What do you know about H_2O?

Why water is so cool?

- 1. It is delicious and refreshing!!!!
- 2. It’s polarity gives it amazing powers.
- 3. Cohesion/Adhesion/Surface Tension
- 4. Perfect for temperature moderation
- 5. Amazing solvent
- 6. Multiple states like: ice, liquid and gas

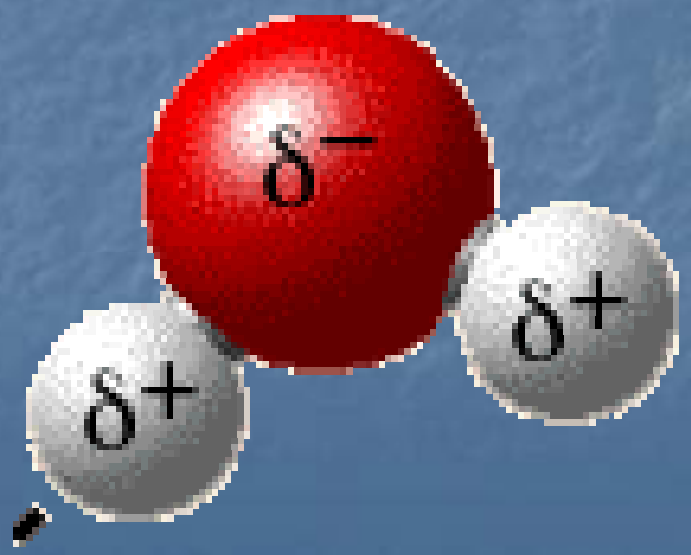
Water: a Polar Molecule

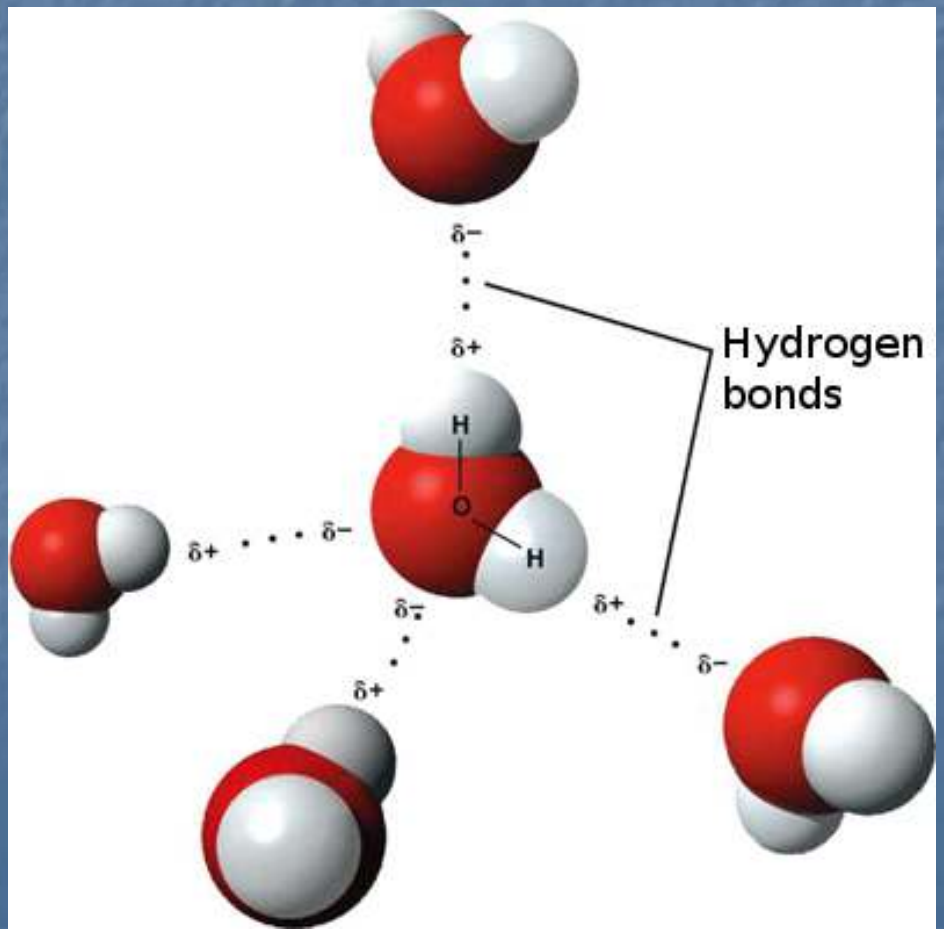
The most important property of the water molecule is that it is slightly charged on each end.

