BIOCHEMISTRY
(The Chemistry of Life)
PACKET 2

NFL Video Link

Organization of Life

ATOMS * combine together to make →

MOLECULES * combine together to make →

MACROMOLECULES combine together to make →

ORGANELLES may combine together to make →

CELLS may combine together to make →

TISSUES may combine together to make →

ORGANS may combine together to make →

ORGAN SYSTEMS may combine together to make →

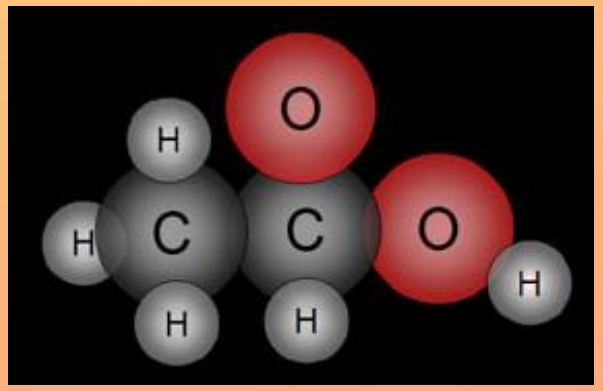
ORGANISM

-
-

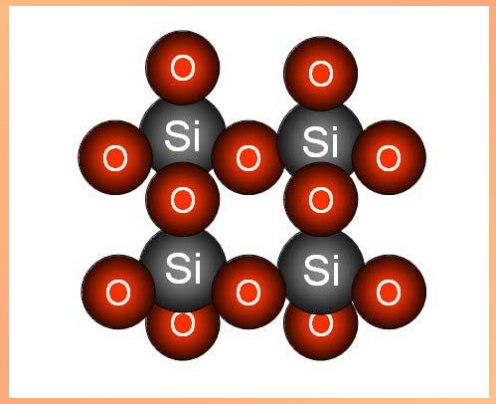
From Simple to Complex – The Building Blocks of Life

- On earth today, living things are the main source of organic compounds.
- **ORGANIC** **Compounds** –contain the element carbon and hydrogen.
- **INORGANIC** **Compounds** – **do not** contain the carbon and hydrogen together.
  - Is carbon dioxide (CO_2) organic or inorganic?

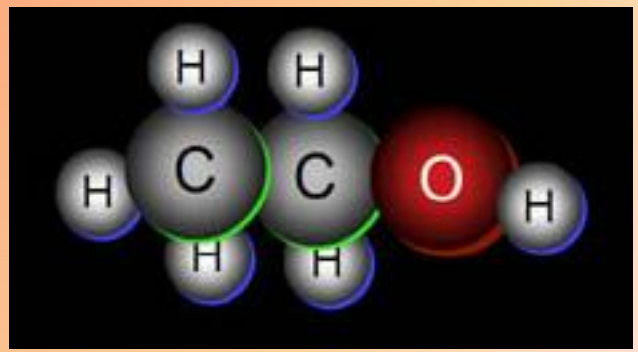
    INORGANIC
- Are these organic or inorganic compounds?



