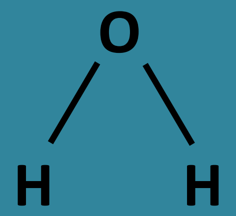

Water

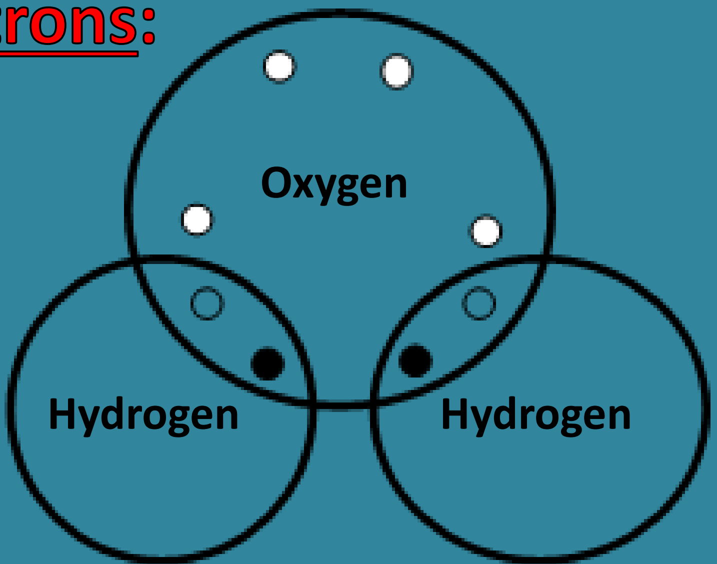
Ways to Symbolize Water

- By <u>content</u>: H_2O means two hydrogen's and one oxygen.
- By <u>content and arrangement</u>: Count the symbols for content, and note the bars that indicated an interaction between the hydrogen and oxygen, but not between the two hydrogen's.



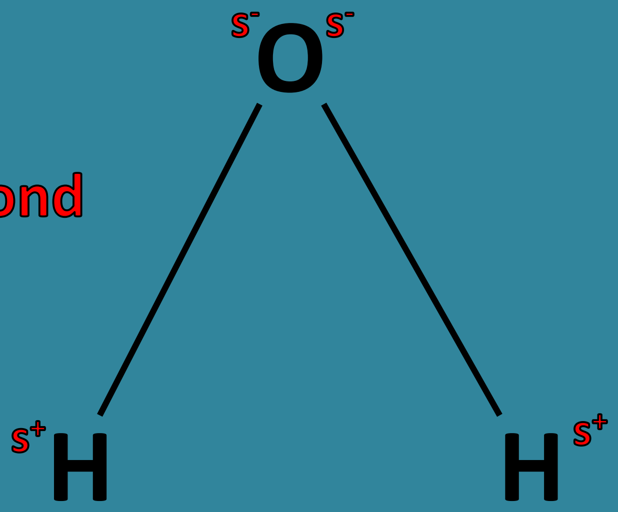
- By the <u>interactions of valence electrons</u>:

  Where the circles intersect there is a sharing of one electron of the oxygen (○) with the hydrogen (H), and one electron of another hydrogen (●) with the same oxygen.