It's Polar!

The polarity of water molecules results in hydrogen bonding

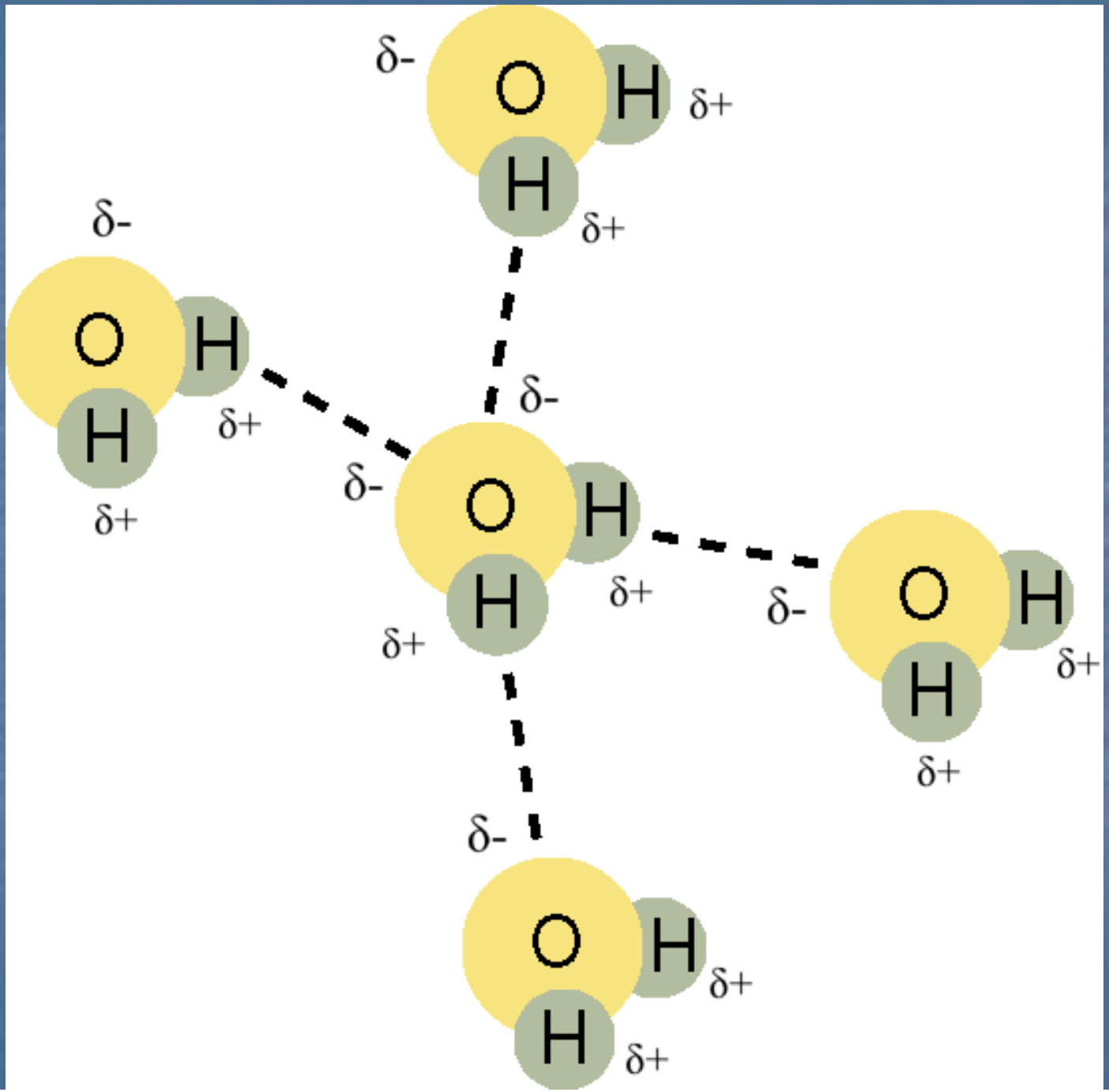
- Remember me?





