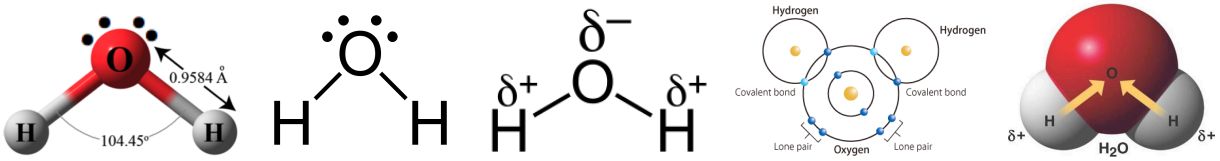
Unit 1: Lesson 1: BIO.A.2.1.1
Slide Outline
Unique Properties of Water--Fun Facts!!

→ **Life on Earth could not exist without water.**
→ Water expands by 9% when it freezes
→ **The average human body is up to 65% water.**
→ Each day, we also lose a little more than a cup of water (237 ml) when we exhale it.
→ **Hot water can freeze faster than cold water under some conditions (commonly known as the Mpemba effect).**
→ It is one of the most important, stable, and abundant molecules found in living things.
→ **There is about the same amount of water on Earth now as there was millions of years ago**
→ Drinking too much water can be fatal (known as water intoxication).
.→ Water memory is the purported ability of water to retain a memory of substances previously dissolved in it even after an arbitrary number of serial dilutions. ... Water memory defies conventional scientific understanding of physical chemistry knowledge and is not accepted by the scientific community.

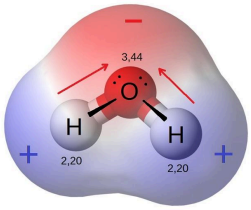
The Structure of Water -- H_2O

Water molecules consist of **2 hydrogen atoms** and **1 oxygen atom**, held together by ***covalent bonds.*** It is written as→ H_2O

Remember a covalent bond occurs when atoms share electrons

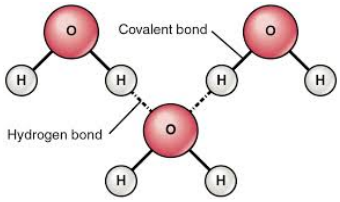


Water is a polar molecule



Polar Molecule - Is a molecule that has one side that is positively charged and one side that is negatively charged. A water molecule, because of its shape, is a ***polar molecule***.

Water has a variety of unique properties because of attractions between polar molecules



The slightly negative regions of one molecule are attracted to the slightly positive regions of nearby molecules, forming a ***hydrogen bond***.

-Each water molecule can form ***hydrogen bonds*** with up to **four** neighbors.

-Remember each water molecule is made of **two** ***covalent bonds***

Water is the (nearly) Universal Solvent

Solubility- the ability of a substance, the ***solve***, to dissolve another substance, the ***solvent.***

.-Water can dissolve many different ***polar*** and ionic substances. This is important because many molecules in cells are ***polar.***

→ ***Polar molecules*** may be described as ***hydrophilic*** or "water-loving"

However nonpolar substances do not dissolve easily in water

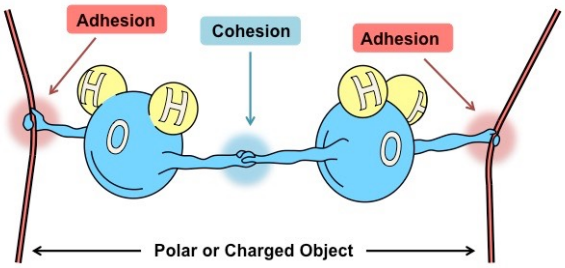
Lipids- include fats and oils and are nonpolar.

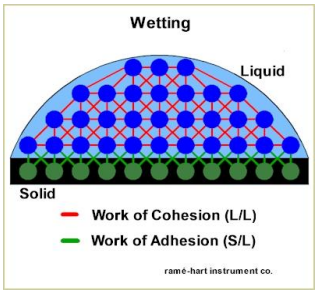
→ Nonpolar molecules may be described as ***hydrophobic*** or "water-fearing"

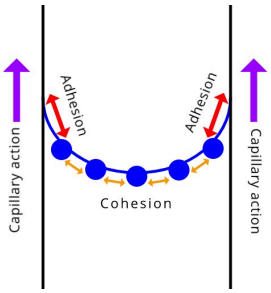
Cohesion and Adhesion

Cohesion: Water is attracted to water.
Adhesion: Water is attracted to other substances.

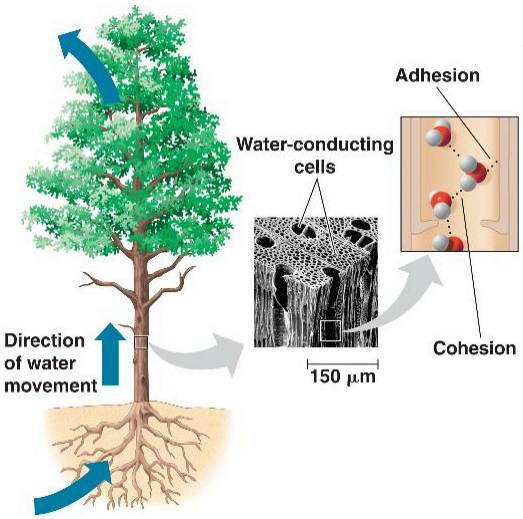
Adhesion and ***cohesion*** are water properties that affect every water molecule on Earth and also the interaction of water molecules with other substances







Because of ***adhesion*** and ***cohesion,*** a concave **Meniscus**, occurs when the molecules of the liquid are attracted to those of the container. This occurs with **water** and a glass tube. (shown above).