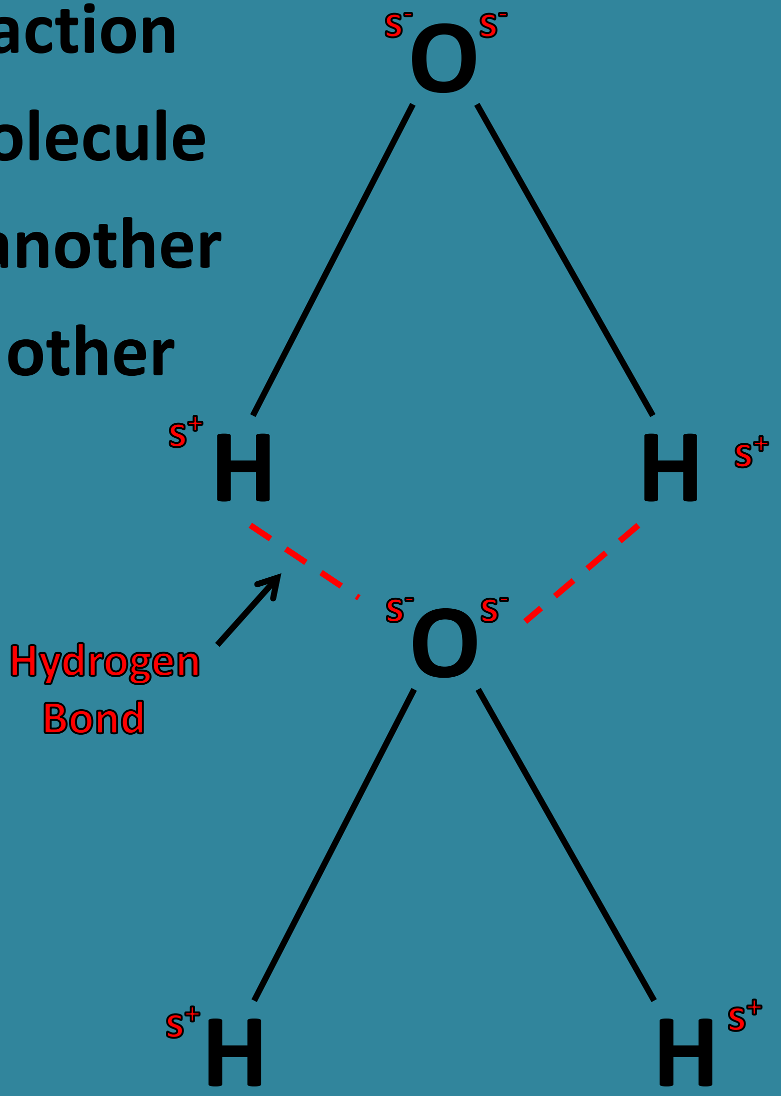
- **By unequal sharing of the electrons between oxygen and hydrogen. The oxygen atom exerts a little stronger pull on the shared electrons than the hydrogen. Since those electrons spend a little more time orbiting the oxygen than they do orbiting the hydrogen, this gives the oxygen atom a slightly negative charge and the hydrogen atoms a slightly positive charge. (Note: s = slightly)**

Polarized Covalent Bond



Exercise 1: Properties of Water (page 91)

- **Hydrogen Bonds**: A slight attraction between the oxygen of one molecule of water to the hydrogen's of another molecule of water. Unlike the other bonds, this is an attraction between two separate molecules (not between atoms within a molecule). This makes water cohesive.



Answer questions 1-4, page 91.

- **Water Adhesion:** The attraction of water to any polarized surface. Either the hydrogen ends or oxygen ends will form hydrogen bonds with that surface. (Answer questions 1-5, page 92).

- **Capillarity:** Because of both the cohesive quality of water and its adhesion to other surfaces, it can crawl up a tube. (Answer questions 1-4, page 92)

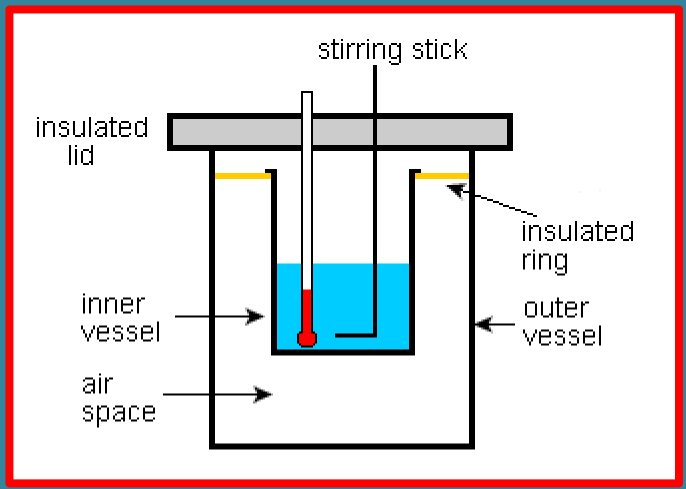
- **Heating Properties of Water:** Water is amazing in maintaining its temperature. It both heats up slowly and cools down slowly in comparison to other substances. (Answer question 1-5, pages 93-94.)

- **Evaporation of Water:** For all intents and purposes beaker A is indirectly acting as a calorimeter (a measuring device for calories) for beaker C. The overall objective is to calculate how much heat (in calories/milliliter of water) is removed from your body during the evaporation process.