Why is polarity important with water?

Because, the important properties of water are based on polarity!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Four major properties of water make Earth a great place for life

- Cohesion and adhesion
- Moderation of temperature
- Insulation of bodies of water by ice
- Solvent properties

Lab and Demo time

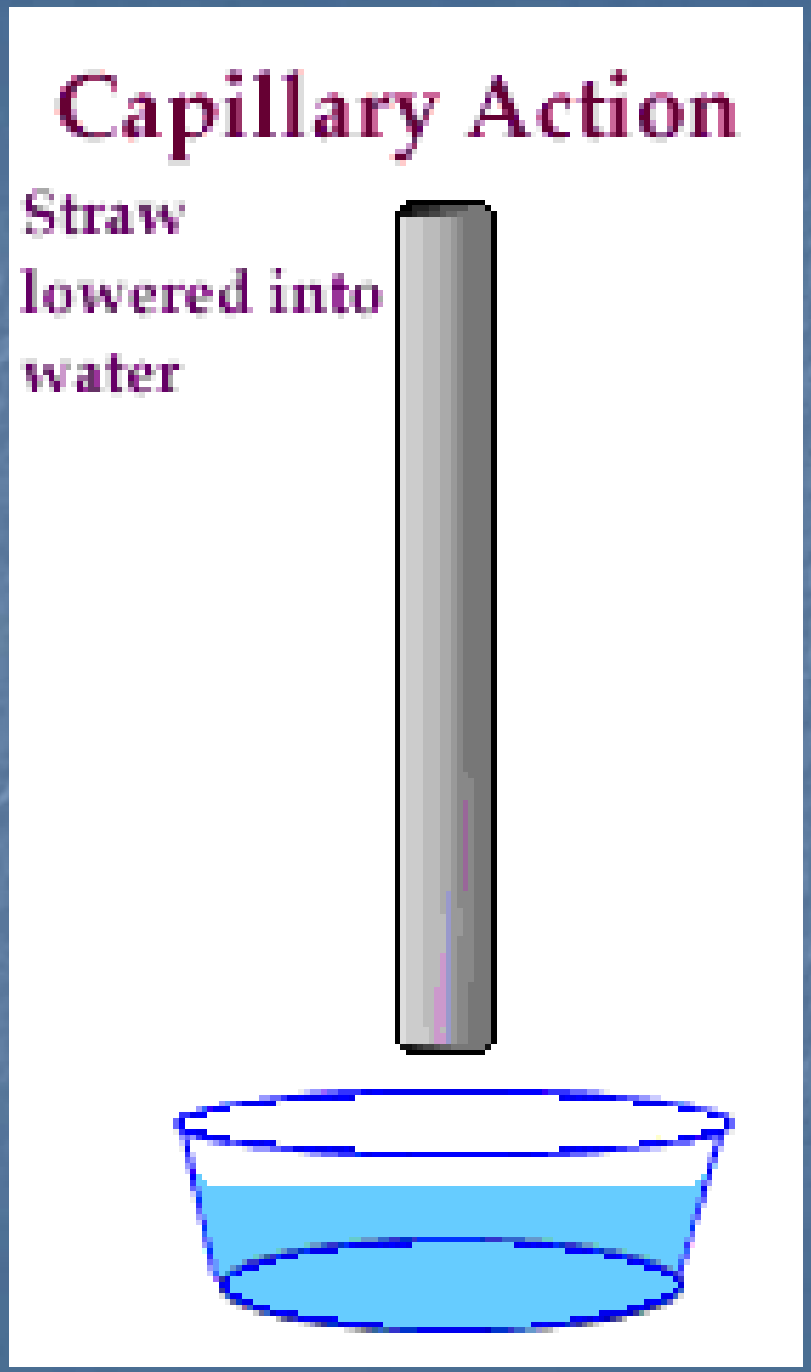
<u>Cohesion</u> – water molecules are attracted to each other due to hydrogen bonding

