

# Chemistry Unit



***Matter***  
***Compounds***  
***Bonding***  
***Water Properties***  
***Acids/Bases***





# *Matter*

## □ So what is matter?

- Composed of tiny particles called atoms
- Makes up everything

## □ ATOMS: are the building blocks of matter

- All atoms have the same kind of particles
  - 3 types

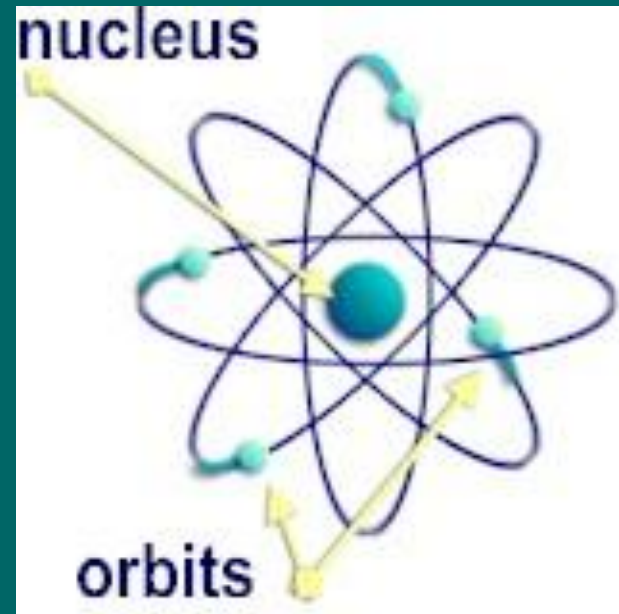


# *3 parts of an Atom*

Name of Particle	Definition	Location	Charge
	+ charged particle	Nucleus	+
	Neutrally charged particle	Nucleus	0
	Negative charged particle	Energy cloud	-

# *Nucleus*

- What is the nucleus?
- The center of an atom
- Made up of protons and neutrons
- Charge is positive

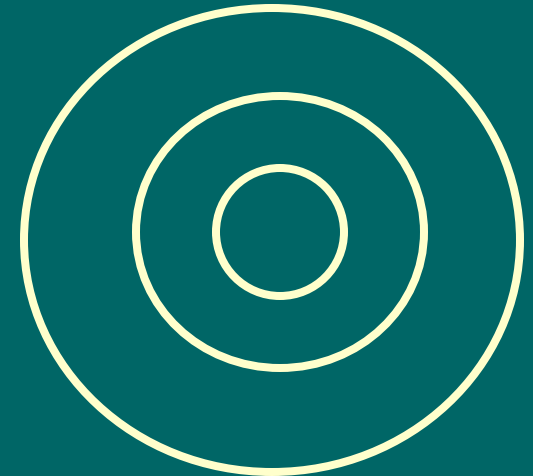


# *Drawing Elements*

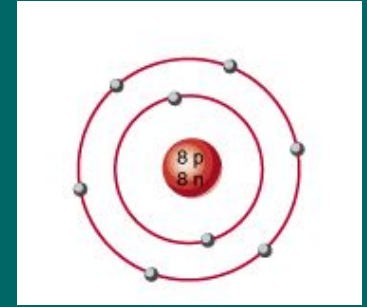
- So how do we draw an atom
- Let's practice but remember

- **Electron Configuration:**

- 2 electrons in the first shell
- 8 electrons in the second shell
- 8 electrons in the third shell



# Atom charge



- e- constantly move around the nucleus in energy levels
- The basic structure based off the attraction between  $p^+$  and  $e^-$
- Atoms typically contain an equal number e-  $p^+$  so the overall charge of an atom is zero

# Elements

## □ What's an element?

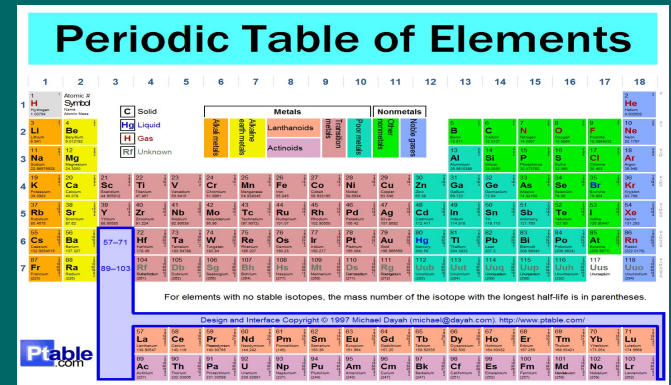
- Pure substance that cannot be broken down into other substances by physical or chemical means

## □ What's it made up of?

- 1 type of atom

## □ How do you write it?

- 1<sup>st</sup> letter = capitalized
- 2<sup>nd</sup> letter = lowercase
- Examples:



A standard periodic table of elements, color-coded by groups. It includes element symbols, atomic numbers, and names. The table is organized into periods (rows) and groups (columns). Key features include the Lanthanoid and Actinoid series, and a legend for element states (Solid, Liquid, Gas, Unknown) and categories (Metals, Nonmetals, etc.).

Periodic Table of Elements

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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# Periodic table

## □ Organized

- **Groups**

- Vertical columns

- **Periods**

- Horizontal rows

- All categorized due to similar properties

**Periodic Table of Elements**

Legend: [C] Solid, [Hg] Liquid, [H] Gas, [Rf] Unknown

Metals: [Al], [Ga], [In], [Tl], [Pb], [Bi], [Po], [At], [Rn], [Fr], [Ra], [Ac], [Th], [Pa], [U], [Np], [Pu], [Am], [Cm], [Bk], [Cf], [Es], [Fm], [Md], [No], [Lr]

Nonmetals: [C], [N], [O], [F], [Ne], [Si], [P], [S], [Cl], [Ar], [Br], [Kr], [Xe], [Rn]

Actinoids: [La], [Ce], [Pr], [Nd], [Pm], [Sm], [Eu], [Gd], [Tb], [Dy], [Ho], [Er], [Tm], [Yb], [Lu]

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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# Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
1	1 <b>H</b> Hydrogen 1.00794	Atomic # Symbol Name Atomic Mass																2 <b>He</b> Helium 4.002602						
	<div><div><div>C Solid</div><div>Hg Liquid</div><div>H Gas</div><div>Rf Unknown</div></div><div><div>Metals</div><div>Alkali metals</div><div>Alkaline earth metals</div><div>Lanthanoids</div><div>Actinoids</div><div>Transition metals</div><div>Poor metals</div><div>Other nonmetals</div><div>Noble gases</div></div></div>																							
2	3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182																	5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.0067	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984032	10 <b>Ne</b> Neon 20.1797
3	11 <b>Na</b> Sodium 22.98976928	12 <b>Mg</b> Magnesium 24.3050																	13 <b>Al</b> Aluminium 26.9815386	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973762	16 <b>S</b> Sulfur 32.065	17 <b>Cl</b> Chlorine 35.453	18 <b>Ar</b> Argon 39.948
4	19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955912	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938045	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933195	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.64	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798						
5	37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.96	43 <b>Tc</b> Technetium (97.9072)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.293						
6	55 <b>Cs</b> Caesium 132.9054519	56 <b>Ba</b> Barium 137.327	57–71		72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.94788	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.084	79 <b>Au</b> Gold 196.966569	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.3833	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98040	84 <b>Po</b> Polonium (209.9824)	85 <b>At</b> Astatine (209.9871)	86 <b>Rn</b> Radon (222.0176)					
7	87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89–103		104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (266)	107 <b>Bh</b> Bohrium (264)	108 <b>Hs</b> Hassium (277)	109 <b>Mt</b> Meitnerium (268)	110 <b>Ds</b> Darmstadtium (271)	111 <b>Rg</b> Roentgenium (272)	112 <b>Uub</b> Ununbium (285)	113 <b>Uut</b> Ununtrium (284)	114 <b>Uuq</b> Ununquadium (289)	115 <b>Uup</b> Ununpentium (288)	116 <b>Uuh</b> Ununhexium (292)	117 <b>Uus</b> Ununseptium	118 <b>Uuo</b> Ununoctium (294)					

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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<b>57 La</b> Lanthanum 138.90547	<b>58 Ce</b> Cerium 140.116	<b>59 Pr</b> Praseodymium 140.90765	<b>60 Nd</b> Neodymium 144.242	<b>61 Pm</b> Promethium (145)	<b>62 Sm</b> Samarium 150.36	<b>63 Eu</b> Europium 151.964	<b>64 Gd</b> Gadolinium 157.25	<b>65 Tb</b> Terbium 158.92535	<b>66 Dy</b> Dysprosium 162.500	<b>67 Ho</b> Holmium 164.93032	<b>68 Er</b> Erbium 167.259	<b>69 Tm</b> Thulium 168.93421	<b>70 Yb</b> Ytterbium 173.054	<b>71 Lu</b> Lutetium 174.9668
<b>89 Ac</b> Actinium (227)	<b>90 Th</b> Thorium 232.03806	<b>91 Pa</b> Protactinium 231.03588	<b>92 U</b> Uranium 238.02891	<b>93 Np</b> Neptunium (237)	<b>94 Pu</b> Plutonium (244)	<b>95 Am</b> Americium (243)	<b>96 Cm</b> Curium (247)	<b>97 Bk</b> Berkelium (247)	<b>98 Cf</b> Californium (251)	<b>99 Es</b> Einsteinium (252)	<b>100 Fm</b> Fermium (257)	<b>101 Md</b> Mendelevium (258)	<b>102 No</b> Nobelium (259)	<b>103 Lr</b> Lawrencium (262)

# A little extra ☺

Pg 25

- **Atomic Number**: number protons in an atom
- **Atomic Weight** (Mass): = number of protons plus neutrons

<i>Element Name</i>	<i>Symbol</i>	<i>Atomic #</i>	<i>Atomic Mass</i>	<i>e<sup>-</sup></i>	<i>n<sup>0</sup></i>	<i>p<sup>+</sup></i>
Carbon			12			
Chlorine			35			
Nitrogen			14			

Do these in journal = Lithium, Aluminum, Arsenic, Neon,



# *Extra Practice*

<i><b>Element Name</b></i>	<i><b>Symbol</b></i>	<i><b>Atomic #</b></i>	<i><b>Atomic Mass</b></i>	<i><b><math>e^-</math></b></i>	<i><b><math>n^0</math></b></i>	<i><b><math>p^+</math></b></i>
Lithium						
Aluminum						
Arsenic						
Neon						



# Isotope

## □ What is it?

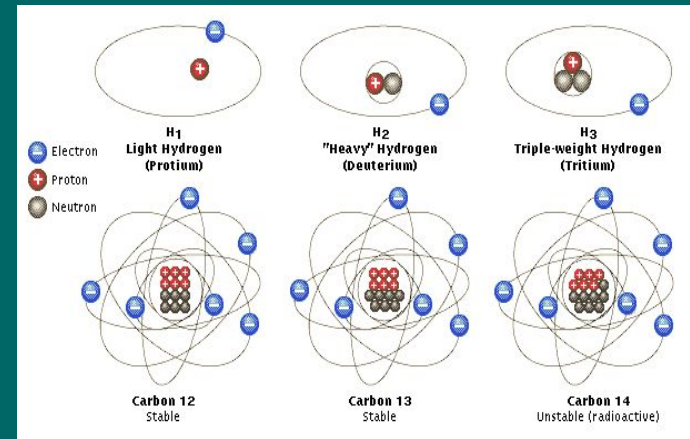
- Atom of the same element that has a different number of neutrons

## □ How do you find it (identify it)?

- Adding  $p^+$  and  $n^0$  together

## □ Where do we use it?

- Carbon dating
- Radiometric dating





# *Compound*

## □ What is it?

- Pure substance formed when 2 elements combine

## □ Examples

- $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{O}_2$ ,  $\text{H}_2$ ,  $\text{CH}_4$

## □ Can it be broken down?

- Yes

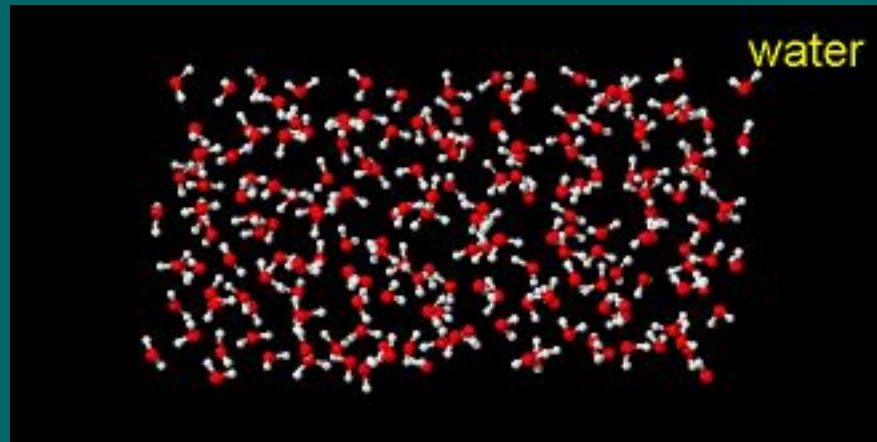
# Covalent Bonds

## □ What are they?

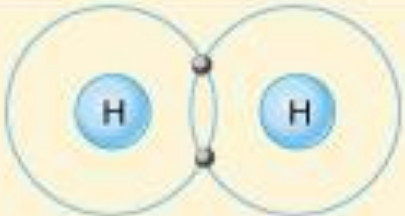
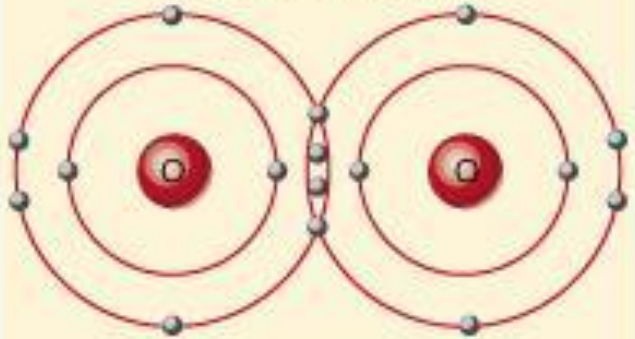
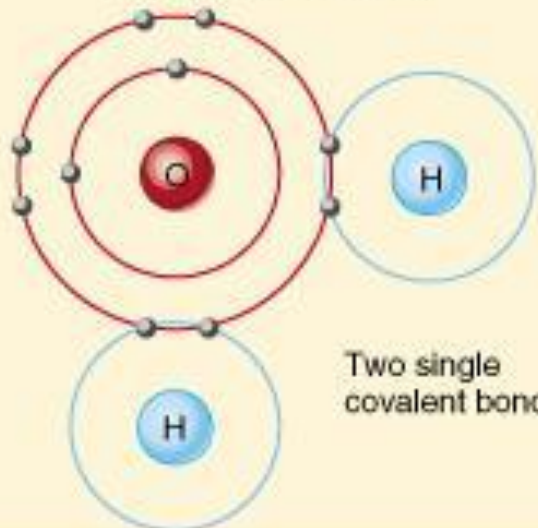
- e- are shared
- Want to fill each outer energy level