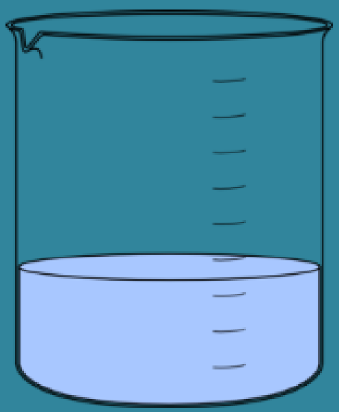
- Evaporation of water is our primary way of getting-rid of our heat; otherwise, if you run out of water in your body, you will die from dehydration, by over-heating,… and this excess heat will scramble your enzymes! (Answer questions 1-6, page 95.)

What is a calorie?

Definition: **the amount of heat energy that is required to raise the temperature of 1 ml of water 1 degree °C.**



Calorimeters



100 ml of Water at 5 °C ⟶ Rises to 60 °C

How many calories of heat did the water absorb?

Exercise 2: "What the heck is pH?" (Page 96)

pH (= Potential Hydrogen ions[H^+'s])

pH Scale

[Zero Potential for H^+'s]

Neutral

(Exponential increase in H^+'s) (Exponential decrease in H^+'s)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Acids (more H^+'s) Bases (more ^-OH's)

Answer questions 1-8, page 97, and 1-3, page 98.

Acids, Bases, Buffers

1. **Acids**: release hydrogen ions (H^+'s) in water.

Ex. HCl + Water —Completely Ionizes→ H^+ + Cl^-

(Hydrochloric Acid)

2. **Bases**: release hydroxyl ions (^-OH's) in water.

Ex. NaOH + Water —Completely Ionizes→ ^-OH + Na^+

(Sodium Hydroxide)

3. **Buffers**: weak acids or weak bases, maintains a stable pH

Ex. H_2CO_3 + H_2O —Incompletely Ionizes→ HCO_3^- + H^+

(Carbonic Acid) (Bicarbonate)

HCO_3^- + H^+ —Removes H+'s→ H_2CO_3 + H_2O

(Bicarbonate) (Carbonic Acid)

How Buffers (Carbonic Acid) Works

Sets up an Equilibrium

$$H_2CO_3 + \text{Water} \rightleftharpoons HCO_3^- + H^+$$

(100) (10) (10)

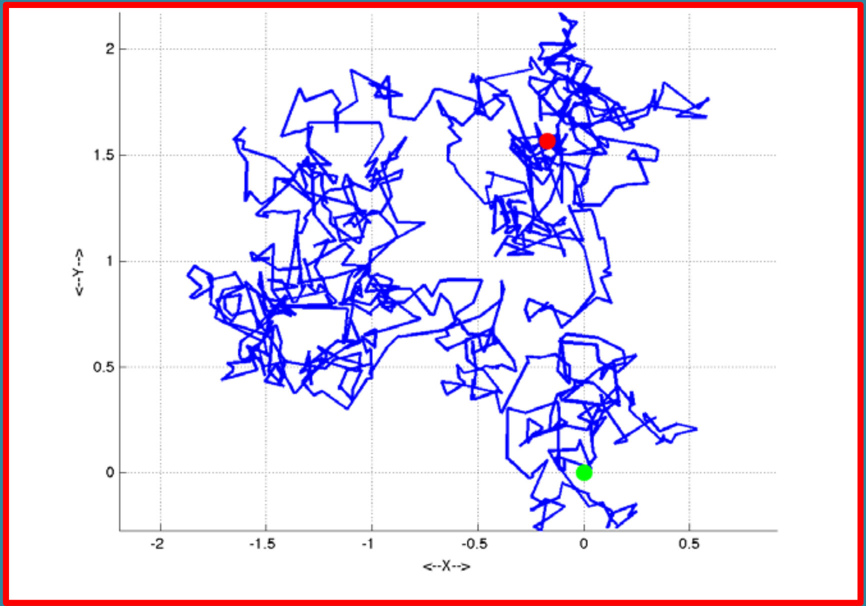
Add an acid (H^+), like lemonade, the H^+'s react with HCO_3^- getting rid of them by forming carbonic acid, and maintaining pH. Bicarbonate is acting as a weak base, and storing the excess H^+'s in the form of carbonic acid.