Acetic Acid
Organic

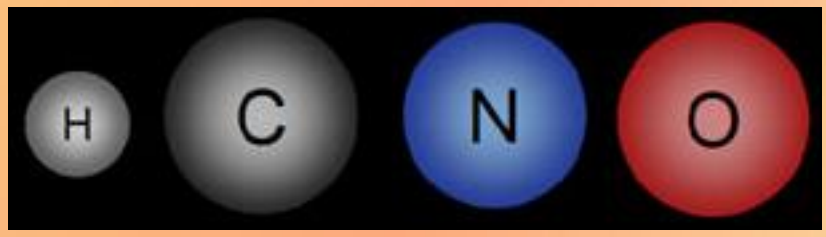


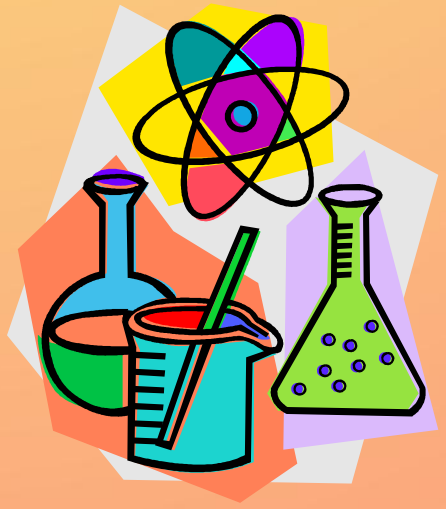
Silicon dioxide
Inorganic

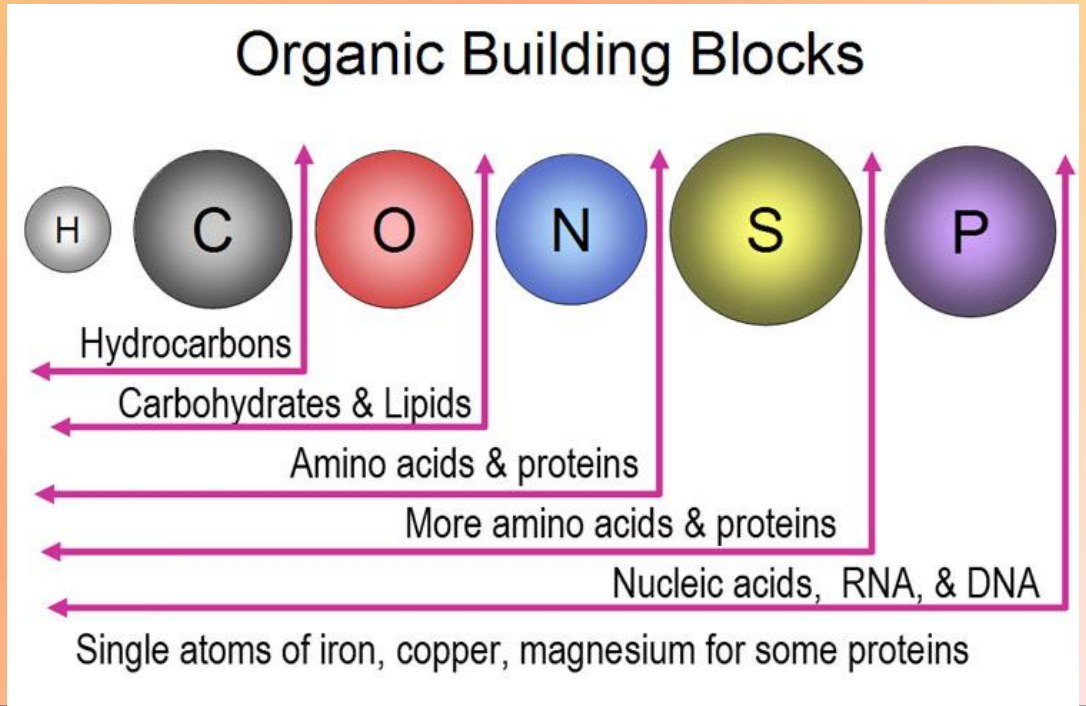


Ethanol
Organic

- The four most abundant elements in living things are **HYDROGEN, OXYGEN, NITROGEN AND CARBON** (HONC). These elements are found in the following 4 organic compounds:
  - Proteins
  - Carbohydrates
  - Lipids
  - Nucleic Acids







- **Autotroph** – such as plants are able to make their own organic compounds from inorganic compounds through photosynthesis (the chemical equation is seen below).

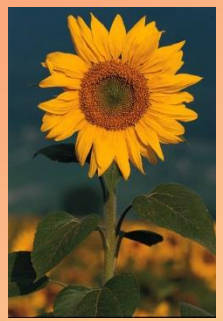
Carbon Dioxide + Water + Solar Energy → Glucose + Oxygen