## □ Examples

- H<sub>2</sub>O





Written formula	Structural representation	Structural formula with covalent bond
Hydrogen (H <sub>2</sub> )	 <p>Single covalent bond</p>	H—H
Oxygen (O <sub>2</sub> )	 <p>Double covalent bond</p>	O=O
Water (H <sub>2</sub> O)	 <p>Two single covalent bonds</p>	$\begin{array}{c} \text{O} - \text{H} \\   \\ \text{H} \end{array}$



# ***Ionic Bonds***

## *▣ How do they form?*

- electrons are \_\_\_\_\_ or \_\_\_\_\_

## *▣ What's an ion?*

- An atom that has lost or gained an e-

## *▣ Examples*

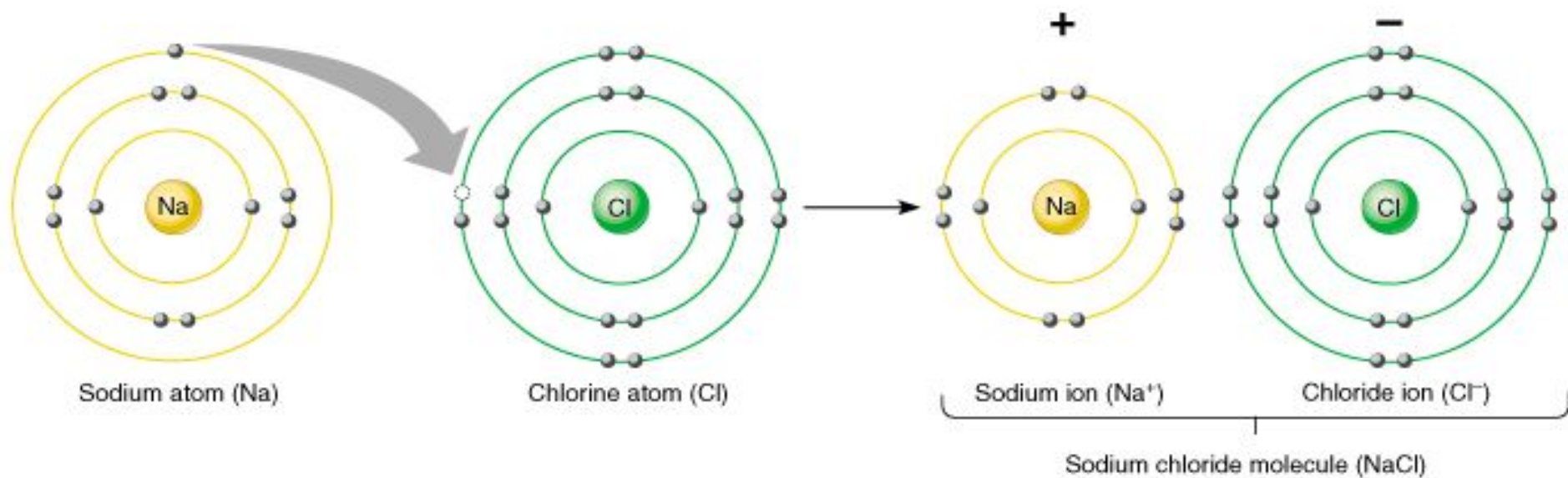
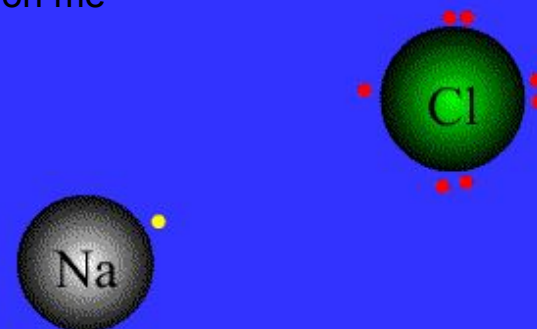
- NaCl or salt





# ***Ionic Bond***

Click  
on me



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Which is a +ion and which is –ion?



# *Section 1*

## *Essential Questions*

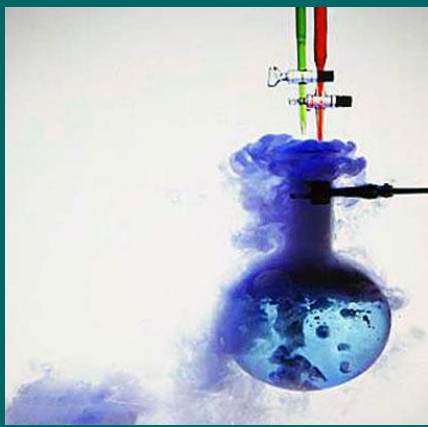
- What are atoms?
- How are the particles that make up atoms arranged?
- How are covalent and ionic bonds alike? Different?

□ *Vocabulary:*

*Atom    neutron    electron    covalent bond*

*Nucleus    element    isotope    ion*

*Proton    compound    ionic bond*



# ***Chemical Reaction***

- Chemical Reactions allow all living things to grow, reproduce and adapt
- **Chemical Reaction:** the process by which atoms in substances are reorganized into different substances



# *Chemical Equations*

REACTANTS    $\square$    PRODUCTS

Reactant is the starting substance

Product is the substance formed

$\square$  Means Yields or forms

# Changes

## □ Chemical Change

- Alters composition
- New substance formed



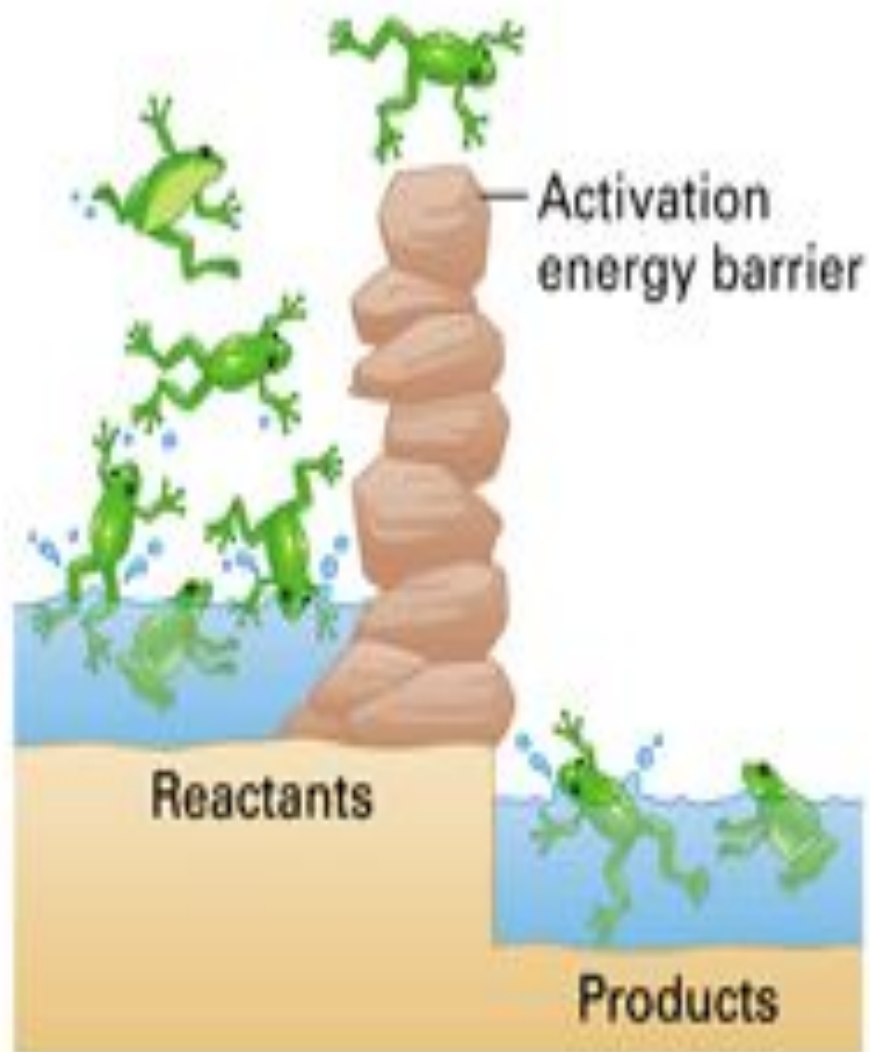
## Physical Change

- Alters appearance but not composition
- Same substance

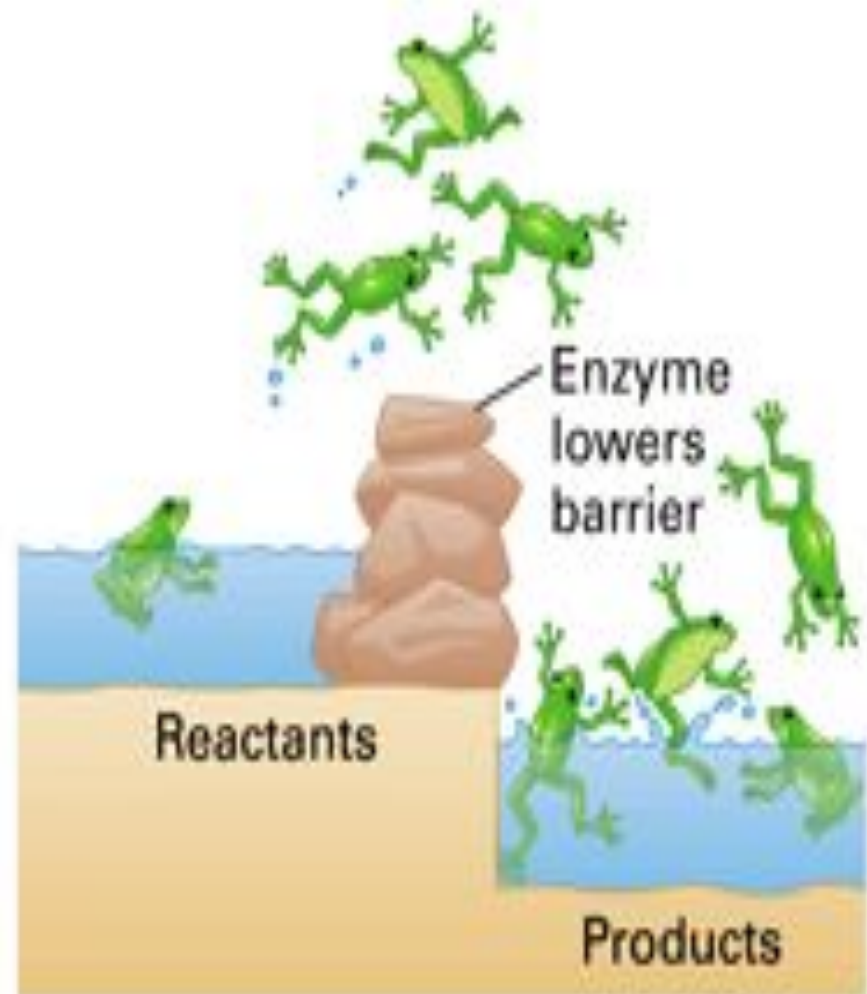


# ***Energy of Reactions***

- The key to starting a chemical reaction is **ENERGY**
- **Activation Energy**: the amount of energy needed for a reaction to occur
  - The “push” for a reaction to start