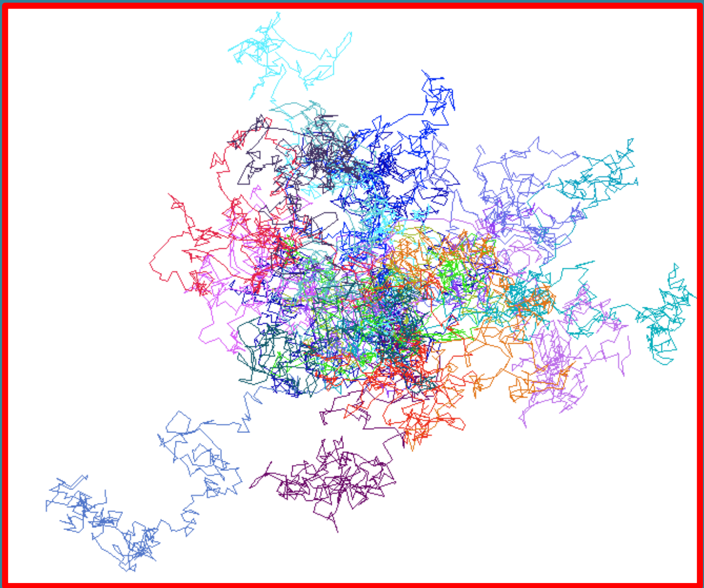
Add a base (^-OH), like many medicines, the ^-OH's react with H^+ to form neutral water ($^+H + {}^-OH \rightarrow H_2O$), and more carbonic acid breaks down into H+'s (acts as a weak acid), also maintaining pH.

(Answer questions 1-3, page 98)

Exercise 3: Molecular Motion (page 99)

- **Seeing Molecular Motion:** Vibratory movement or "Brownian motion."   Random moving of particles suspended in a fluid (a liquid or a gas) resulting from their bombardment by the fast-moving atoms or molecules in the gas or liquid.   (Based on the physical principle that all atoms are moving.) Named for botanist Robert Brown, who was looking through a microscope at pollen grains in water.





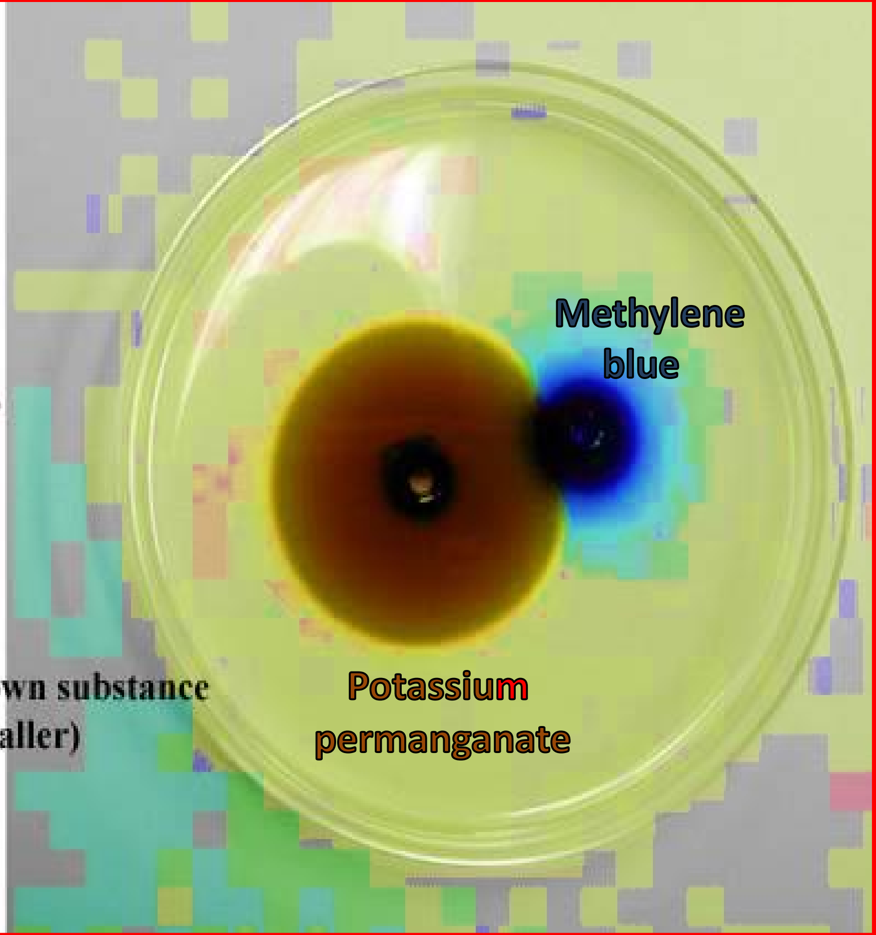
(Answer questions 1-3, page 99).

