

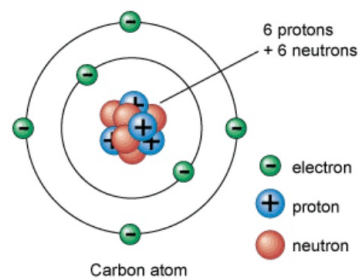
# Chemistry in Biology



## Chemistry Basics:

**Atoms: build living and non-living things  
made of 3 parts:**

- **protons- particle with a positive charge**
- **neutrons- particle with a neutral charge**
- **electrons-particle with a negative charge**



**Elements: substance made up entirely of one kind of atom**

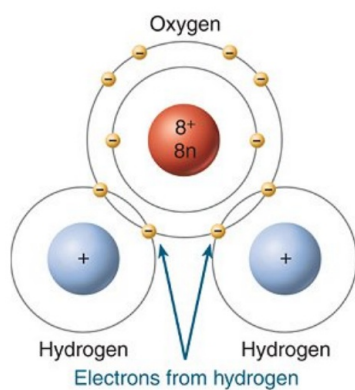
**The periodic table: elements are organized by their atomic number**

# The Periodic Table

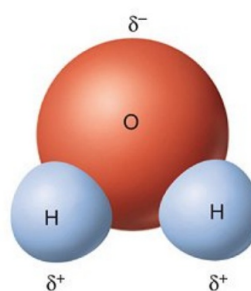
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu			
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr			

**Common symbols: H-hydrogen      C-Carbon      O-Oxygen**  
**N-Nitrogen      P- Phosphorus      Cl- Chlorine      S-Sulfur**

**Compounds: a combination of elements.**



(a) Electron shells in a water molecule



(b) Distribution of partial charges in a water molecule

**Example: Glucose  $C_6H_{12}O_6$**

Is the above molecule an atom, element, or compound?

What elements make up glucose?

How many atoms of each element are there?

### Inorganic versus Organic:

Inorganic compounds do not contain carbon and hydrogen together. They may contain carbon but no hydrogen or vice versa.

Ex: H<sub>2</sub>O

CO<sub>2</sub>

NaCl (salt)

acids and bases

**Carbon!**



Organic compounds do contain carbon and hydrogen.

Ex: Carbohydrates (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>)

Lipids

Proteins & Enzymes

Nucleic Acids

*Organic*

*Inorganic*

***Categorize the  
molecules***

## Important Inorganic Compounds

Water- Organisms are composed of 80-90% water. It is used to regulate temperature in humans, and used to dissolve important minerals. Most abundant or common inorganic molecule.

Salts- Salts are partially composed of metals. They help electrical impulses travel through vertebrate organisms.

Acids and Bases (pH)- It is important to maintain pH in certain parts of the body.

Ex: Your stomach needs to be acidic to digest food, and your blood must be neutral because it travels through the entire body.



## pH (Power of Hydrogen)

Acids have a pH between 0-6.

Acids have a high concentration of  $H^+$  ions.

Ex: HCl

Bases have a pH between 8-14.

Bases have a high concentration of  $OH^-$  ions.

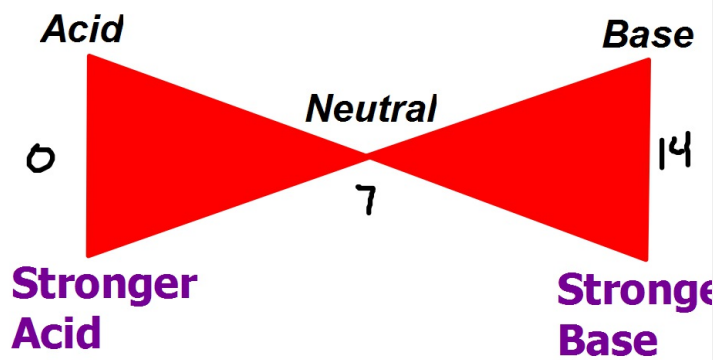
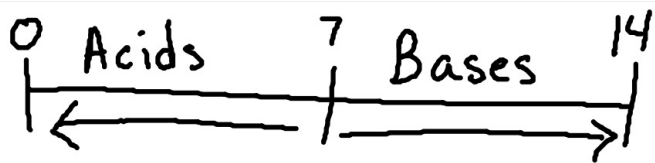
Ex: NaOH

Neutral solutions have a pH of 7.

★ Buffers are mixtures that can react with acids or bases to keep the pH within a certain range. Maintain pH!

pH-The measure of how acidic or basic a solution is.

pH Value	Examples
0	Battery acid
1	Stomach acid
2	Lemon juice, vinegar
3	Orange juice, cola
4	Tomatoes
5	Bananas
6	Normal rainwater
7	Urine, healthy lake
8	Pure water
9	Blood, tears
10	Seawater
11	Baking soda
12	Great Salt Lake
13	Household ammonia
14	Soapy water
	Oven cleaner
	Sodium hydroxide (NaOH)



 [Glencoe pH interactive](#)

### Important Organic Compounds

Living organisms are primarily made of large organic molecules. These large molecules are made of smaller subunits or building blocks called monomers. Monomers join together to make larger molecules called polymers. Polymers join together to make macromolecules.