Without enzyme

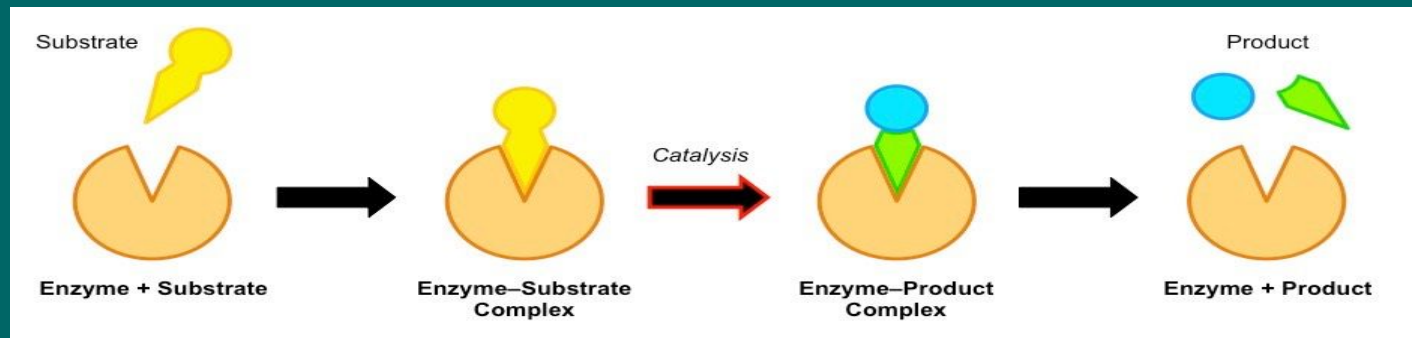


With enzyme



# Enzymes

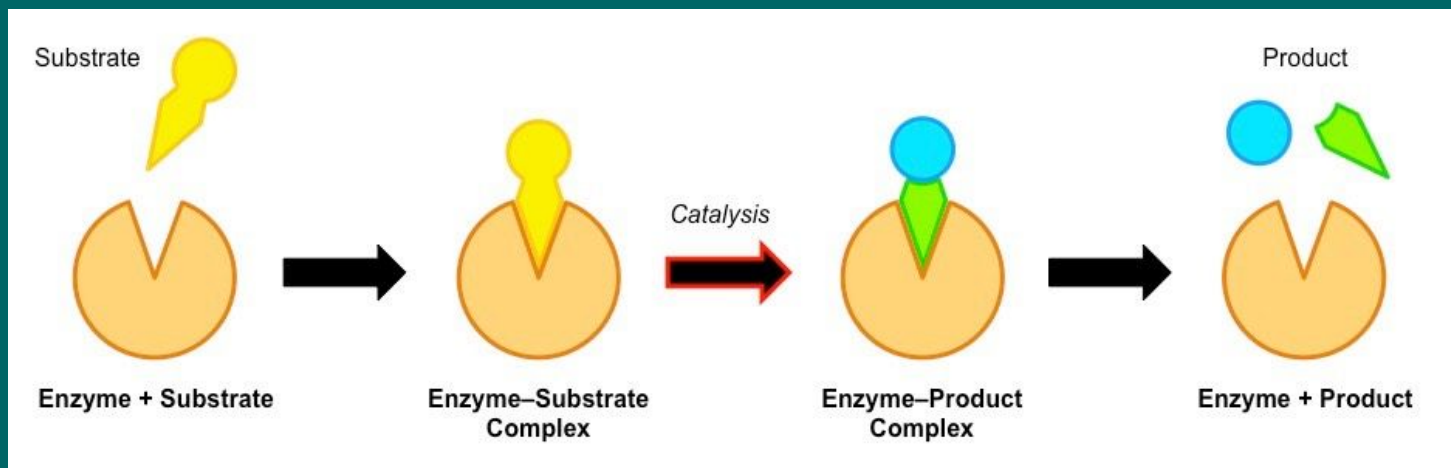
- All living things are chemical factories driven by chemical reactions.
- Chemical reactions proceed very slowly in a lab setting due to Activation energy is too high when in lab
- Need other substances to reduce activation energy





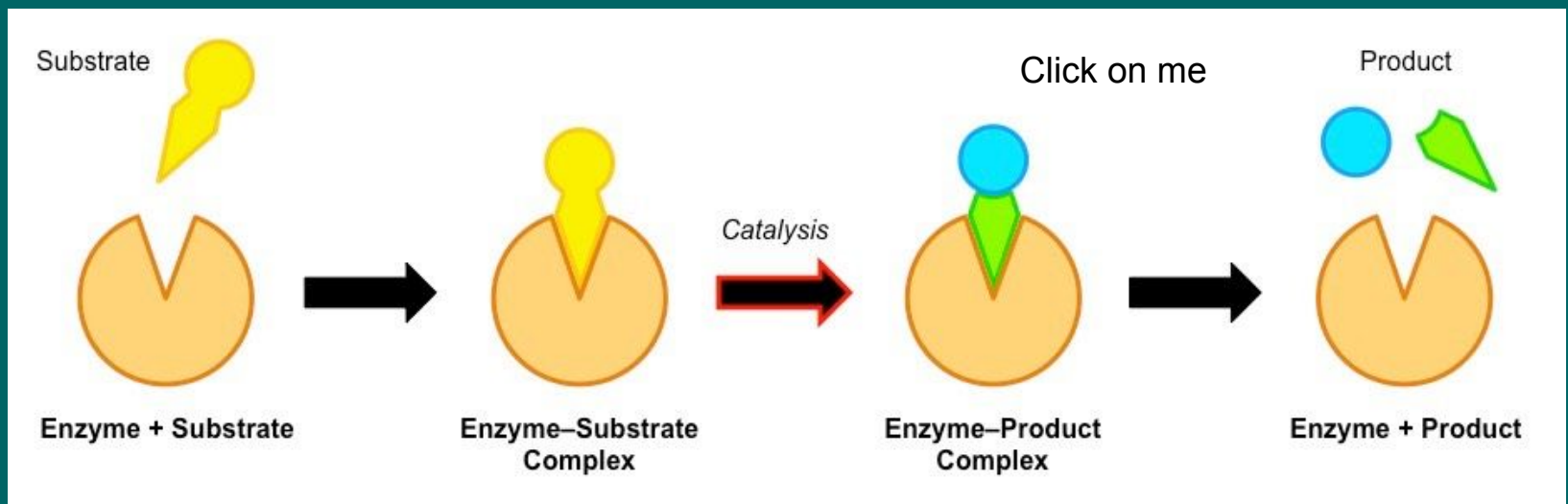
# Catalyst

- A substance that lowers the activation energy needed to start a chemical reaction
  - Does NOT increase product amount
  - Does NOT get used up (can be reused)



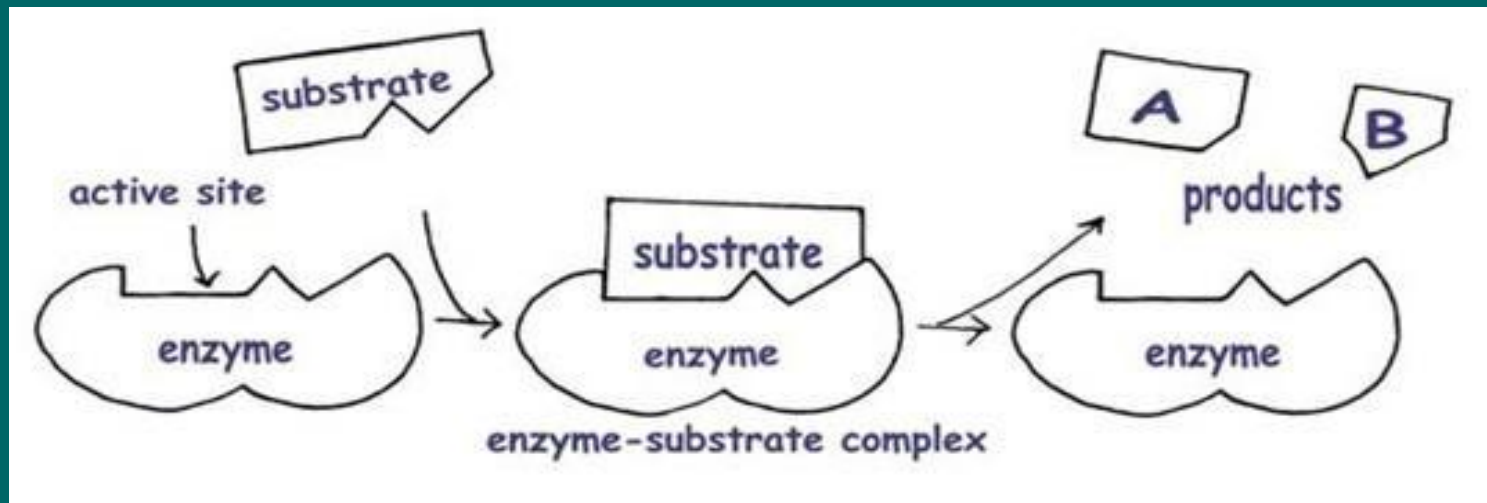
# Enzyme

- Enzyme – protein that acts as a catalyst
- A type of Protein
- Essential to life
- An enzyme's name describes what it breaks down



# Enzymes Parts

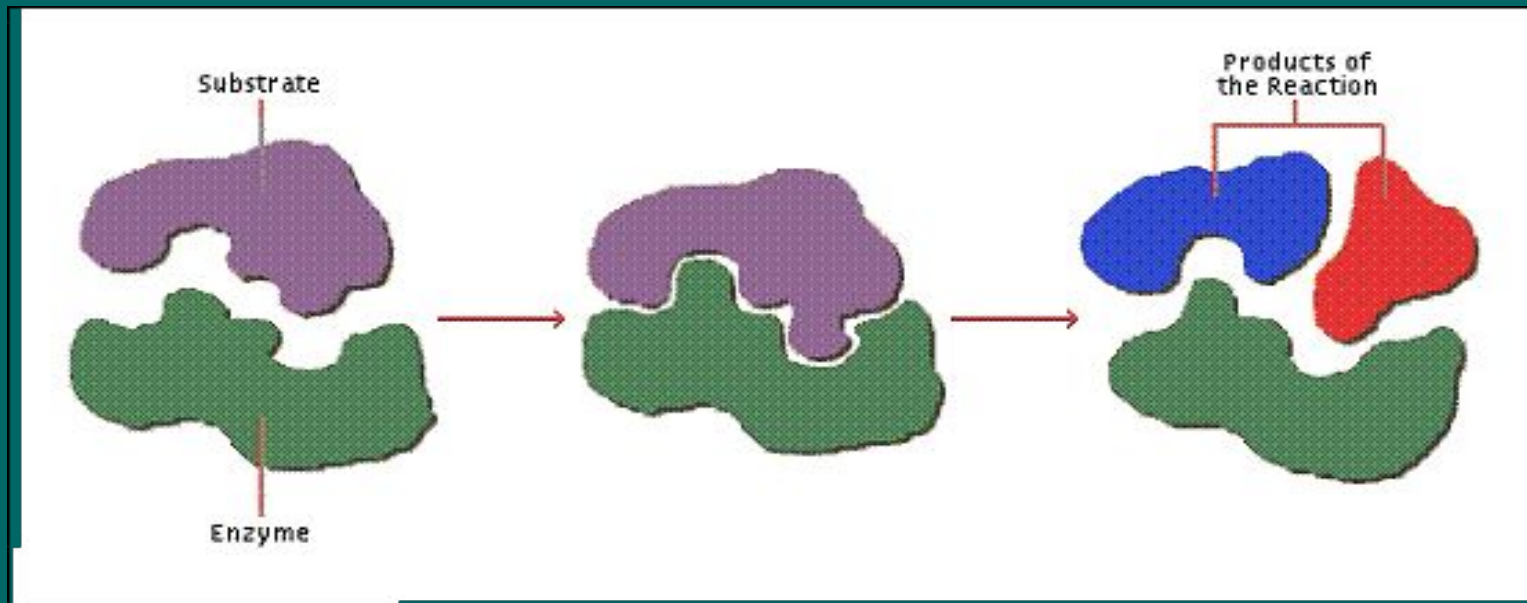
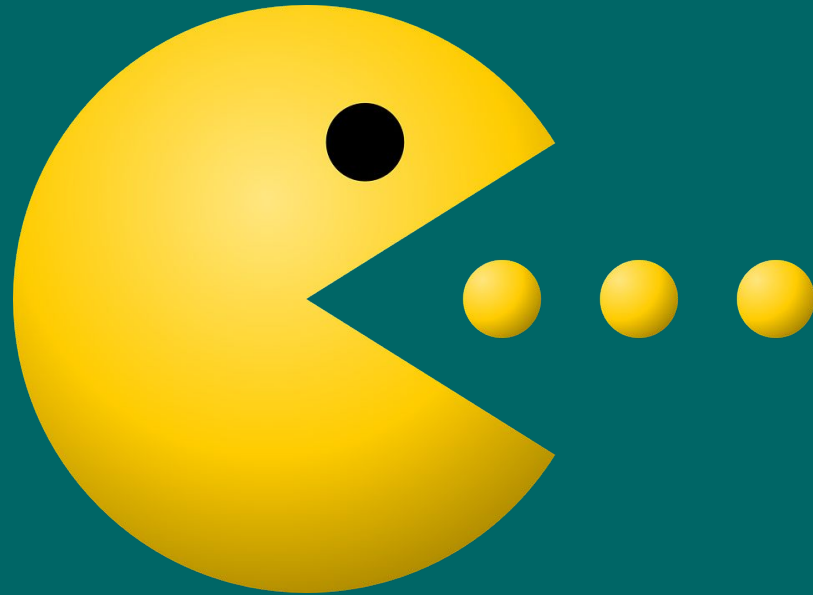
- ❑ Substrate – the “chemical reaction” the enzyme works on
- ❑ Active Site - the specific region of the enzyme which combines with the substrate
- ❑ Product – the outcome of the enzyme action