$6\ CO_2$ + $6\ H_2O$ + Solar energy → $C_6H_{12}O_6$ + $6\ O_2$

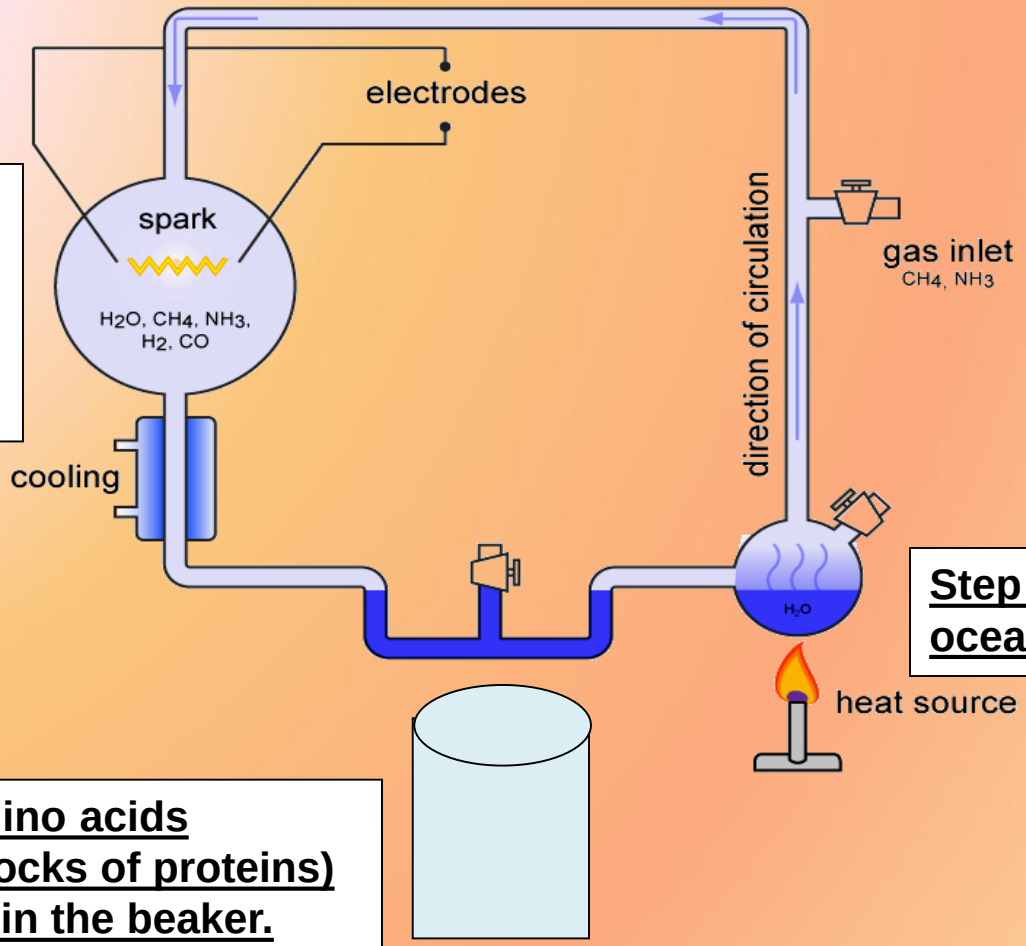
INORGANIC INORGANIC ORGANIC INORGANIC

So today, almost all organic compounds are formed **biotically** (by **LIVING** things), then the question became – **how did the first organic compounds form?**






Miller and Urey Experiment to answer how first organic compounds formed:



Step 2 – Spark is lightning in the sky that helps to combine all the reactants

Step 1 – Represents the ocean and evaporation

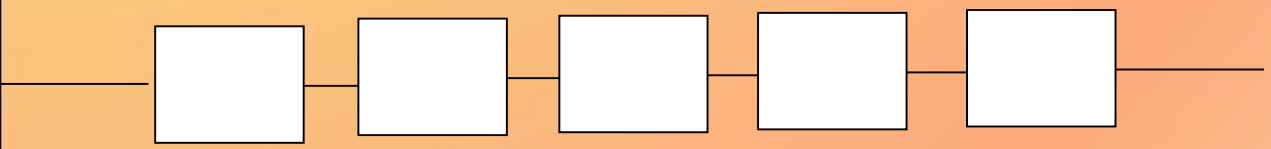
Step 3 – Amino acids (building blocks of proteins) were found in the beaker.

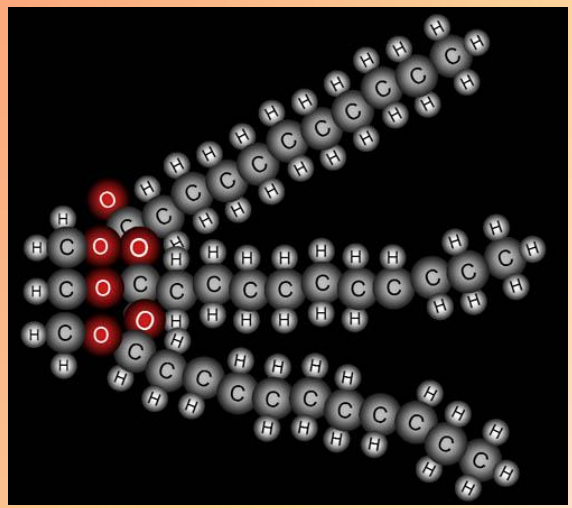
Miller & Urey's experiment provides support for the idea that conditions on lifeless, 'primordial' Earth could have allowed the spontaneous formation of more complex (organic) molecules. Since the conditions on earth are now very different, we do not see the same reactions occurring.