Ex: Bead = monomer

Necklace = polymer/macromolecule

\*\*\*Now come up with your own!!

## Carbohydrates (Examples: Bread, pasta, sugars)

**Elements:** Carbon, Hydrogen, and Oxygen usually in a ration of 1:2:1

Example: Glucose  $C_6H_{12}O_6$

**Function:** For immediate energy source.

**Monomers:** monosaccharides (*building block/subunit*)

**Polymers:** disaccharides & polysaccharides

### Three Types:

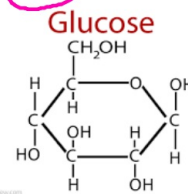
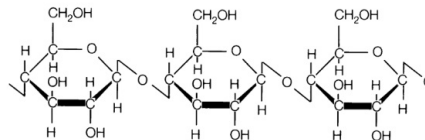
1. Monosaccharides-simple sugars like glucose, galactose, or fructose.
2. Disaccharides-sugars composed of two monosaccharides like sucrose, maltose, and lactose.
3. Polysaccharides-complex sugars. (3 or more monosaccharides put together.)



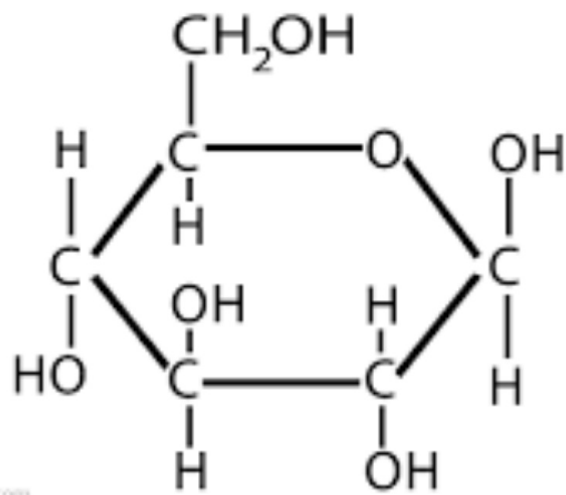
Animals store excess sugar as glycogen.

Plants store excess sugar as starches. Cellulose is a tough but flexible molecule that give plants their strength and allow them to grow tall.

cellulose



# Glucose



jn

## Nucleic Acids

**Elements:** Hydrogen, Oxygen, Nitrogen, Carbon, and Phosphorus

**Function:** Store and transmit genetic information.

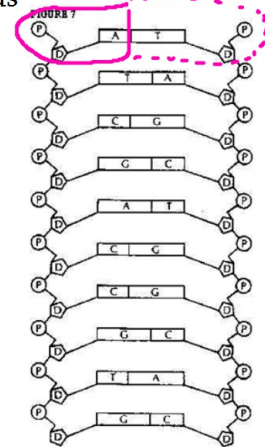
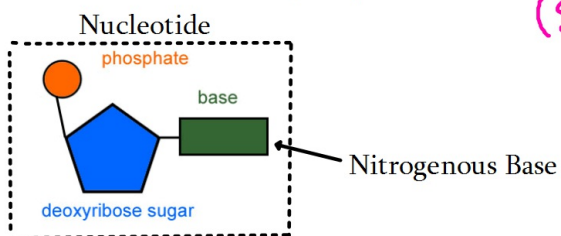
Instructions for making proteins.

**Monomers:** Nucleotides (sugar, phosphate, nitrogenous base)

**Polymers:** Nucleic Acids

### Two Types:

1. Deoxyribonucleic Acid (DNA)-contains the sugar deoxyribose. *(Double Strand)*
2. Ribonucleic Acid (RNA)-contains the sugar ribose.

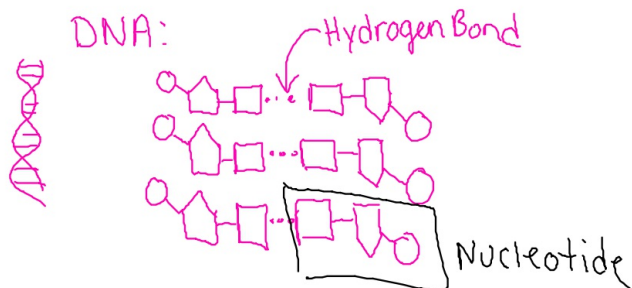


DNA- made of many nucleotides.