# Enzyme Action

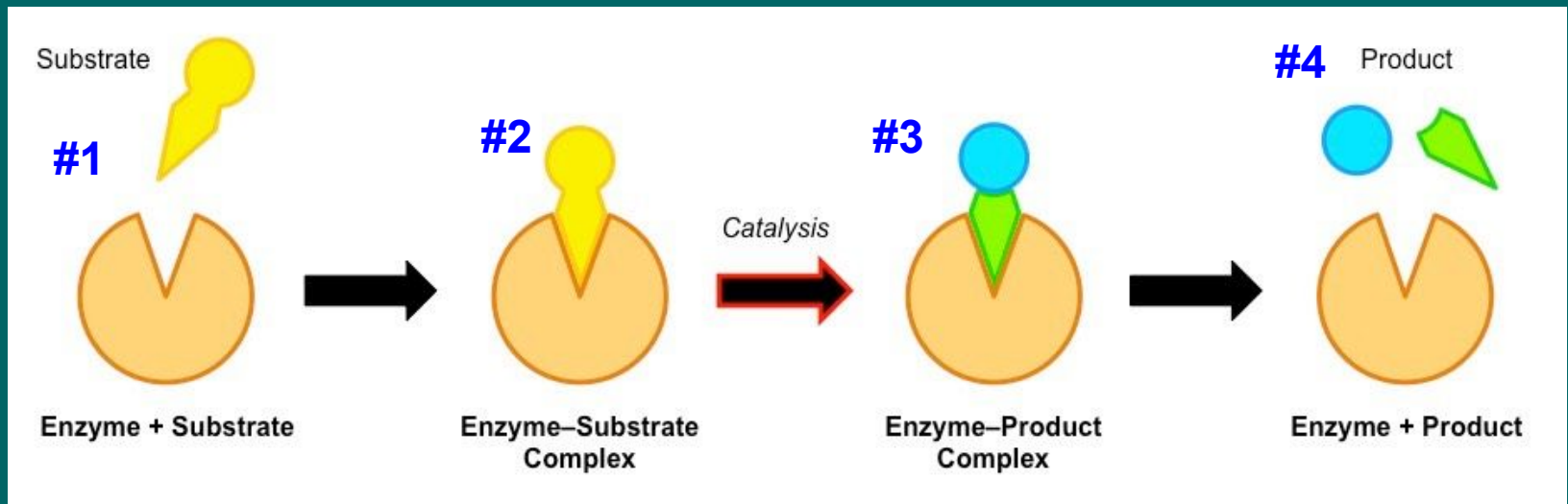
*Amoeba sisters*

<https://www.youtube.com/watch?v=qqVFkRn8f10&feature=youtu.be>



# 4 steps of how an enzyme functions

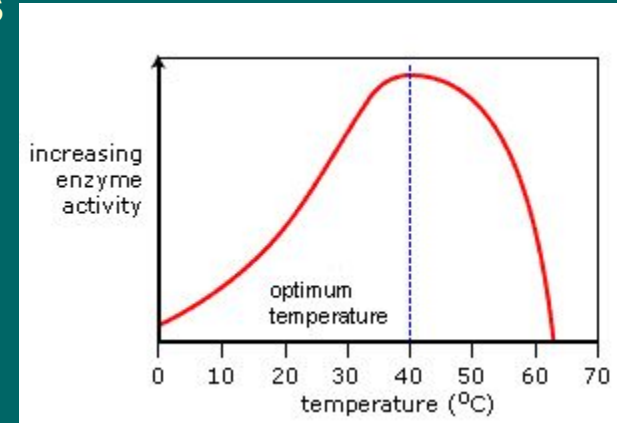
1. Substrate binds to the active site on the enzyme
2. Active site changes shape and forms the enzyme-substrate-complex
3. Substrate reacts to form products
4. The enzyme releases products



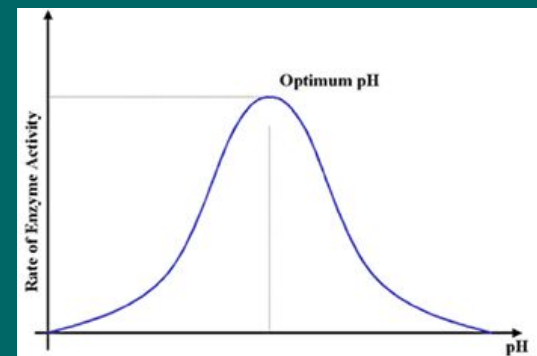
# 5. Factors that Affect an Enzyme

- ❑ **Temperature** – all enzymes have an optimum temperature at which they perform
- ❑ **pH** - extreme changes in pH can cause enzymes to denature making them unable to function
- ❑ **Enzyme concentration** – increase the rate of reaction only until substrate is used up
- ❑ **Substrate concentration** – will only have an effect if it is a limiting factor; meaning it is stopping a reaction from occurring

## Temperature's Affect on Enzymes

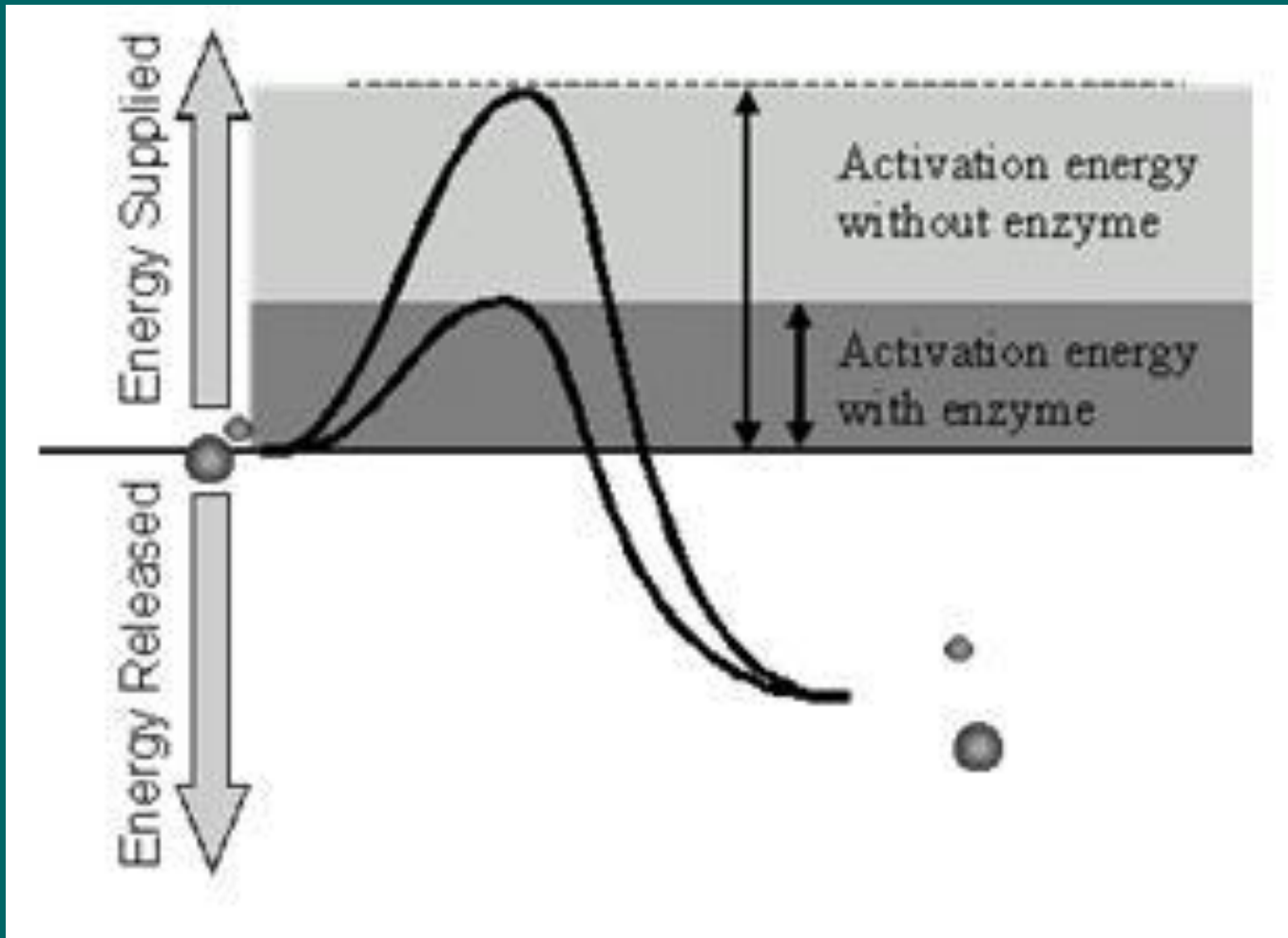


## pH's Affect on Enzymes



# Energy Use

## *With & Without an Enzyme*





# *Enzyme*

- Enzyme Foldable – homework if not completed in class Page 27
- Hand – do this on page 28 in journals





# *Day 2 Notes*

- Water Properties
- Acid/Bases
- Begin Organic Chemistry

# ● ● ● | ***Water helps to:***

- The properties of water make it well suited to help maintain homeostasis
- Water accounts for 70% of a cells mass
- One of the most important molecules of life
  - Retains heat (ocean in May vs Aug)
  - Sweating

