit mass of a liquid into a solid
 - Temp of surrounding rises



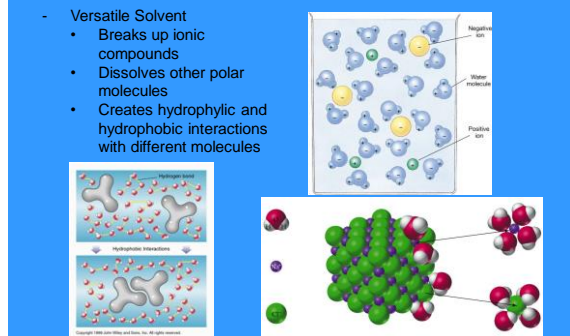
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

- Density
 - Less dense as solid than liquid
 - Due to hydrogen bonding
 - Crystalline lattice keeps molecules at a distance
 - Water is most dense at 4°C= ice floats
 - Keeps free water on earth



SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

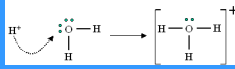
- Versatile Solvent
 - Breaks up ionic compounds
 - Dissolves other polar molecules
 - Creates hydrophilic and hydrophobic interactions with different molecules



SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

– Acid/Base & pH

- Water dissociates into a hydrogen ion (hydronium ion) and a hydroxide ion



- Acids release H^+ ions
- Bases release OH^- ions

• pH Scale

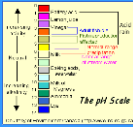
- "power/percent of hydrogen"
- measures H^+ concentration
- Each step is a 10x increase

• Buffers

- Substances that accepts or donates H^+ ions
- Minimize change in pH

• Acid Rain

- Causes deforestation by changing soil pH
- Destroys life in water



Acid rain damage. From: *Chemical Principles*, Tenth Edition, C. Corwin, The Environmental Picture Library