Important Terms to know:

- **MONOMER**: A single compound or building block used to make a larger compound.

- **POLYMER**: Many monomers joined together to form a large compound

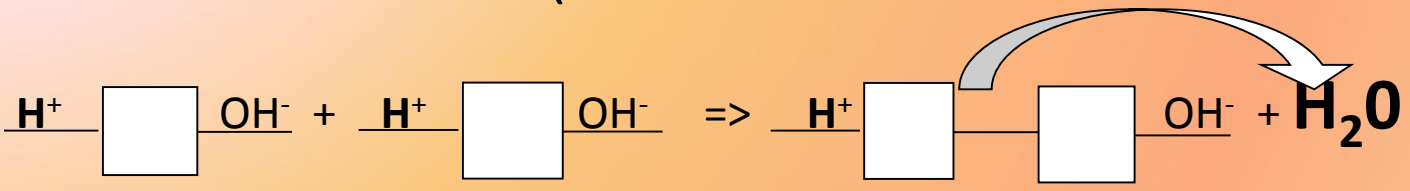




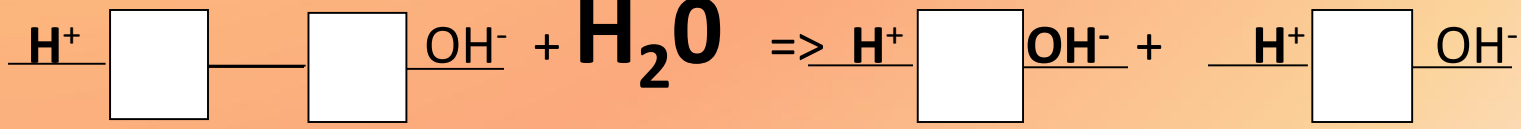
The Macromolecules Song

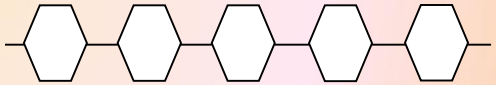
Macromolecules: Carbohydrates, Proteins, and Lipids

- **DEHYDRATION SYNTHESIS**: The process of combining small compounds to form large compounds and water molecules. (Also known as Condensation Reaction).



- **HYDROLYSIS**: **Breaking down** a larger compound (polymers) into smaller pieces (monomers)… Enzymes and water are needed to break the polymer down.





Carbohydrates

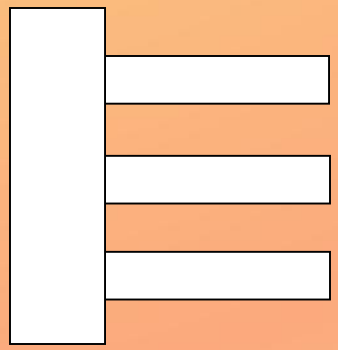
- Monomers - **Monosaccharides (sugar)** Example: **glucose**
- Polymers - **Polysaccharides**
- Examples: **cellulose** - in plant cell walls
- **starch** - how plants store extra carbs
- **glycogen** - how animals store extra carbs
- Functions **Quick energy, builds structures**
- Foods include: **Fruit, veggies, potatoes, pasta, bread**
- Indicator test:
- Sugar - **Benedict's**, Positive color is **orange**
- Starch - **Iodine**, Positive color is **black**

Lipids

- Monomers - **Fatty acids & glycerol**
- Polymers - **Fats, Oils & Waxes**

  Examples: **steroids** - such as cholesterol that makes hormones and parts of cells

  phospholipids - make up the cell membrane
- Functions **Long-term energy, insulation, water-proofing**
- Foods include: **Butter, mayo, oil, salad dressing**
- Indicator test: **Brown paper towel**, Positive color is a **Grease stain**



triglyceride

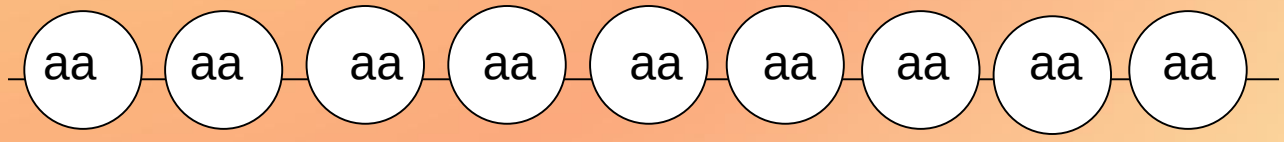
Proteins

- Monomers - **Amino acids**
- Polymers - **Polypeptide**
- Functions / Examples –