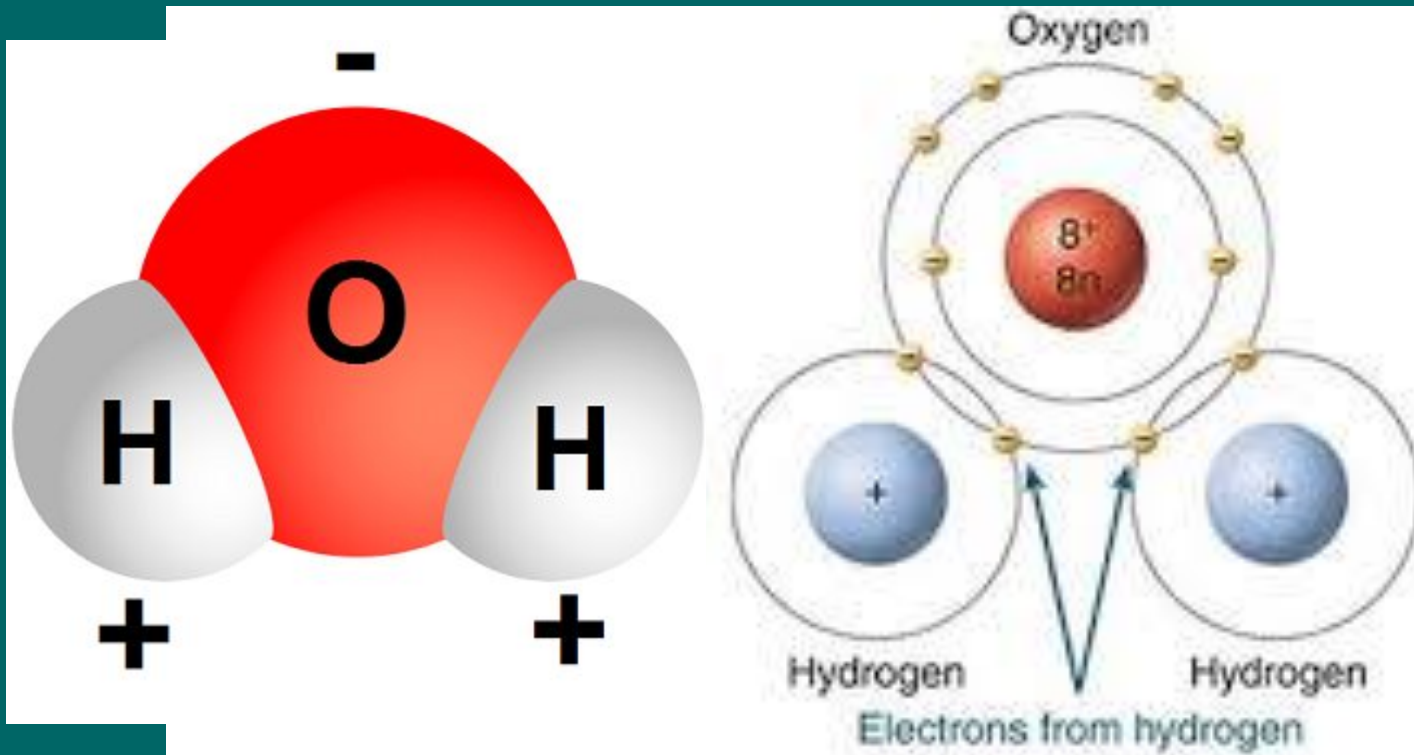


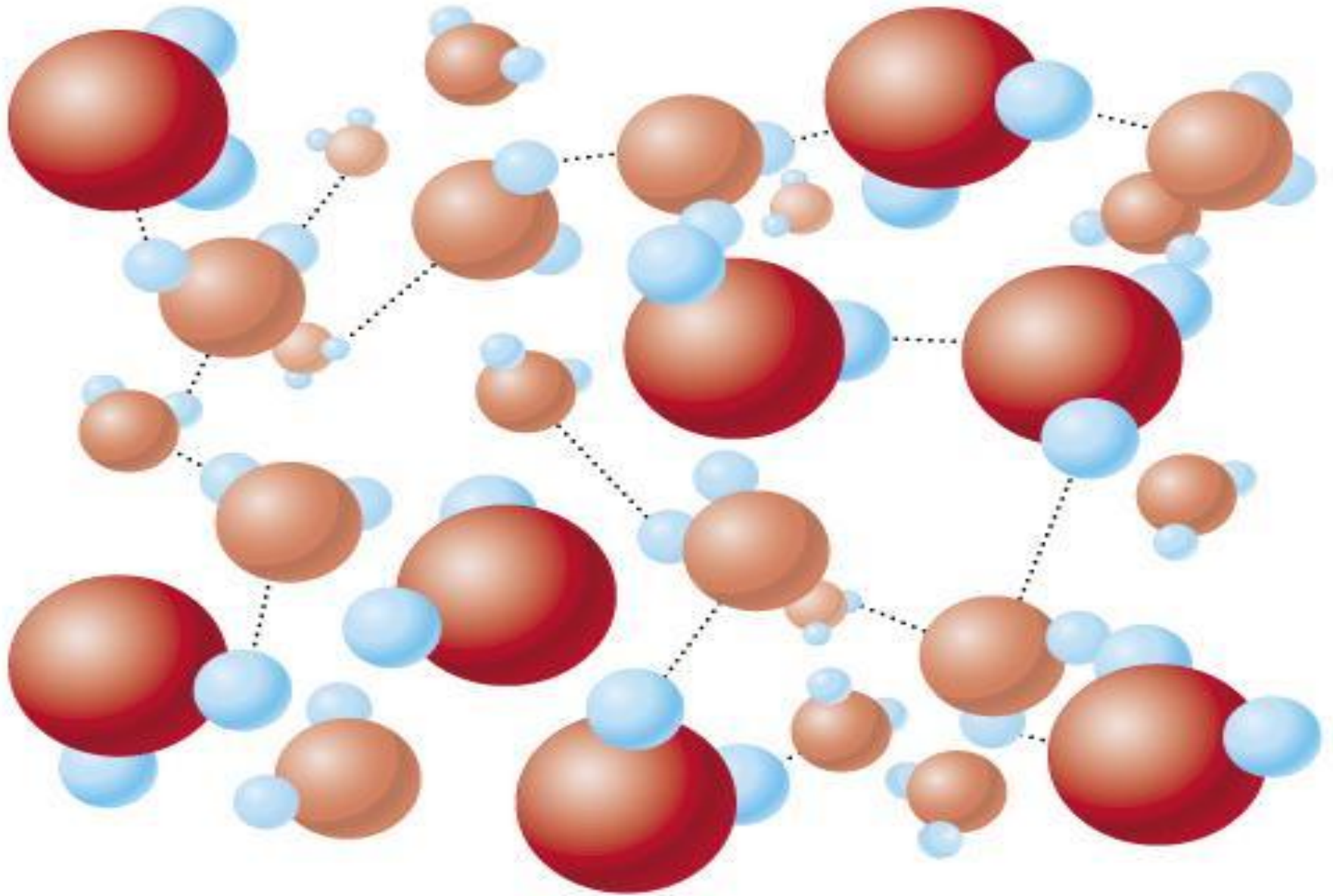
# ***Water Properties***

- Water makes a covalent type of bond
- There is an unequal distribution of e-
- Oxygen's end has a negative charge
- Hydrogen's end has a positive charge
  - Thus it is a POLAR molecule
    - Have an unequal distribution of charges
    - Has 2 opposite poles
    - Act like magnets
    - **hydrogen bond**: a weak bond involving hydrogen atoms



*Oxygen is \_\_\_\_\_*  
*Hydrogen is \_\_\_\_\_*





**(a)**

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Head/Arms  
Demo

# ***Making of a Water Droplet Activity***

- Do you have all of the materials?
- Practice with the pipette
- Make yourself a water droplet
- Name it 😊



# Cohesion



## □ How does it work?

- Water molecules are attracted to each other

## □ What's it create? : Surface Tension

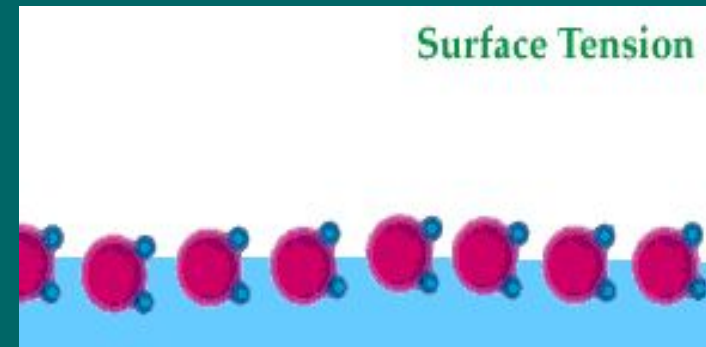
## □ Causes water to form droplets

- The hydrogen bonds link together
- Allows things to float/rest on water

## □ Examples

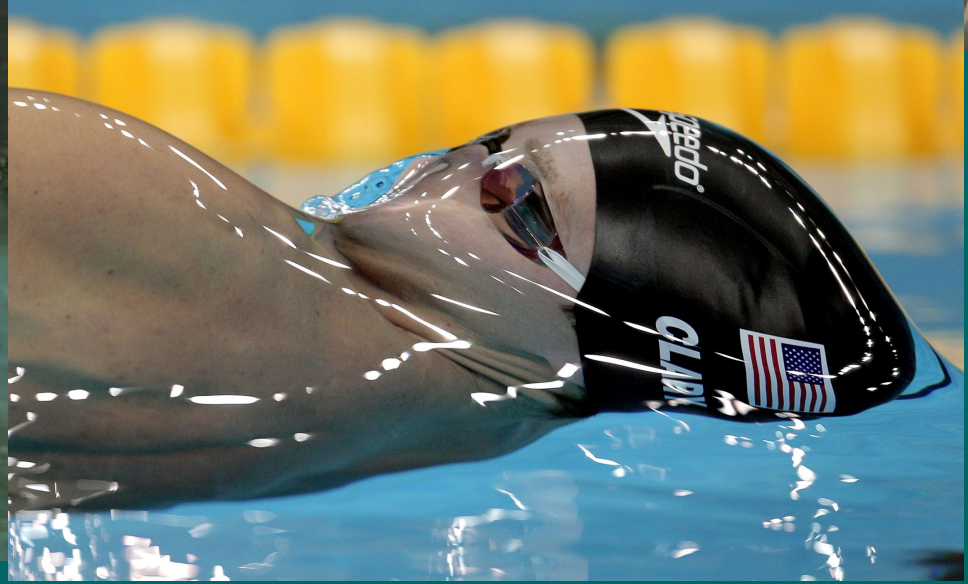
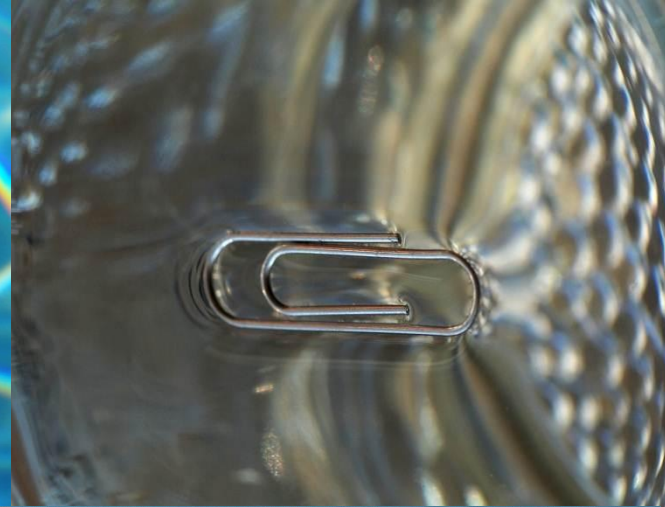
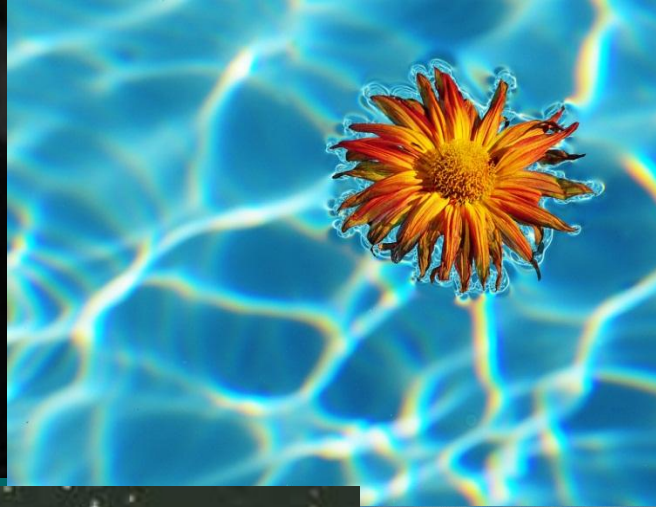


Water is “STICKY” since the bonds are attracted to other

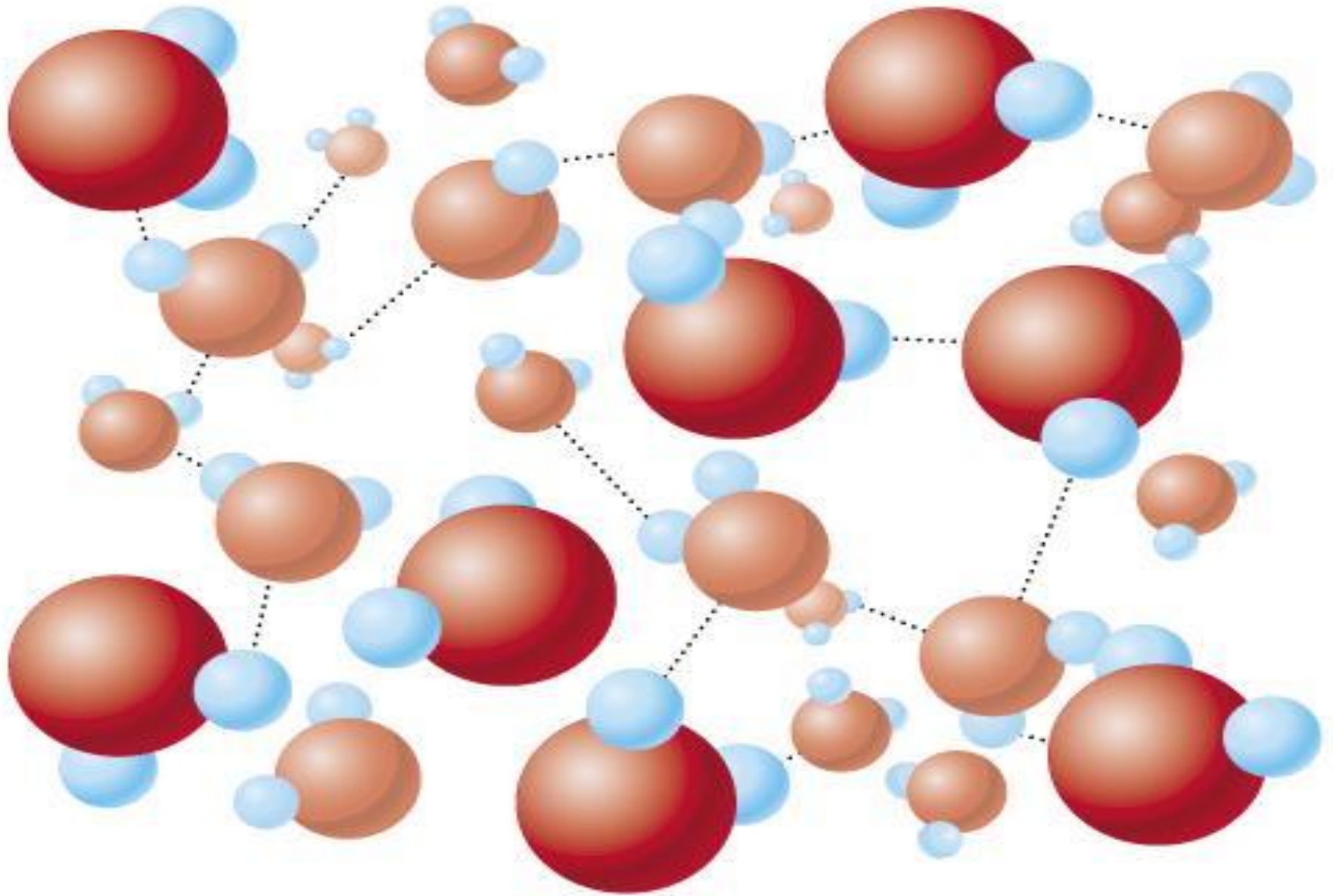




# *Surface Tension*







**(a)**

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Head/Arms  
Demo

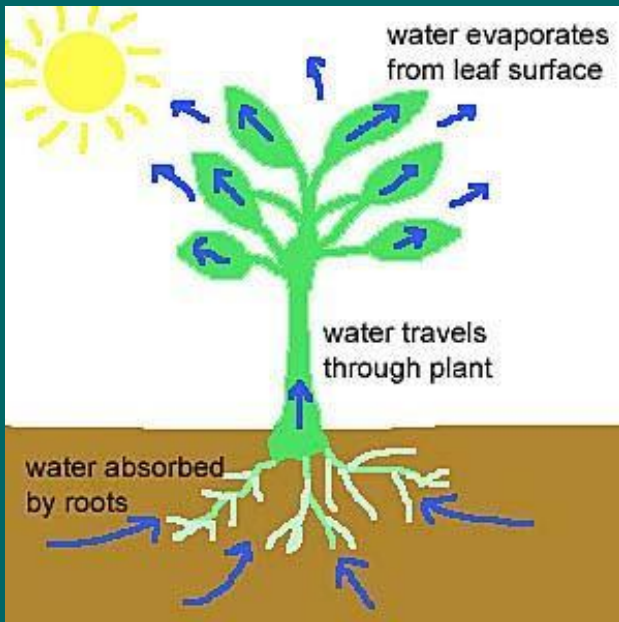
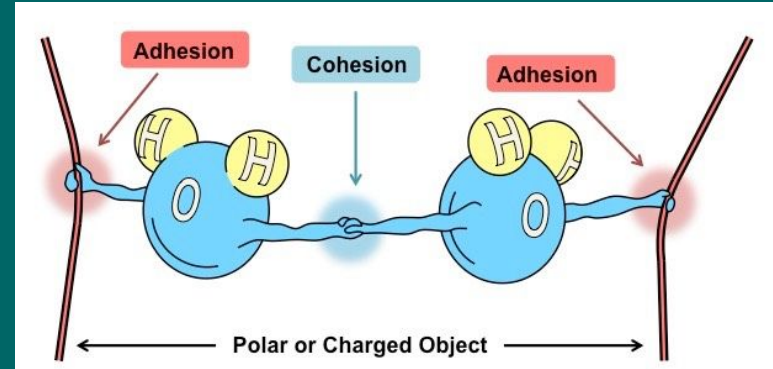
# Adhesion