- Adhesion – water molecules are attracted to other surfaces and substances
- Why?

How else could these two properties be useful for living things?

- Surface Tension

- Capillary Action



- Impact on Life???

2. Temperature Moderation

- What does that mean and why is it an important property?

Specific Heat

- Water is able to stabilize temperatures because it has a high specific heat
- Specific Heat: The amount of heat needed for 1 g of that substance to change in temperature by 1 degree Celsius.
- Water is resistant to heat change!
- Why is it so stubborn?

Table 6.1 Specific Heats for Various Common Substances, in Terms of How Many Calories of Heat are Required to Heat up 1 Gram by 1°C

Substance	Specific Heat (cal/g/°C)
Alcohol	0.58
Aluminum	0.21
Copper	0.09
Gold	0.03
Leather	0.36
Marble	0.21
Salt	0.21
Sugar	0.27
Synthetic rubber	0.45
Water	**1.00**
Wood	0.42

Specific Heat = Life???

Heat of Vaporization

- Molecules stay close together because of attractions but when heated (more energy) they move faster and can overcome these attractions (evaporation)
- Heat of vaporization: amount of heat needed for 1 g of substance to change from liquid to gas

Evaporative Cooling

- How is water affected by the H of V?
- How does this do anything for life?

- As liquids evaporate, remaining surface liquid is cooler

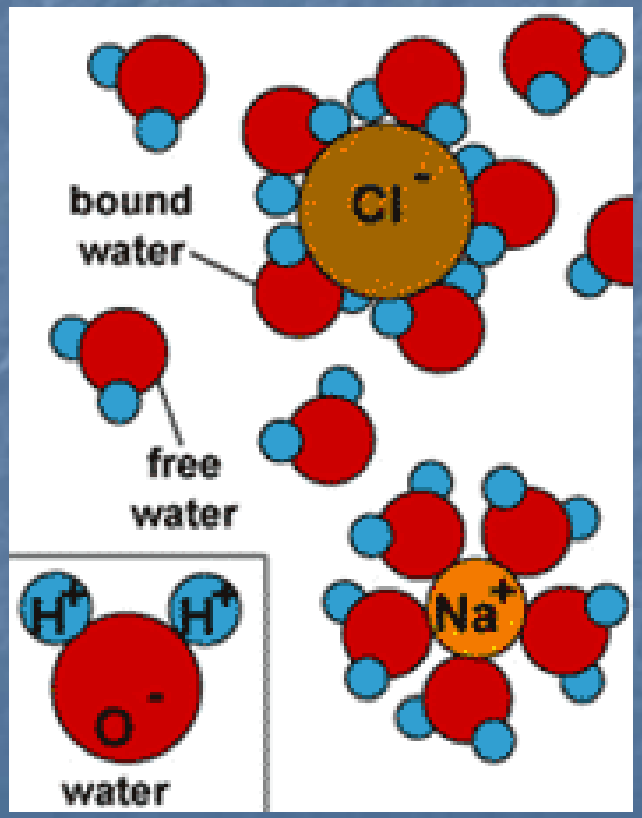
3. Water is an insulator of bodies of water