  insulin - absorb extra sugar from blood

  hemoglobin - on red blood cells, carries oxygen

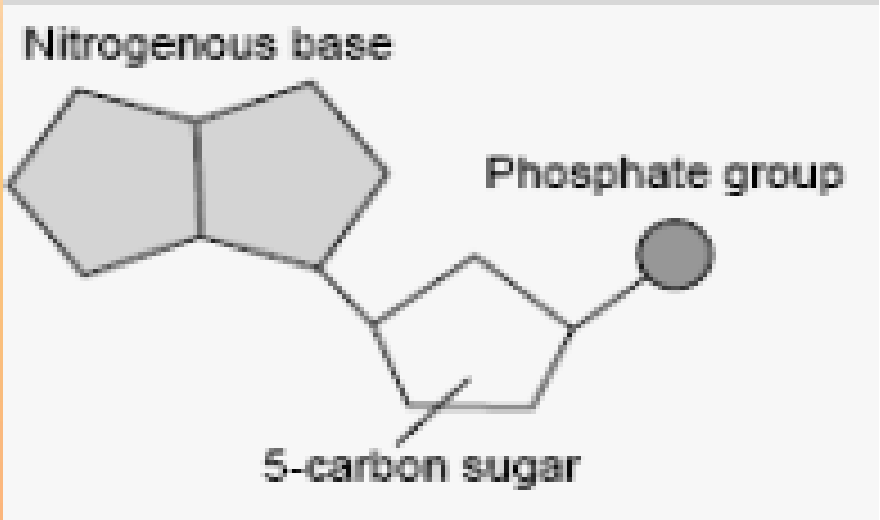
  enzymes - help with chemical reactions
- Foods include: **Eggs, meat, fish, tofu**
- Indicator test: **Biuret**, Positive color is **purple**

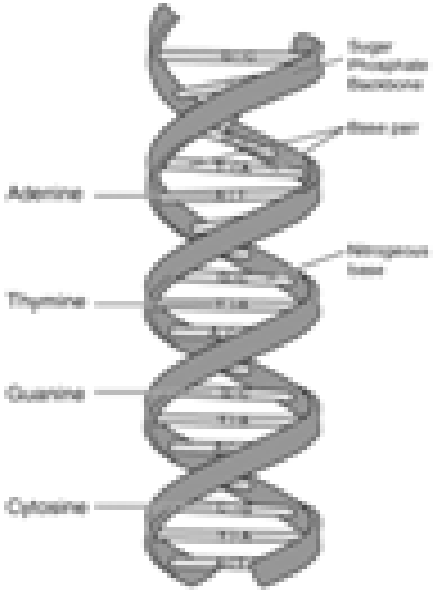


Polypeptide (protein)

Nucleic Acids

- Monomers - **nucleotides**
- Polymers - **DNA & RNA**
- Functions **Contain genetic info and help make proteins**





The Chemistry of Life…Organic Compounds

Description	Carbs	Lipids	Proteins	Nucleic Acids
1. Made up of nucleotides				
2. Most consist of three fatty acids bonded to a glycerol molecule				
3. Quick source of energy				
4. DNA and RNA				
5. Contain peptide bonds				
6. Directs the production of proteins				
7. Commonly called fats and oils				
8. Subunits or building blocks are simple sugars				
9. Made up of amino acids				
10. Used for long-term energy storage, insulation & protective coatings				
11. Help carry out chemical reactions				
12. Important parts of biological membranes (makes up most of the membrane)				
13. Transport substances in and out of cells				
14. Store & transmit hereditary information				

15. **STARCH** is how plants store excess sugar and animals store excess sugar as **GLYCOGEN**. Both are complex carbs.