## What is it?

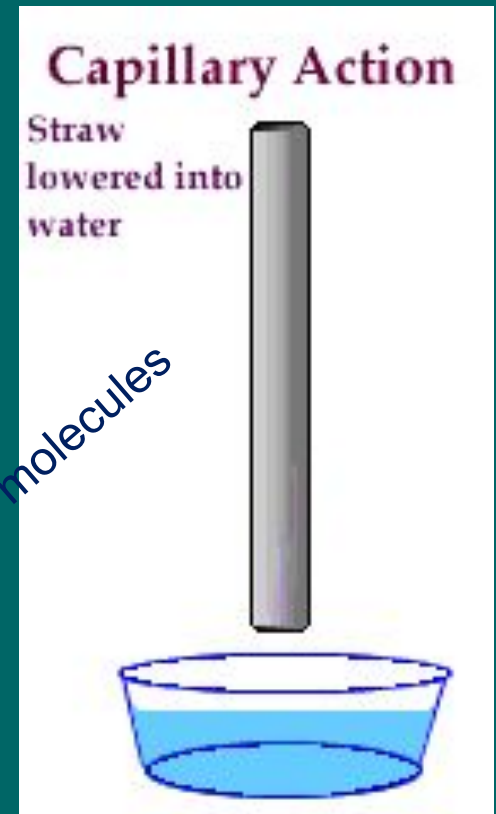
- Water forms hydrogen bonds with molecules on other surfaces

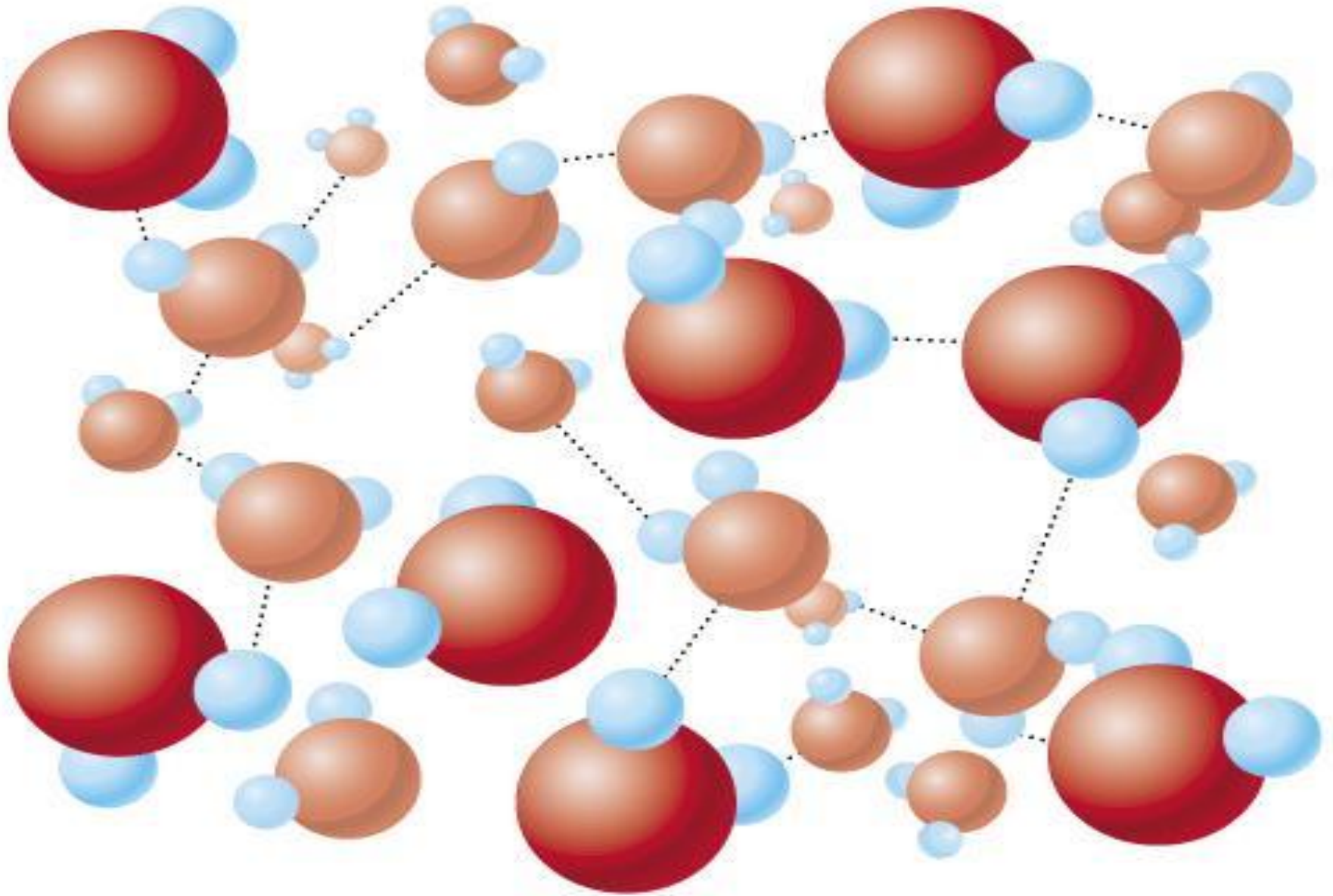
## What does it create? Capillary action

## Water can travel up stems



Attracted to other molecules





**(a)**

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Head/Arms  
Demo

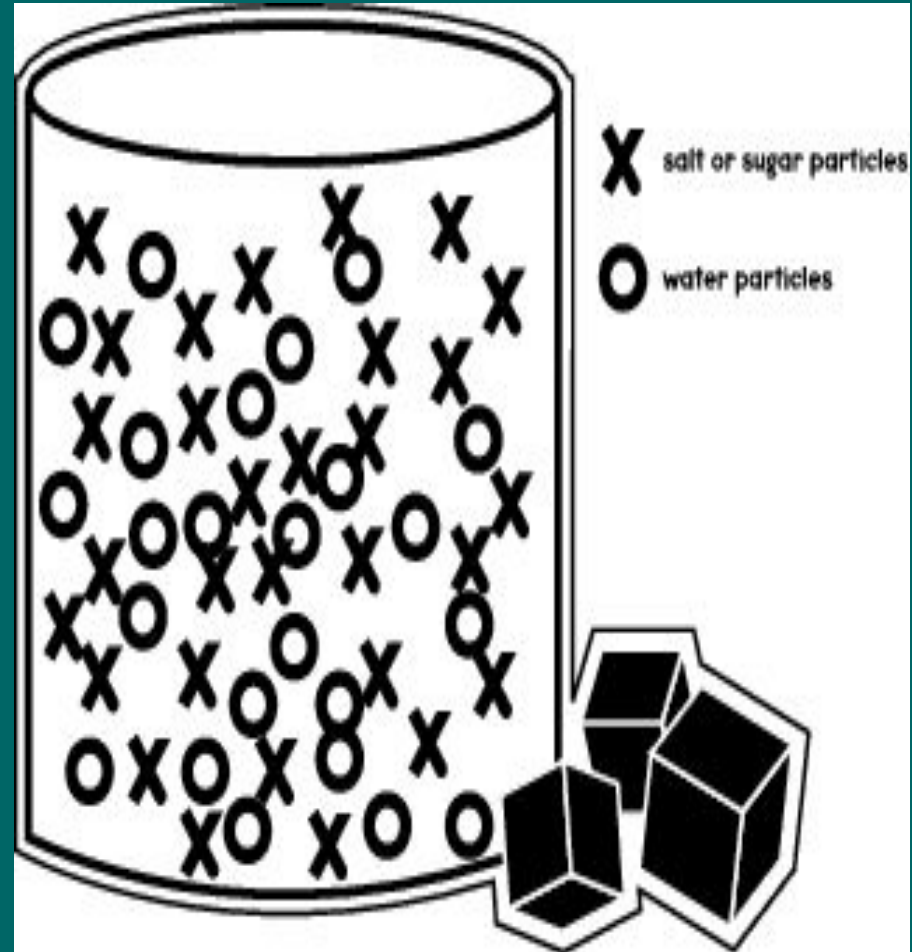
# *Universal Solvent*

## Solvent

- Substance **DOING** the dissolving

## Solute

- The substance that is **DISSOLVED**





# *Acid / Base*

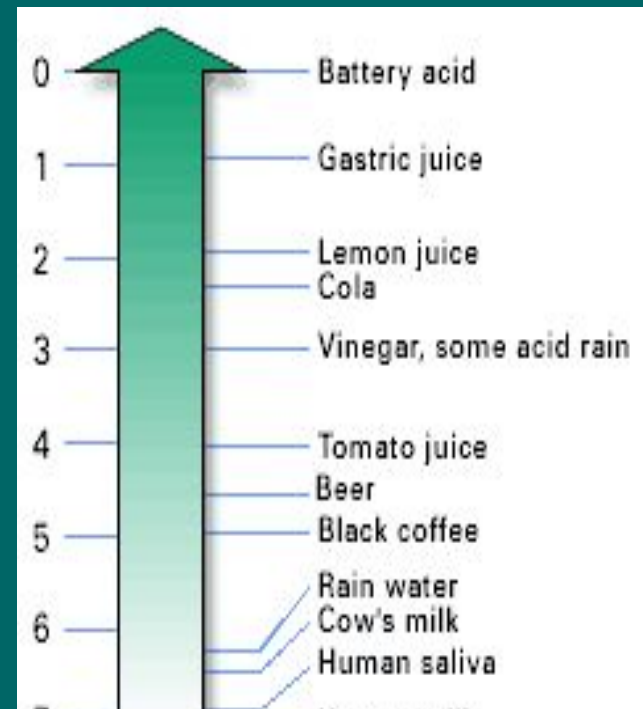
If water is broken down it forms Hydrogen ions & hydroxide ions





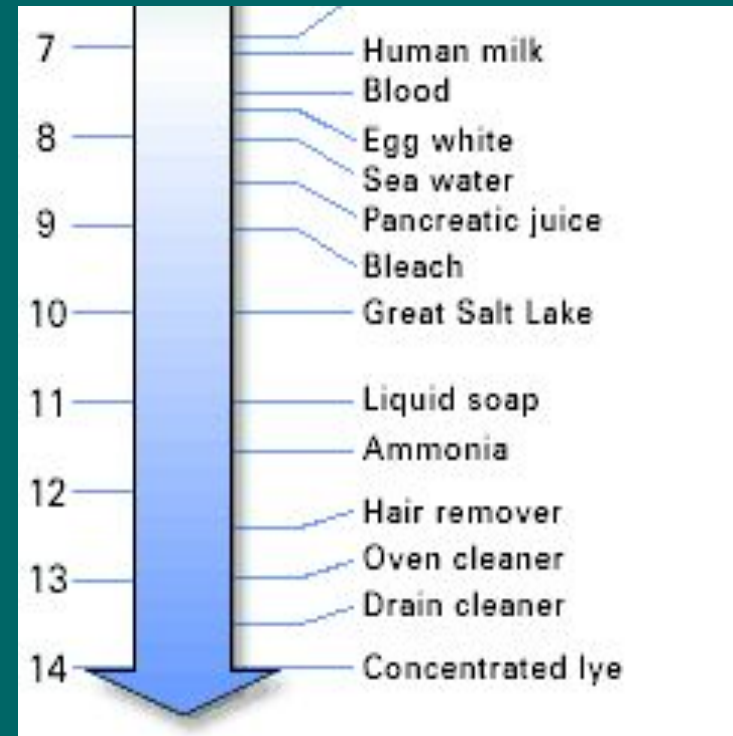
# Acid Facts

- Will release Hydrogen ( $H^+$ ) when dissolved in water
- Sour to taste
- Tingle to touch
- Range (0 – 6.9)
- LEFT Side of pH scale
- Examples



# Base Facts

- Forms hydroxide ( $\text{OH}^-$ ) in water
- Bitter to taste
- Slippery to touch
- Range (7.1 - 14)
- RIGHT side of pH scale
- Examples