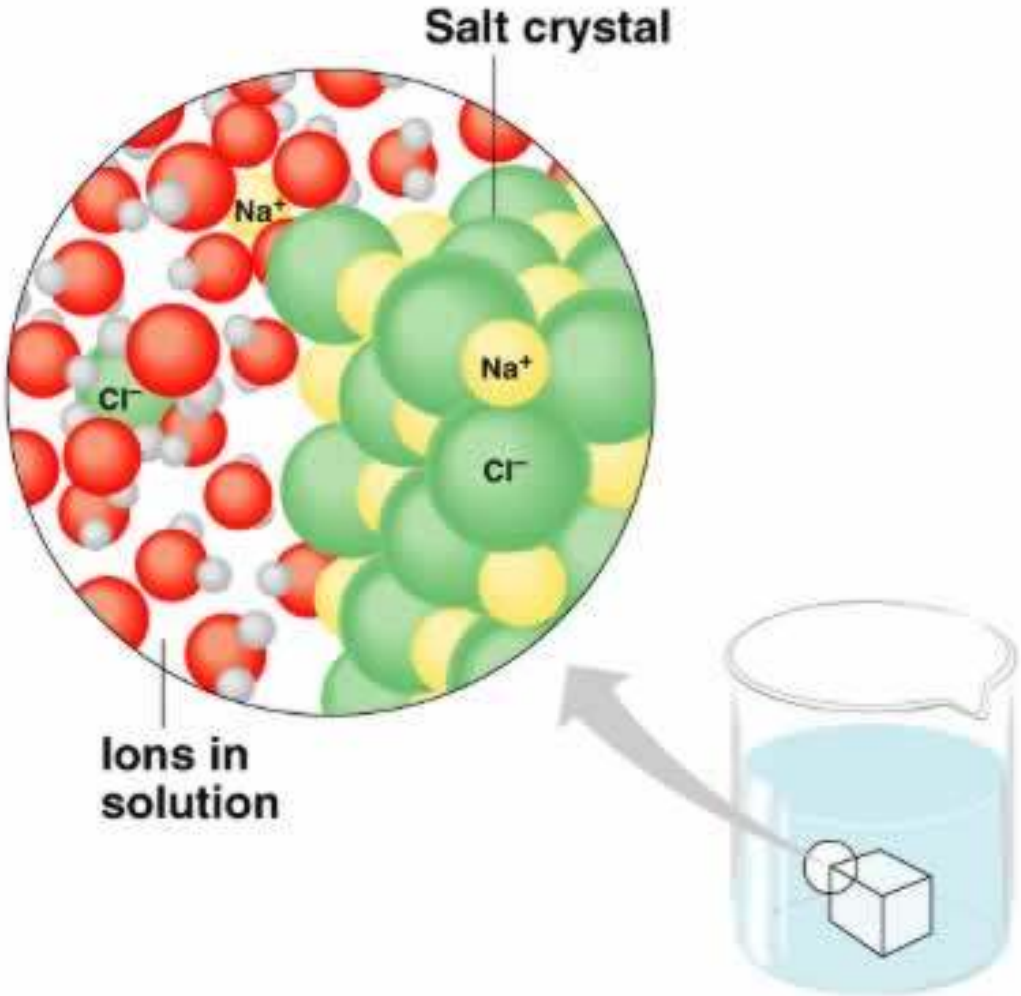
- Water is less dense when frozen, so it floats
- How come water is able to do this?
- If this wasn't true what problems would it cause?

4. Water as a solvent

- Water is so amazing that it dissolves all sorts of things
- How is it that water is able to dissolve many things?
- Why is this important?