Nitrogen Bases:

DNA: Adenine, Thymine, Guanine, Cytosine

RNA: Adenine, Uracil, Guanine, Cytosine



### Lipids (Example: Butter, Oil, Waxes, and Phospholipids,

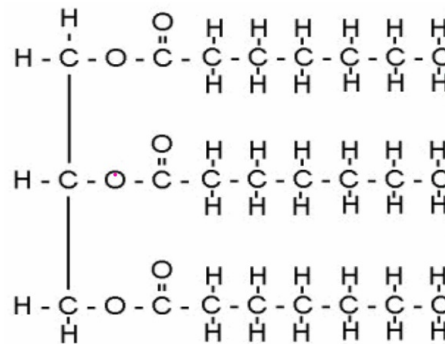
**Elements:** Carbon, Hydrogen, and Oxygen.

**Function:** Long term energy storage.

2. Are parts of the cell membranes (phospholipids)
3. Insulation
4. Steroids-are chemical messengers.
5. Waxy waterproof covering

**Monomer:** Glycerol and 3 fatty acids

**Macromolecule:** Lipids



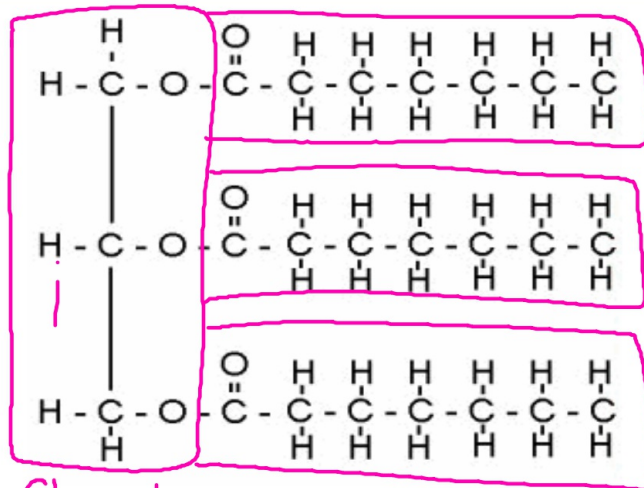
○ Lipids can be saturated or unsaturated. If they are saturated then they are a solid at room temperature. If lipids are unsaturated then they are a liquid at room temperature.

○ Lipids are not soluble in water b/c they do not mix with H<sub>2</sub>O.

Ex: saturated-butter, unsaturated-olive oil







Glycerol

Fatty Acids

## Proteins (Example: fish, meats, and eggs)

**Elements:** Carbon, Hydrogen, Oxygen, Nitrogen, and Sulfur

**Function:** 1. Control the rate of reactions.

2. Regulate cell processes

ex: hormones

3. Some are used to form bones and muscles.

4. Transport materials

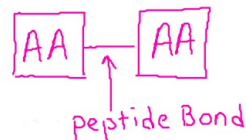
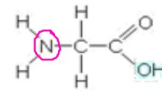
ex: transport proteins and hemoglobin

\* 5. Insulin - control the amount of sugar in your blood.

**Monomers:** Amino Acids (more than 20 different amino acids) joined by a peptide bond.

**Polymers:** Proteins / Polypeptide

Another type of protein is an **enzyme**. Enzymes act as a catalyst, which speed up chemical reactions. Enzymes end in -ase.



## Indicators

An indicator is a chemical that turns color in the presence of the substance it is testing for.

Indicators for Macromolecules:

1. **Benedict's Solution:**

- Tests for simple carbohydrates (monosaccharides). Ex: Glucose
- Changes from a light blue to an orange/green color. \*Put in warm water!

2. **Iodine/Lugol's Solution:**

- Test for complex carbohydrates (polysaccharides). Ex: Starch
- Changes from an amber or yellow color to blackish blue.

3. **Biuret's Solution:**

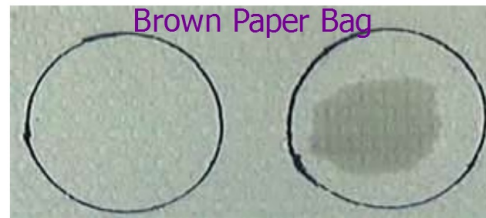
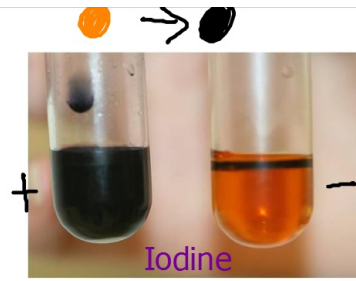
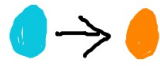
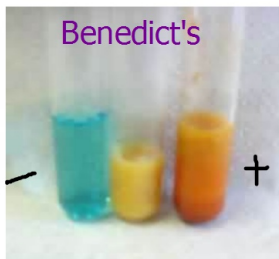
- Tests for proteins.
- Changes from blue to a purple.