	[H <sup>+</sup> ]	pH	Common examples
Acids	1 x 10 <sup>0</sup>	0	Hydrochloric acid
	1 x 10 <sup>-1</sup>	1	Stomach acid
	1 x 10 <sup>-2</sup>	2	Lemon juice
	1 x 10 <sup>-3</sup>	3	Vinegar
	1 x 10 <sup>-4</sup>	4	Soda (carbonic acid)
	1 x 10 <sup>-5</sup>	5	Rainwater
	1 x 10 <sup>-6</sup>	6	Milk
Neutral	1 x 10 <sup>-7</sup>	7	Pure water
Bases	1 x 10 <sup>-8</sup>	8	Egg whites
	1 x 10 <sup>-9</sup>	9	Baking soda
	1 x 10 <sup>-10</sup>	10	Antacid
	1 x 10 <sup>-11</sup>	11	Ammonia
	1 x 10 <sup>-12</sup>	12	Quicklime (calcium hydroxide)
	1 x 10 <sup>-13</sup>	13	Drain cleaner
	1 x 10 <sup>-14</sup>	14	Lye (sodium hydroxide)

# pH scale

- The measure of the concentration of H<sup>+</sup> in a solution is called pH
- Range?
  - 0-14
- Difference between each number?
  - 10x the strength
- How to draw a basic pH scale?
- **Buffers**: a mixture that reacts with an acid or base to keep the pH within a particular range



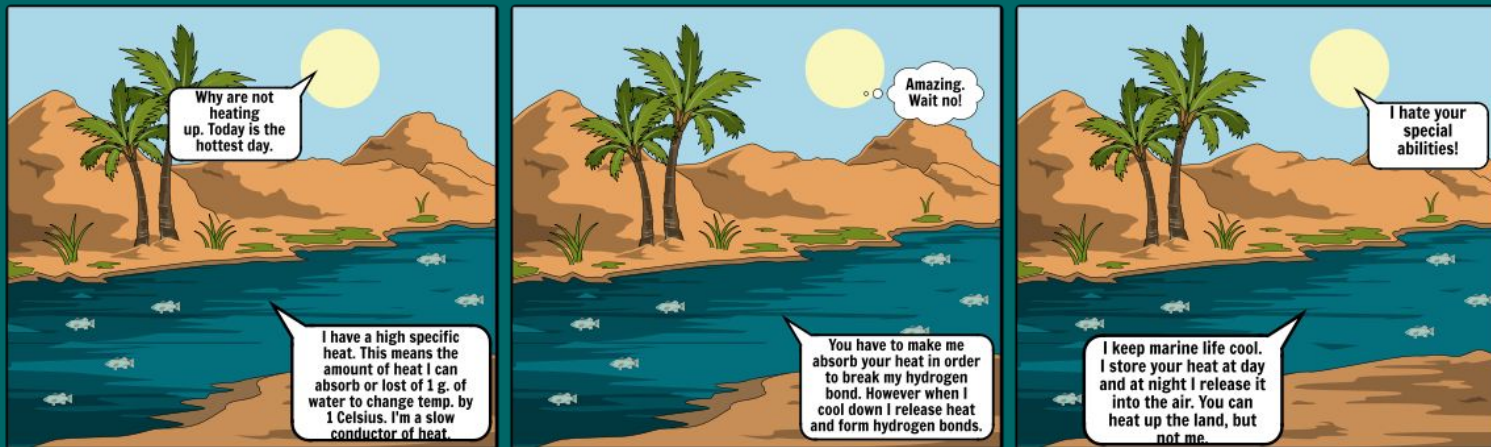


# *Properties of Water*

1. Cohesion (surface tension)
2. Adhesion (capillary action)
3. Universal solvent
4. pH
5. High specific heat
6. Freezing and expansion
7. Diffusion
8. Osmosis

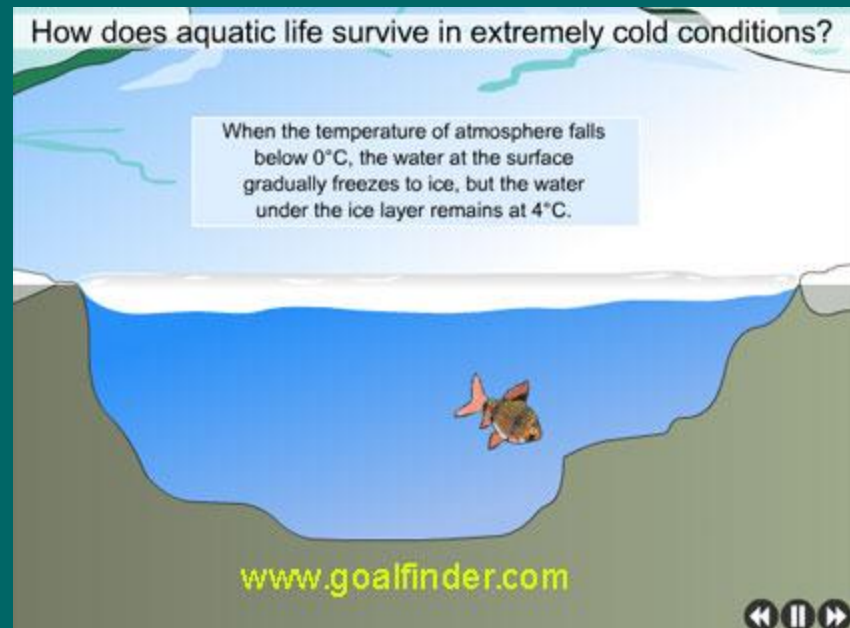
# 5. High Specific Heat

- Specific heat of a substance is the heat needed (gained or lost) to change the temperature of 1 g. of a substance 1 degree Celsius.



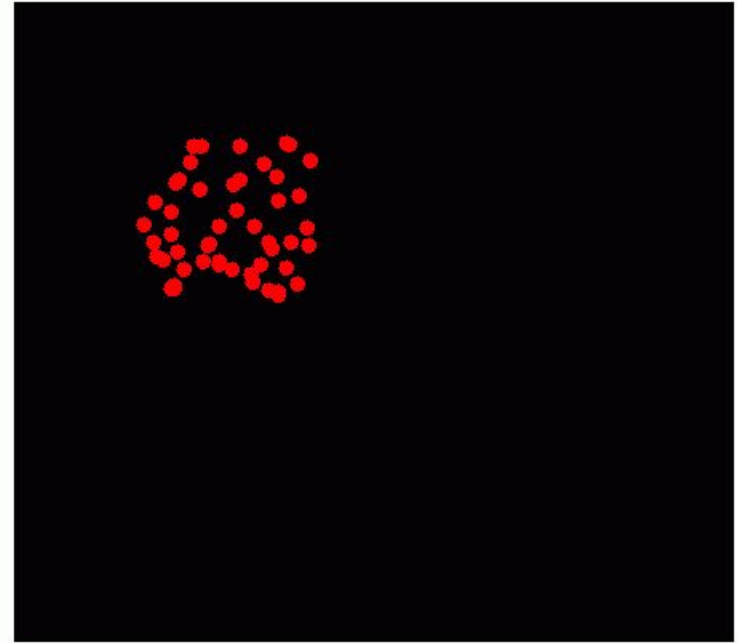
# 6. *Freezing and expansion*

- ❑ Ice (solid water) is less dense than liquid water,
- ❑ ice floats, preventing lakes and oceans from freezing solid.
- ❑ The ice at the top of the water insulates the liquid below.



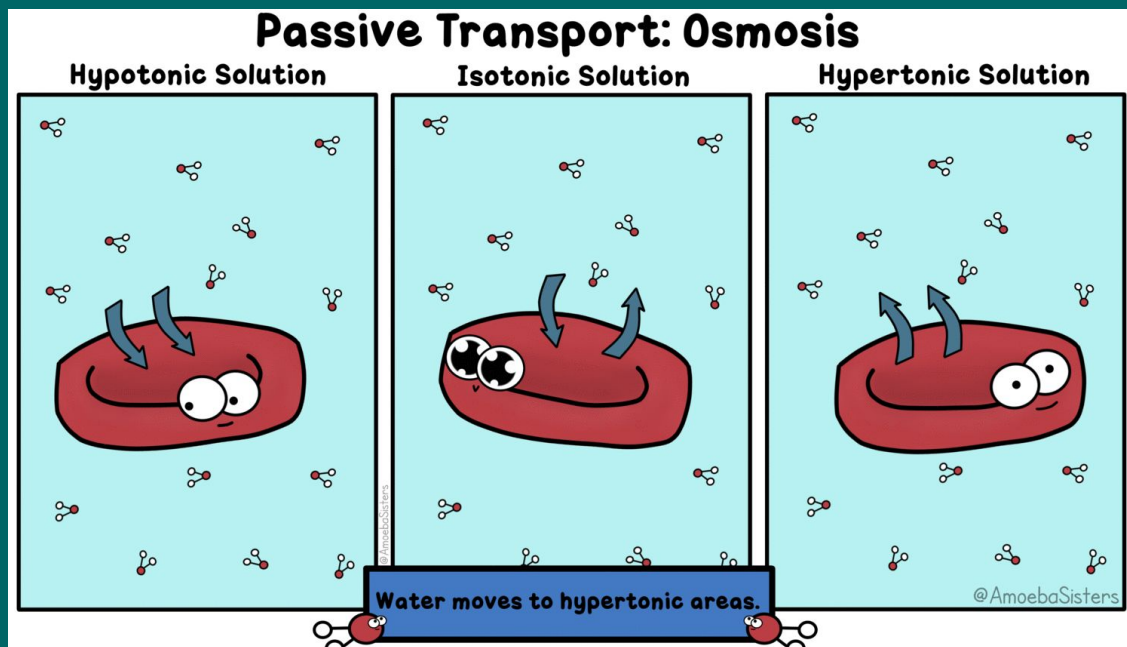
# 7. *Diffusion*

- Occurs in cells when substances (oxygen, carbon dioxide, salts, sugars, amino acids) which are dissolved in water move from an area of higher concentration to an area of lower concentration.



# 8. *Osmosis*

- The movement of water molecules through a semipermeable membrane from an area of greater water concentration to an area of lesser water concentration.





# Section 3

## *Essential Questions*

- How does the structure of water make it a good solvent?
- What is the difference between a solvent and solute?
- Name 4 differences between acids and bases.
- *Vocabulary: polar molecule, mixture, solution, solvent, solute, acid, base, pH, buffer, cohesion, adhesion*



# *Chemistry Lab*

- All water properties
- Acid/bases
- Physical/chemical change
- Homogeneous/heterogeneous
- Atom chemistry
- Water foldable



# *Section 3*

## *Basic Building Blocks of life*

- Organisms are made up of **CARBON** molecules
- **ORGANIC** = comes from living things and contains carbon
  - Examples
- **INORGANIC** = does not come from living things and does not contain carbon
  - Example: water





# ***Terms to know*** 😊

## ▣ **Macromolecule**

- Large molecule formed from smaller molecules

## ▣ **Polymer**

- Molecule made from repeating smaller units

## ▣ **Monomer**

- Smallest unit to make up polymers
- AKA basic building block (BBB)

# 4 categories of macromolecules



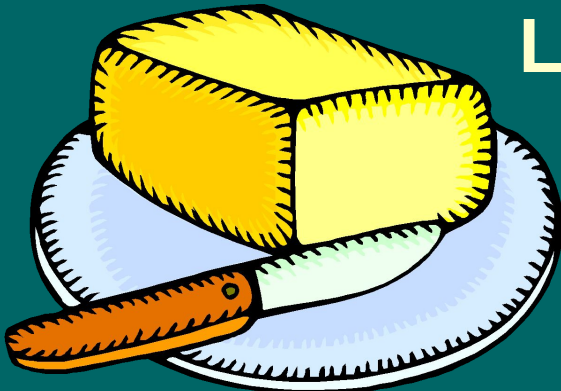
Protein



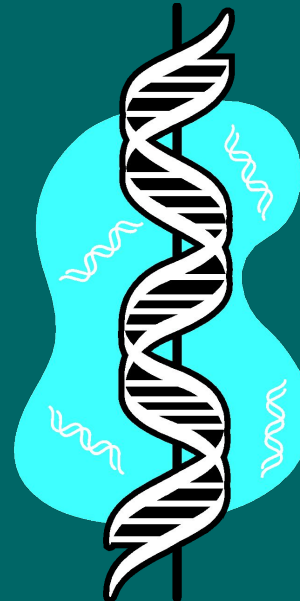
Carbohydrate



Lipid




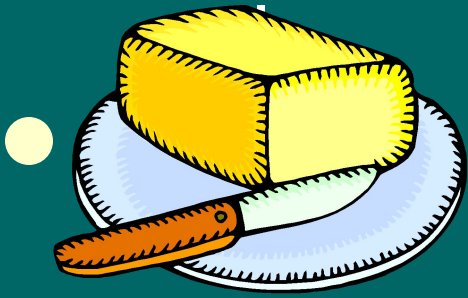
Nucleic  
Acid



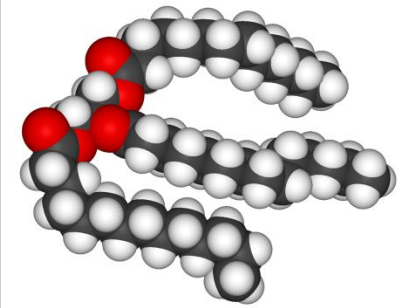


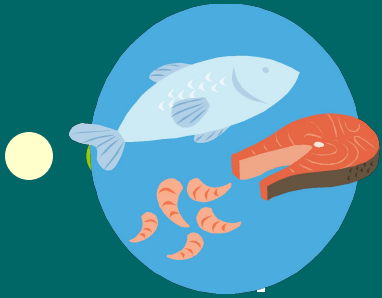
# *General Information of Carbohydrates*