NaCl as an example





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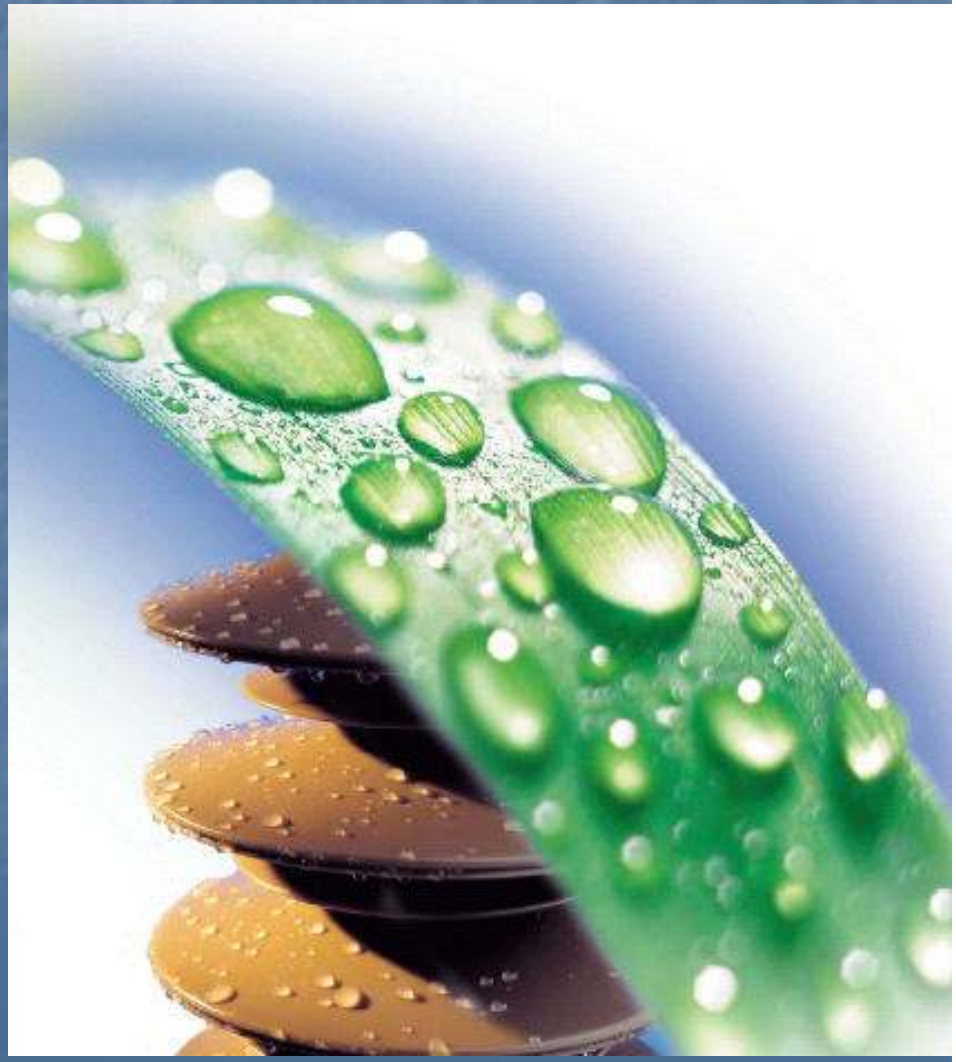
Some Vocab

- Solution : complete mixture of multiple substances; uniformly spread throughout-Homogeneous
- Solvent – substance that does the dissolving
- Solute – what is to be dissolved