16. This is a protein in red blood cells **HEMOGLOBIN**.

17. A protein that can change the rate of a reaction is an **ENZYME**.

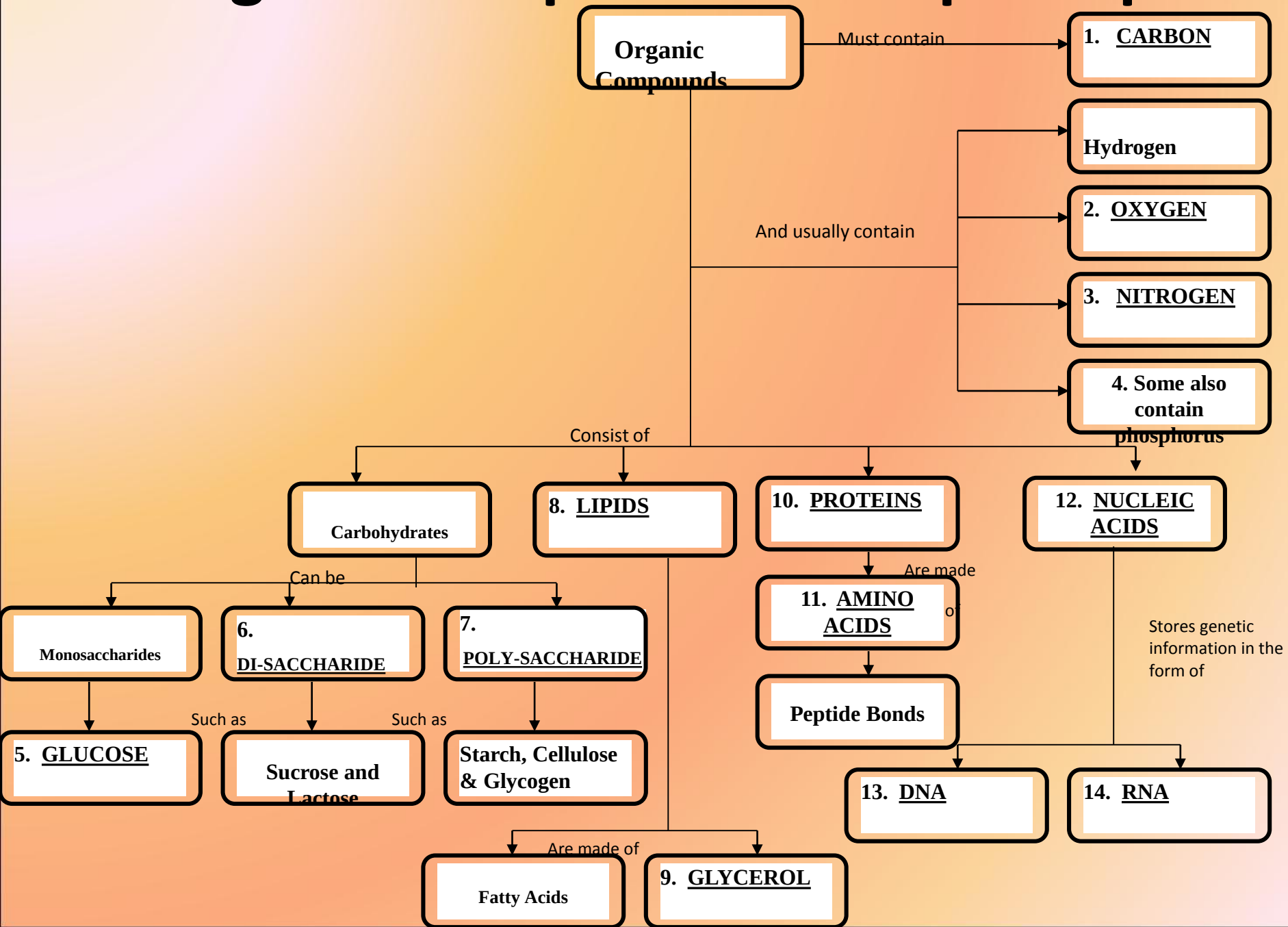
18. Triglyceride is lipid made up of a glycerol molecule and **3 (#) FATTY ACIDS**.

19. The monomers that make up nucleic acids are known as **NUCLEOTIDES**

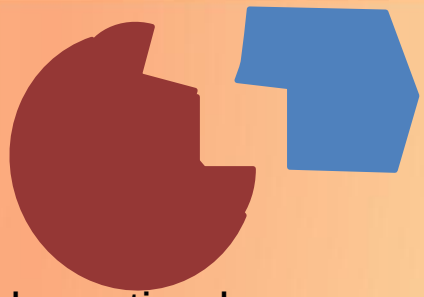
20. The two basic kinds of nucleic acids are **DNA & RNA**

21. If you see a word end in –ose (Ex: glucose, sucrose) then think **SUGAR**. If the word ends in –ase (Ex: cellulase, amylase) then think **ENZYME**.