Food Source	General Purpose	BBB	Elements	Structure
	Quick energy	Monosaccharides (GLUCOSE)	C H O	



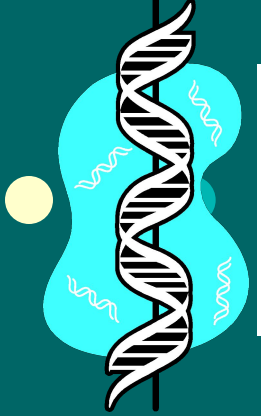
# General Information of *Lipids*

Food Source	General Purpose	BBB	Elements	Structure
	Stored energy  Provide barriers	Fatty acids Glycerol	C H O	

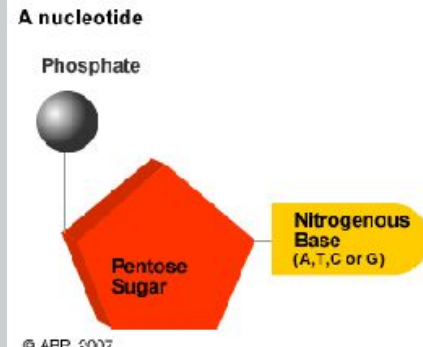


# General Information of *Proteins*

Food Source	General Purpose	BBB	Elements	Structure
	<ol style="list-style-type: none"><li>1. Fight disease</li><li>2. Transport substance</li><li>3. Speed up reactions</li><li>4. Provide structure support</li></ol>	Amino Acids	C H O N	

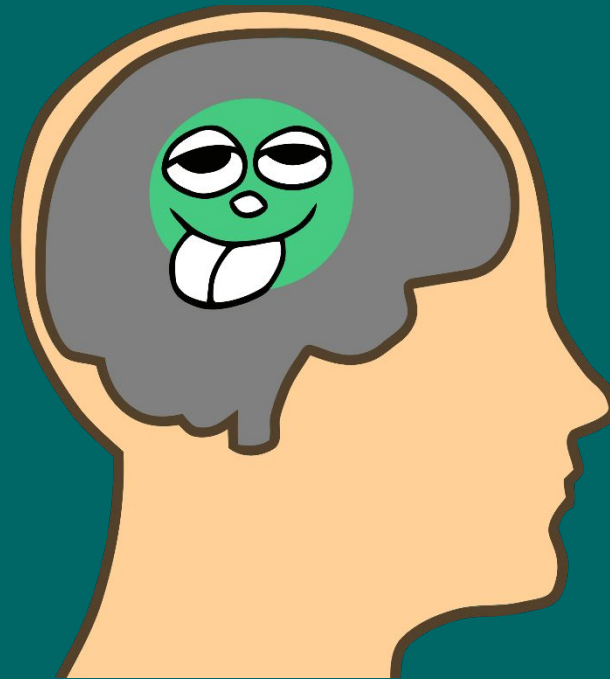


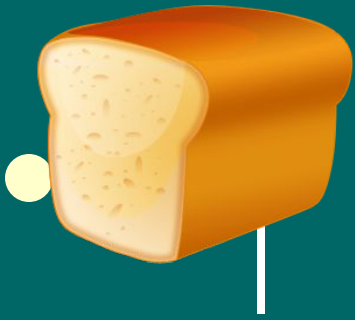
# General Information of **Nucleic Acids**

Food Source	General Purpose	BBB	Element	Structure
NONE  Found In the body	Heredity information (DNA)  Makes Proteins (RNA)	Nucleotide	C H O N P	

# Day 3 Notes

- Complete Chart on page 29
- No Notes..... Just your Brain 😊





# ***CARBOHYDRATES***

- *referred to as simple sugars*

Basic building block is called the  
**MONOSACCHARIDE**

3 or more BBB bonded together is called  
polysaccharide

EX: starch, cellulose, chitin, glycogen

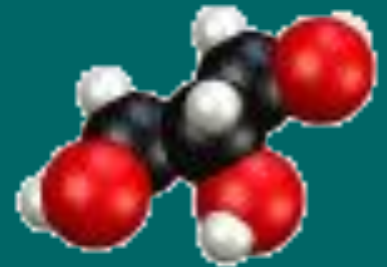




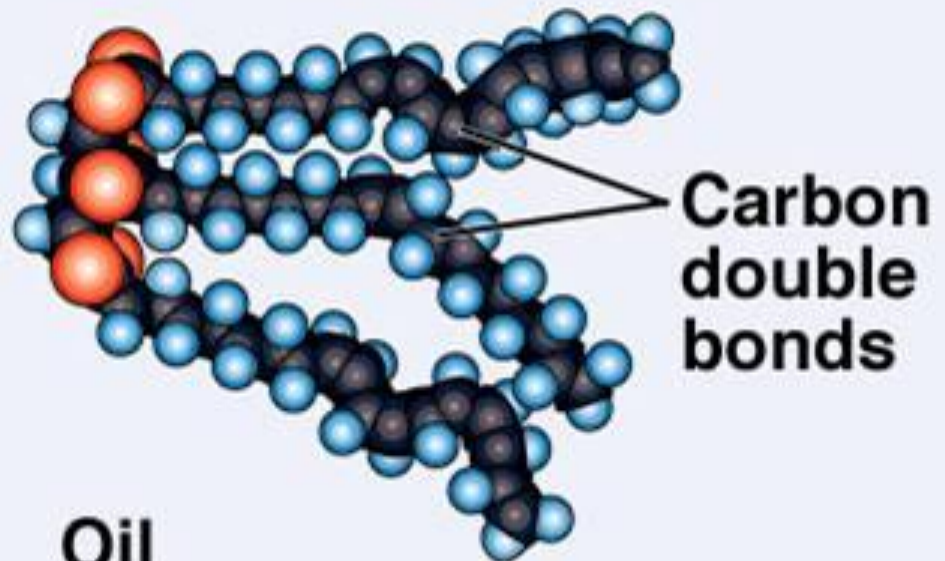
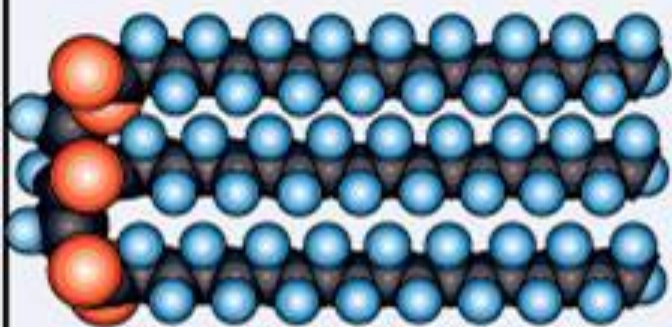
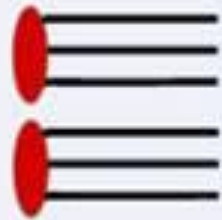
# Lipids

The word "butter" in a red, serif font with a small star above the 't', set against a yellow background with orange rays.

- **Composed of:** Fatty Acids & Glycerol
- **Function:** stores energy
- **Main type** is called = Triglyceride
- Organisms need lipids to function **properly**



# Saturated and Unsaturated Fats



**Hard fat  
(saturated)**

**Oil  
(unsaturated)**



# ***Saturated vs. Unsaturated Fats***

## ***Saturated Fats***

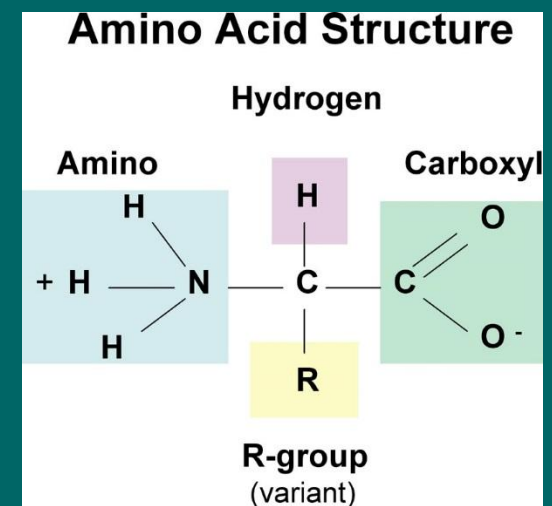
- White in color
- Derived from animals
- All have single bonds between carbons
- Fatty acids straight
- Examples are the hard fats (lard)
- Solid
- BAD

## ***Unsaturated Fats***

- Yellow in color
- Derived from plants
- Some double bonds between carbons
- Fatty acids crooked
- Examples include corn, canola, and olive oils
- Liquid
- BETTER



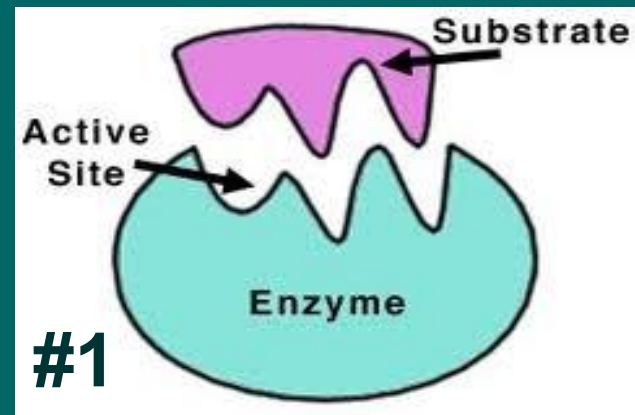
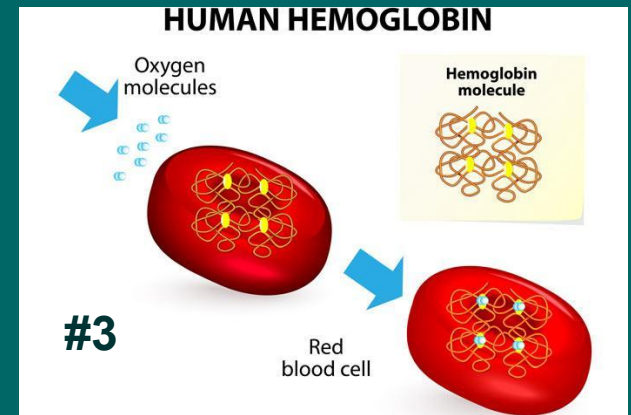
# *Proteins*



- The monomer (basic building block) is amino acid
- 2 amino acids bonded = Peptide bond
- Makes up 15% of body mass
- Involved in nearly every function of the body

# Four functions of proteins

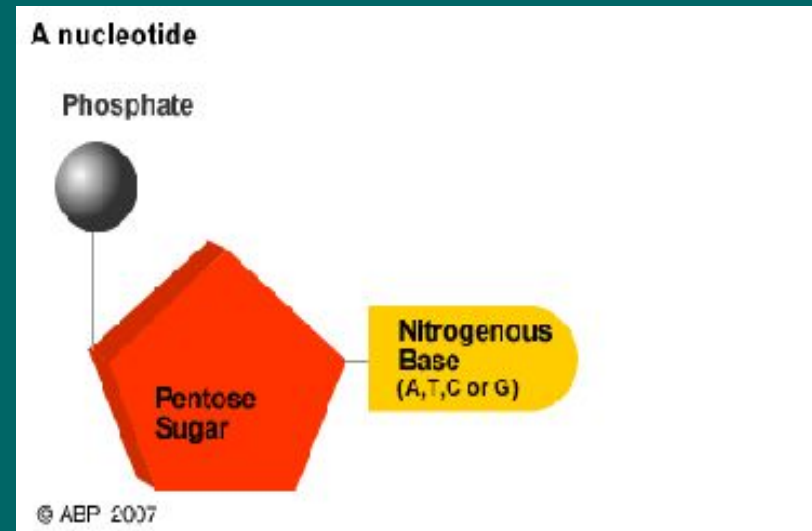
1. Enzymes speeds up chemical reactions
2. Collagen makes up structure of hair/nails/skin
3. Hemoglobin transports oxygen in blood
4. Antibody helps fight disease



# *Nucleic Acids*

□ Basic building blocks called nucleotides

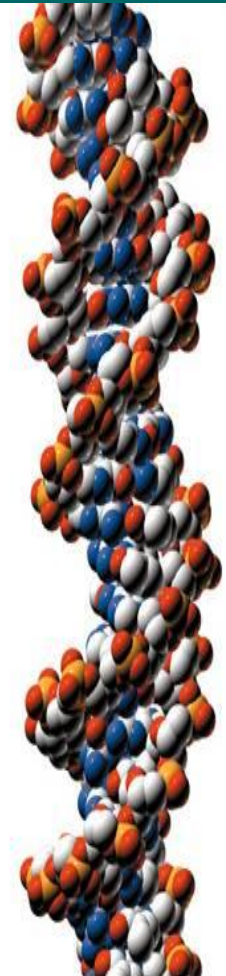
- Made up of 3 things
  - Phosphate group
  - Sugar
  - Base



# DNA

- **Deoxyribonucleic Acid**
- Stores genetic information
  - Double Stranded
  - Deoxyribose sugar

The DNA  
Double  
Helix



# RNA

- ▣ **Ribonucleic Acid**
- ▣ Directs the production of proteins
  - Single Stranded
  - Ribose sugar







□ Energy for cells



# Section 4

## Essential Questions

- What is the role of carbon in living organisms?
- List 2 facts about each of the macromolecules
- What are the major functions of each of the biological macromolecules?
- *Vocabulary: macromolecule, polymer, carbohydrate, lipid, protein, amino acid, nucleic acid, nucleotide*