Ex: Sugar and water

- Hydrophillic is usually a polar or ionic substance

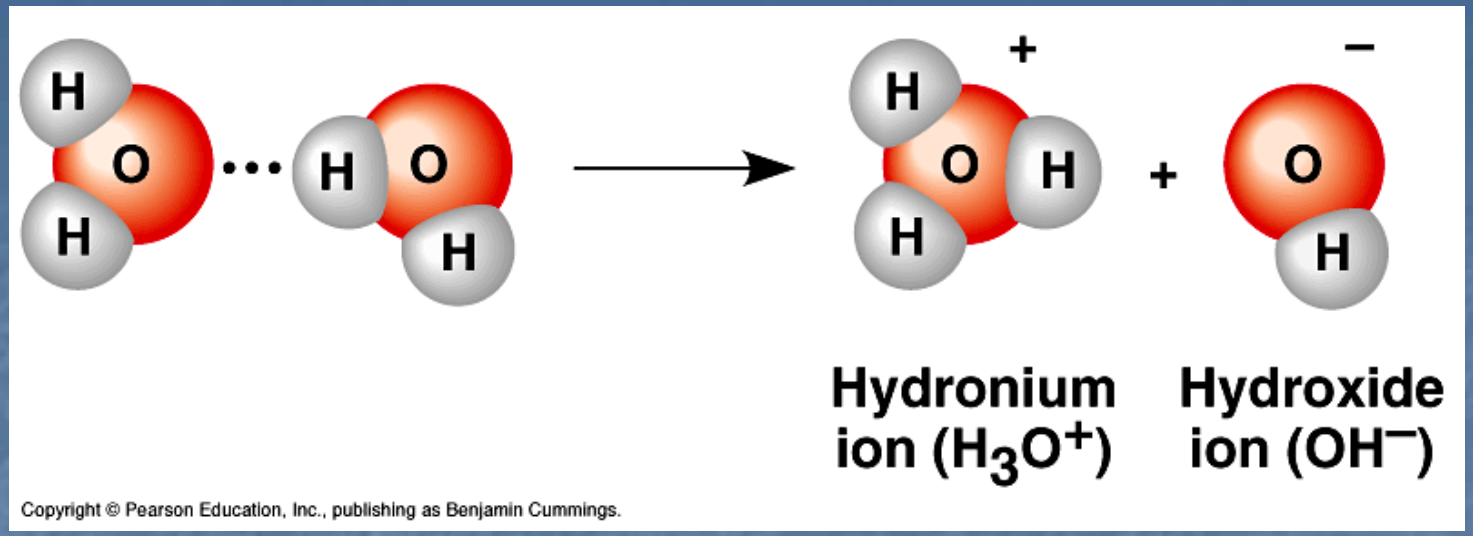
- Hydrophobic is usually a non polar substance



Concept 3.3: Dissociation of water molecules leads to acidic and basic conditions that affect living organisms

What ???????

- Dissociation of what?
- A hydrogen atom can shift from one molecule to another. As a result it leaves an electron behind.