4. **Brown Paper Bag Test:**

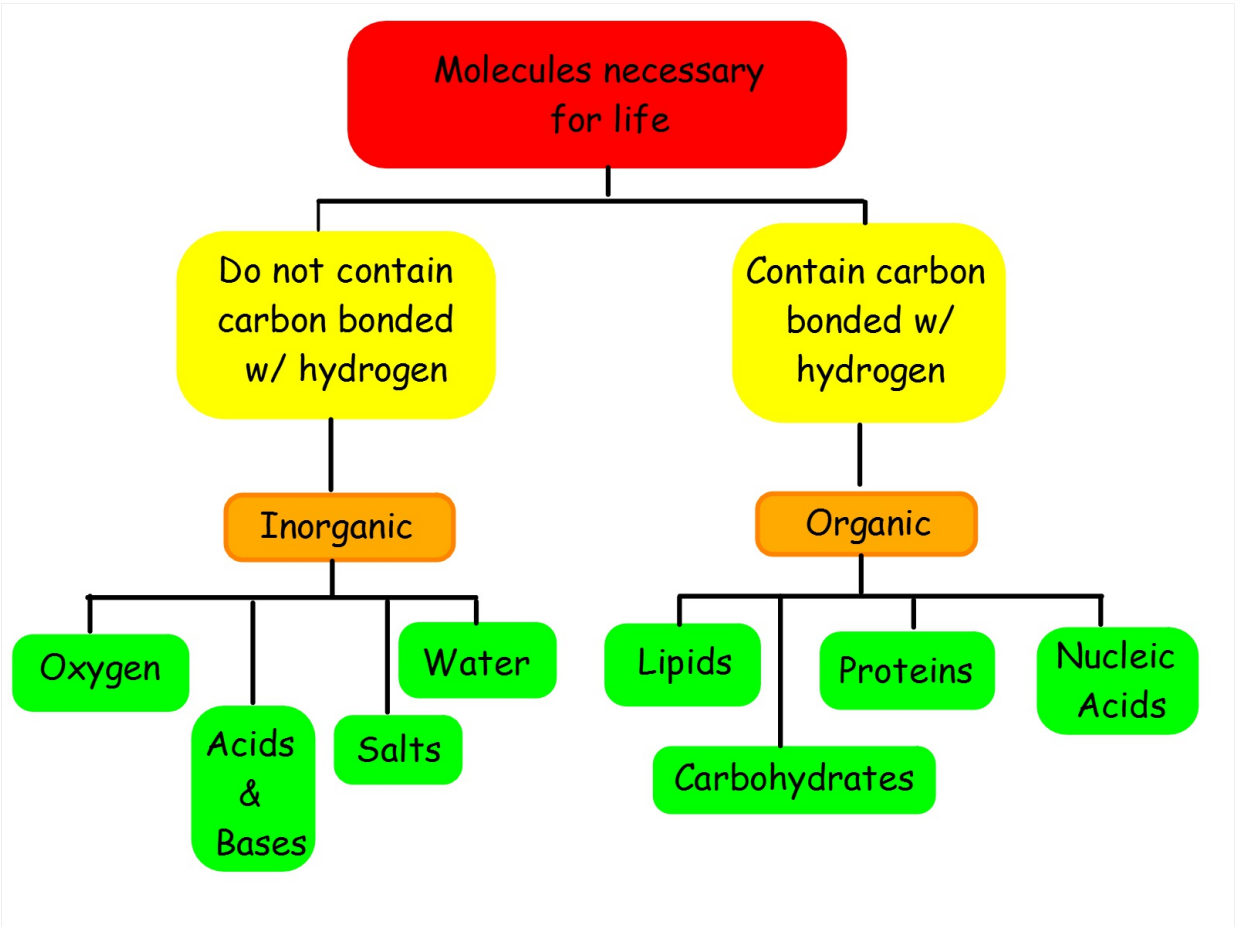
- Tests for lipids.
- Leaves a greasy spot when dry.

In your notes copy the following chart:

Indicator	Organic Molecule	Positive Result	Negative Result
Benedict's Solution			
Lugol's Iodine			
Biuret's Solution			
Paper Bag Test			



Substance	Simple Sugar (Benedict's Solution)	Complex Sugar (Lugol's Iodine Solution)	Protein (Biuret's Solution)	Lipids (Paper Bag Test)
Mt. Dew	+	-		
Peanut Butter	-	-		
Oil	-	-		
Egg Whites	-	-		
Milk	+	-		
Rice Water	-	+		
Potato	-	+		
Water (Control)	-	-		



<b>Organic Molecule</b>	<b>Function</b>	<b>Monomer</b>	<b>Elements</b>
		Monosaccharide	
			C, H, O
Proteins			
	Protein synthesis Genetic information		