• Light Molecules vs. Heavy Molecules:

The molecules in the agar plate are moving randomly (a process called Brownian motion)

The particles tend to move from areas of high concentration to areas of lower concentration (a process called simple diffusion)

Because the red-brown substance spreads out faster than the blue substance we know that the red-brown substance has a lower molecular weight (is smaller)

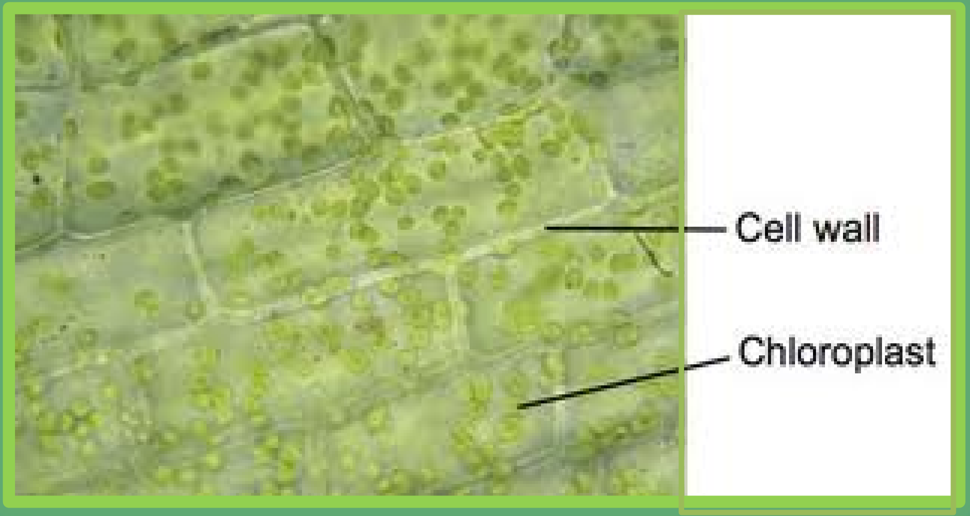


(Answer questions 1-3, page 100).

Exercise 4: Diffusion of Water Into and Out of Cells

Page 101

Osmosis with *Elodea*



***Elodea* in pure (100%) water**

***Note**: Chloroplast are spread out due to swelling of the cell membrane.**

***Elodea* in Salt Water**

***Note**: Chloroplast are bunched due to shrinking of the cell membrane**

Answer questions 1-6, page 102, and 1-2, page 103.

Dying of Thirst in the Middle of Water

- You're in the middle of the ocean, like the crew of the USS Indianapolis, for five days without water. Should you drink the ocean water?

- Ocean water has more solute in it than the solute of your body; meaning ocean water is a (hypotonic or hypertonic) solution? If you drink it, when you are already de-hydrated, what do you think will happen to the water contained in the neurons of your brain? What behavior do you think you will start exhibiting?
- Alert-Alert, "all hands on deck!" Stay tuned-in for a real life story, as told to me by my uncle Sherman Chester Booth, one of only 317 (of the 1,500) survivors on this World War II Battleship.

Biographical Information

Sherman with his
father Clarence

1923-2005

Name: Sherman Chester Booth
State of Birth: OK
Gender: Male
War or Conflict: World War II, 1939-1945
1947-1953 (Korean War)
Status: Veteran
Dates of Service: 1942-1945 (WW II)
1947-1953 (Korean War)
Branch of Service: Navy
Unit of Service: USS Indianapolis
Highest Rank: Seaman First Class
Note: Veteran was aboard the USS Indianapolis when it carried the atomic bomb to Tinian and then was sunk. Booth survived for five days in the water before being rescued. He attributed his survival to the facts that he refused boarding a life raft and, more importantly, was covered -from head to toe- in oil.