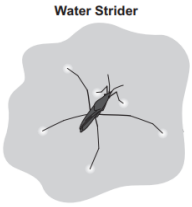


Capillary action, or capillarity- is the ability of a liquid to flow against gravity in a narrow space, such as a thin tubes.

Cavitation- When an air bubble forms and blocks the transport of water, by breaking cohesion, adhesion, and capillary action, in trees and plants

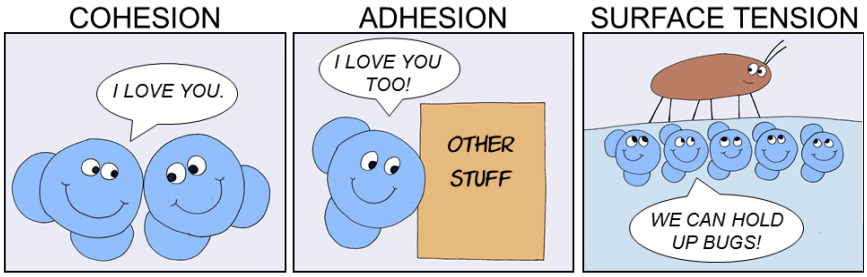
Transpiration- Plants ability to move water from there roots to the tops of their shoots, defying gravity
Plants use ***capillary action*** to conduct water though interconnected tube-like cells. When water on an upper leaf evaporates, the water just below it is pulled up to take its place. All the water molecules, down to the roots, are pulled along too.--This movement of water is caused by ***cohesion*** between water molecules and the ***adhesion*** of water to the cell walls

Surface Tension



Is the measure of the force necessary to stretch or break the surface of a liquid, it is related to ***cohesion***.

---Because of ***hydrogen bonding***, water has a greater ***surface tension*** than most other liquids.
---Some organisms can stand, walk or run on water without breaking the surface as the water strider.



Specific Heat

The amount of heat energy that must be absorbed or lost, for a gram of a substance to change its temperature by 1°C.

- Water has one of the highest ***specific heat*** capacity of any substance.

Because water absorbs and releases heat slowly, it creates a more moderate environment for organisms.

It also makes it easier for an organism to control its body temperature.

- *Cold-blooded* animals can absorb enough heat during the day to last them through the night.
- *Warm-blooded* animals can more easily maintain a constant internal temperature

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Heat of Vaporization & Heat of Fusion

Heat of Vaporization- The amount of heat needed for water to evaporate or when water changes from a liquid to a vapor

Heat of Fusion- The amount of heat needed for water to freeze or when liquid water freezes to ice

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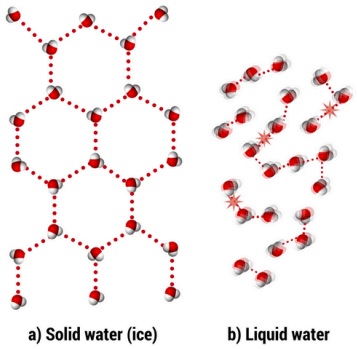
Water Density



Water has a greater ***density*** as a liquid than as a solid.

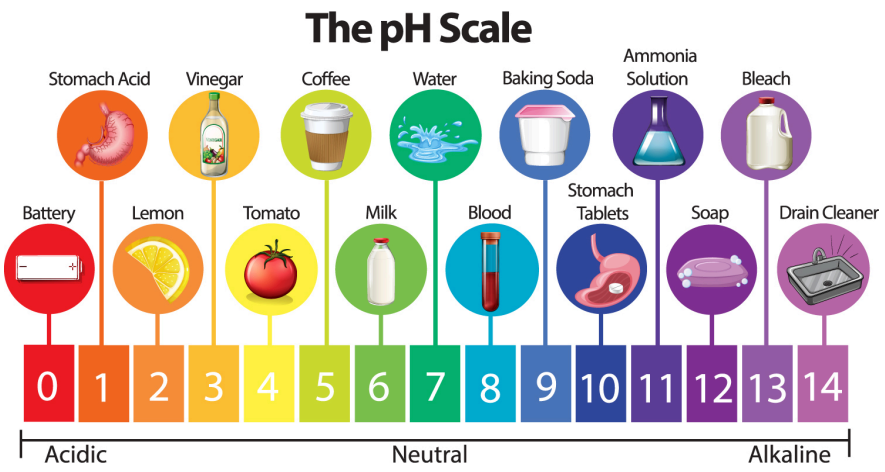
When liquid water reaches its ***freezing point***, the water molecules arrange themselves into an orderly structure, leaving more space between them.

Because ice is less dense than liquid water, it floats on the surface of ponds and other bodies of water. This acts as an insulating barrier for the water below it, allowing bodies of water to not freeze completely and for aquatic organisms to survive cold winters.

Neutral pH- water has a pH of around 7

pH Scale- measures the acidity of substances (0-14)

-This is important because most biological functions take place in a neutral pH


The pH Scale
Stomach Acid
Vinegar
Coffee
Water
Baking Soda
Ammonia Solution
Bleach
Battery
Lemon
Tomato
Milk
Blood
Stomach Tablets
Soap
Drain Cleaner
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Acidic
Neutral
Alkaline