Organic Compound Concept Map



Enzymes



- A special type of **PROTEIN**
- Function - to **SPEED UP** a chemical reaction by **LOWERING** the energy needed to start the reaction (**ACTIVATION ENERGY**)

Enzyme Animation Link

- Enzymes are **SPECIFIC** since they only work on one type of substrate.
- Enzymes are **REUSABLE** since they can be used over and over.
- Enzymes are affected by **TEMP** and **PH**. Their **SHAPE** changes so they can no longer fit with the substrate.
- **Equation for a chemical reaction (PHOTOSYNTHESIS):**

$$6\ CO_2 + 6\ H_2O + light \xrightarrow{ENZYME} C_6H_{12}O_6 + 6\ O_2$$

- **REACTANTS** → **PRODUCTS**

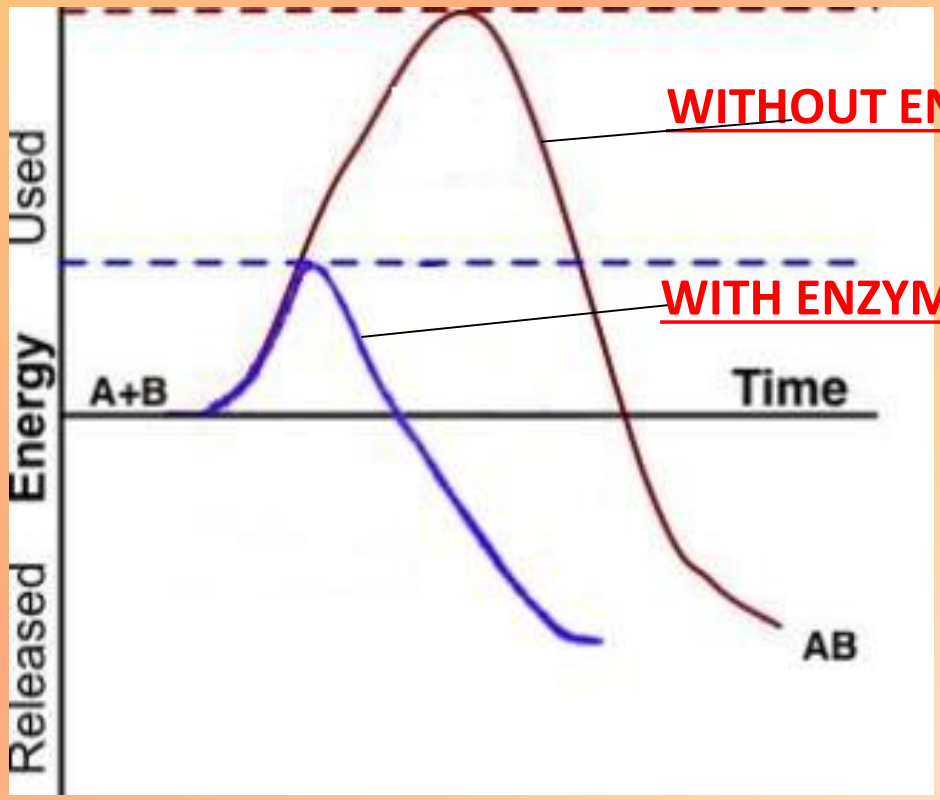
With vs. without an enzyme

Label the lines:

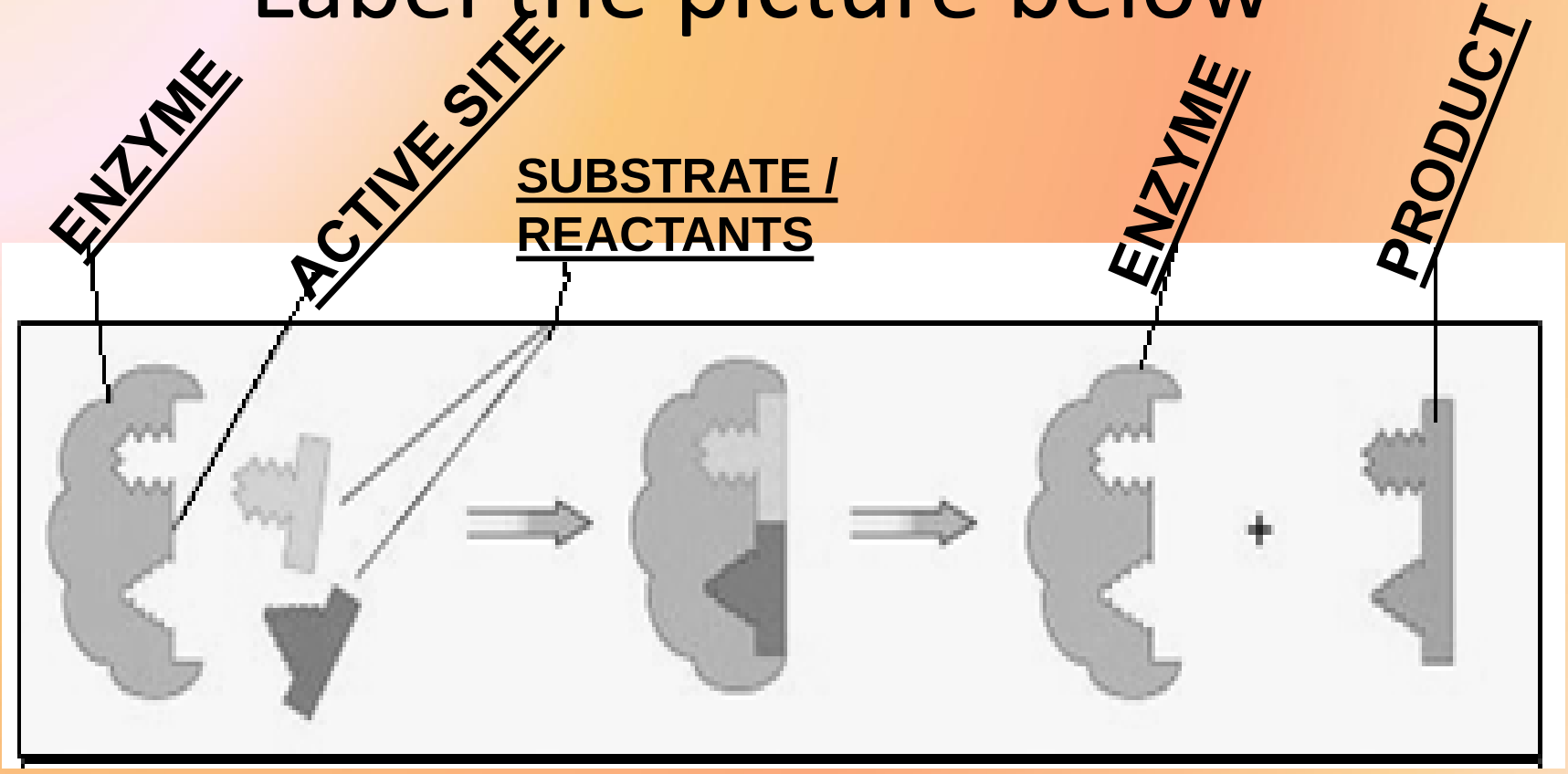
- Without enzyme
- With enzyme

How do you know?

The one with the enzyme doesn't use as much energy



Label the picture below



Enzyme Animation Link

The pH Scale

pH Scale:

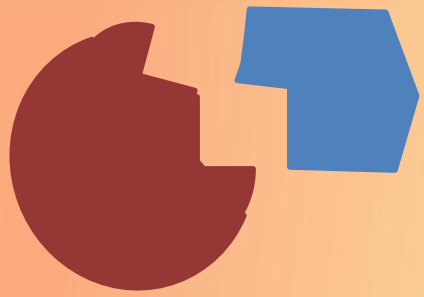
Neutral

0 ←---------- 7.0 ----------→14

STRONG acid ← **WEAK** acid **WEAK** base → **STRONG** base

- **BUFFERS** help maintain **homeostasis** by minimizing changes in **PH**. Most body systems function optimally at a pH of near **7.4**. As the pH changes **ENZYMES** may stop working, nerve and muscle activity weakens, and finally all chemical reactions are affected.

Chemical Reactions & Enzymes



Term/To Do	Definition/Picture
	process that changes one set of chemicals into another set of chemicals.
	compounds that enter into a chemical reaction
	compounds that are made by the reaction
Label the lines under the reaction with the 2 terms directly above this box.	$C_6H_{12}O_6$ + 6 O_2 → 6 CO_2 + 6 H_2O + ATP
	amount of energy needed to get a chemical reaction started
	allows a reaction to occur more quickly by lowering the amount of activation energy