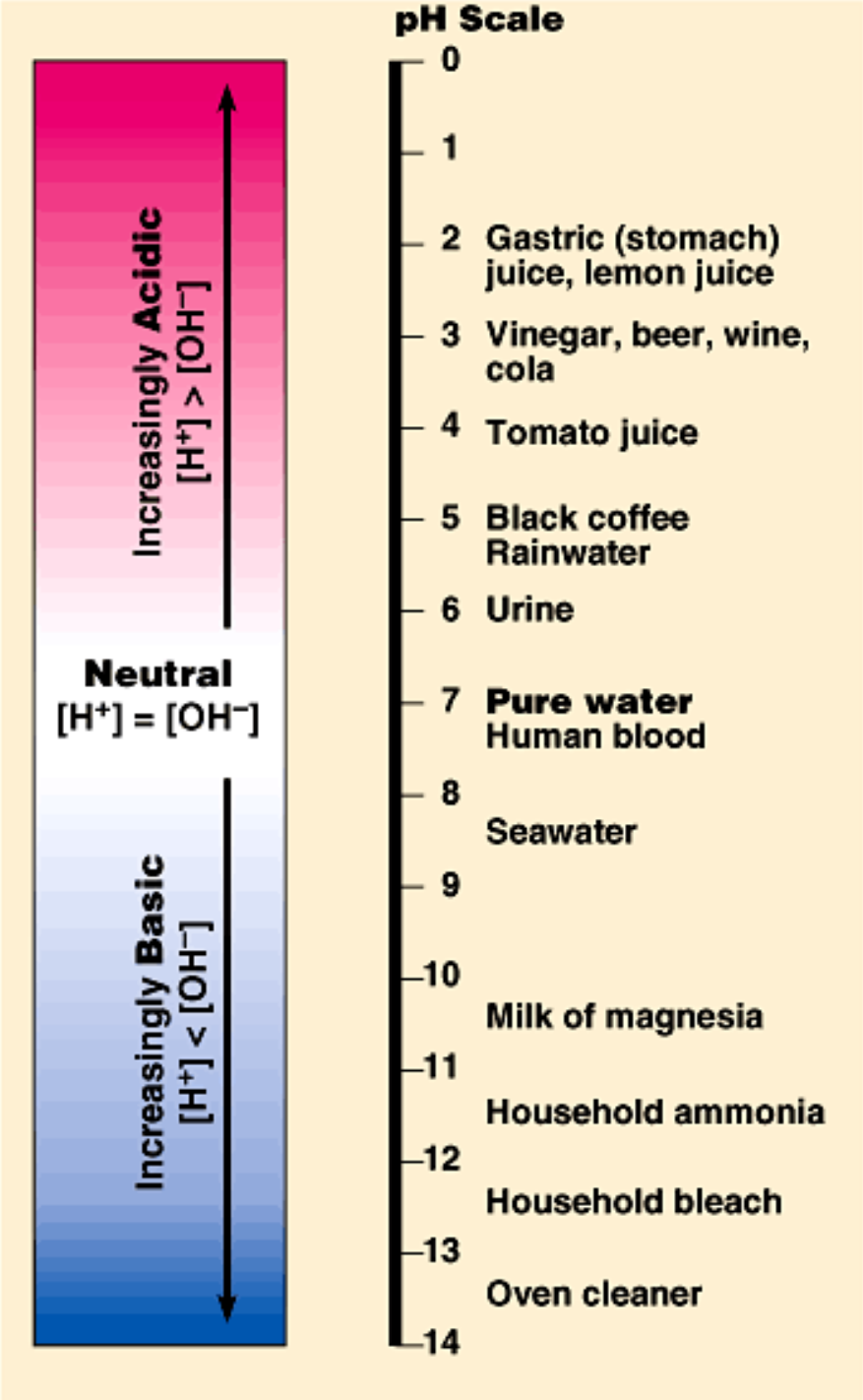
- So what actually transfers is a hydrogen ion (one proton)
- Overall result of this reversible reaction is to create a Hydrogen ion (H^+) and a hydroxide ion (OH^-)
- Very Reactive

Acids and Bases

- Acids release H^+ into the solution
- A base reduces the amount of H^+ found in the solution by binding it up

HCl Hydrochloric acid	$HC_2H_3O_2$ Acetic acid
H_2SO_4 Sulfuric acid	$H_3C_6H_5O_7$ Citric acid
HNO_3 Nitric acid	H_3PO_4 Phosphoric acid
H_2CO_3 Carbonic acid	$H_2C_2O_4$ Oxalic acid

The more H^+ present, the lower the pH #



The more OH^- present the higher the pH #

$$pH = -\log_{10}[H^+]$$

Table 1. Correlation of pH values and Hydronium ion concentrations

pH	Hydronium ion concentration (moles/L)	
1	.1	(1×10^{-1})
2	.01	(1×10^{-2})
3	.001	(1×10^{-3})
4	.0001	(1×10^{-4})
5	.00001	(1×10^{-5})
6	.000001	(1×10^{-6})
7	.0000001	(1×10^{-7})
8	.00000001	(1×10^{-8})
9	.000000001	(1×10^{-9})
10	.0000000001	(1×10^{-10})
11	.00000000001	(1×10^{-11})
12	.000000000001	(1×10^{-12})
13	.0000000000001	(1×10^{-13})
14	.00000000000001	(1×10^{-14})

Buffers

- Living things need to maintain a pH close to neutral (about 7) in living systems
- Why?
- Chemical reactions are sensitive to pH. If the pH changes, the reaction won't happen.
- ☹

Buffers

- How can a buffer help this?
- Buffers are balanced solutions that minimize change between H^+ and OH^-
  - Bicarbonate and Carbonic Acid
  - H_2CO_3 «=» HCO_3^- + H^+