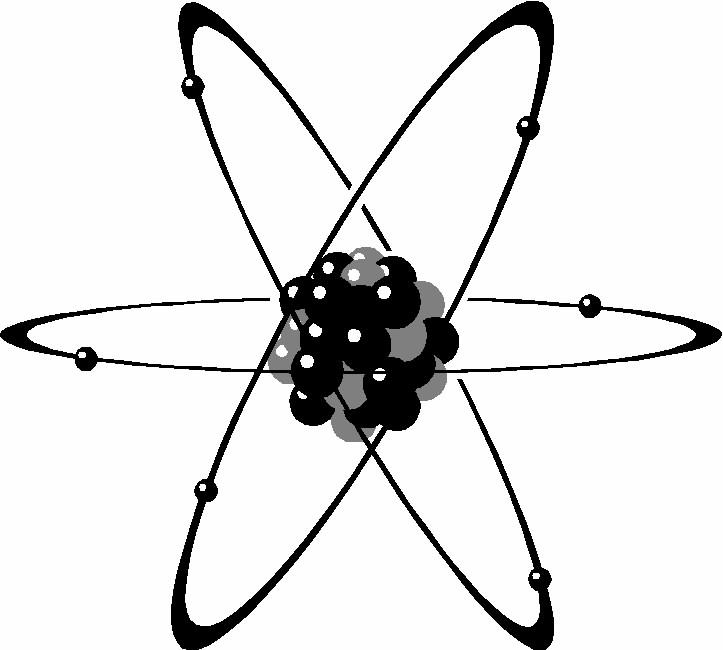
Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Unit 2 All Topics

Period: \_\_\_\_\_\_ Page: \_\_\_\_\_\_\_

**Unit 2 Notes: Biochemistry**

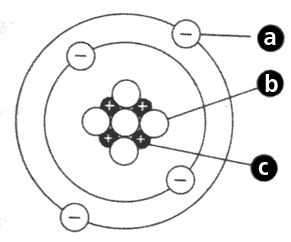
*****Topic 1: Atomic and Molecular Structure***

**Topic 1 Objectives:**

By the end of this topic, you should be able to…

* I can label an atom and it’s subatomic particles (with their charge)
* I can differentiate between different types of bonds (covalent & ionic)
* I can explain the similarities and differences between: atom, ion, element, compound, molecule
* I can list the six main elements in living things

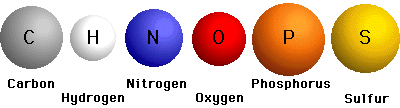
1. **Atoms**
2. What is an atom?
   * Basic unit of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * **Smallest** particle of an element that contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that element
3. Atoms are made of 3 types of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are even smaller than an atom.
   1. Proton: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge (\_\_); located \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an atom
   2. Neutron: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge (\_\_); located \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an atom
   3. Electron: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charge (\_\_); \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an atom
4. Label the Following Atom:

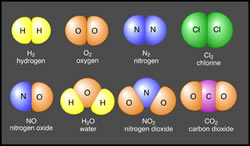


1. More about each subatomic particle:

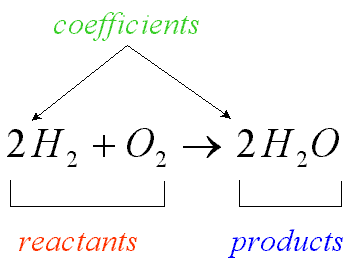
|  |  |  |
| --- | --- | --- |
| **Neutrons** | **Protons** | **Electrons** |
| * Atoms of the same element may have different numbers of neutrons   + (In this case, we are looking at \_\_\_\_\_\_\_\_\_\_\_\_ of that element) * ***Isotope:*** each of two or more forms of the same element that contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in their nuclei, and hence ***differ in atomic mass*** but not in chemical properties | * Atoms of the same element MUST all have the same number of protons in the nucleus of the element * The number of protons is also equal to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ * The number of protons is balanced by the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | * Electrons are negatively charged subatomic particles that surround the nucleus of an atom * Little to no \_\_\_\_\_\_\_\_ (negligible, not included in atomic mass) * Travel at high speeds around the nucleus * Play a large role in chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Periodic Table Information:**   * Atomic number = # of protons * Atomic mass = # of \_\_\_\_\_\_\_\_\_\_\_\_\_ plus # of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (add together everything found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) * Protons & neutrons each have a mass of 1 amu (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) * Mass of electrons is negligible, so we do not add that in | | |

1. **Elements**
2. 92 natural elements (examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Na), \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Cl), and \_\_\_\_\_\_\_\_\_\_\_\_\_ (Pb) )
3. An element is composed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. **Six** main elements in living things (in order from most abundant to least abundant):



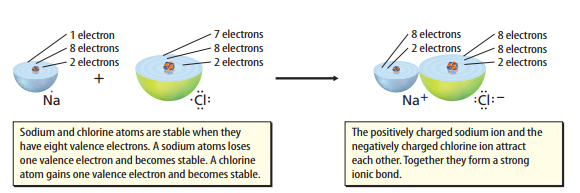
1. **Compounds**
2. Atoms are the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Elements are made of atoms of one type
4. **Compounds** are formed by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Always formed from a specific combination of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Always formed in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
      * + Ex: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Compounds are chemically joined, so they \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the elements that they are made of (H2O is very different than hydrogen and oxygen on their own)
   4. Chemical formulas are used to show the \_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of atoms of each element in the compound
5. **Molecules**
6. Atom – smallest unit of matter (repeat vocab! …must be important!)
7. Element – made of one type of atom
8. Compound – two or more elements chemically bonded together
9. Molecule – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ joined together chemically
   * + - All compounds are molecules, but not all molecules are compounds!
       - ***Draw an arrow*** pointing to the row that contains molecules that ARE NOT compounds.

**Explain your arrow:**

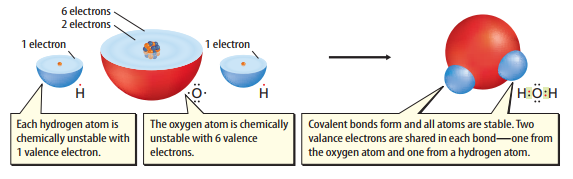
****

1. **Understanding Chemical Formulas**
2. Subscript \_\_\_\_\_\_\_\_\_\_\_ a symbol tell the number of atoms of each element
3. H2O has 2 atoms of hydrogen & 1 atom of oxygen
4. Coefficients \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a formula tell the number of molecules
   * + - 3O2 represents 3 molecules of oxygen or (3x2) = 6 atoms of oxygen
5. **Chemical Bonds**
6. Atoms in a compound are held together by chemical bonds
   1. The electrons in the outermost shell that are used to form these bonds are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. There are two types of bonds:

|  |  |
| --- | --- |
| **Ionic** | **Covalent** |
| -What happens to the electrons?  -What forms as a result?  ***Ion***: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  -Oppositely charged *ions* are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to one another  -How are positively charged ions formed?   * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   -How are negatively charged ions formed?   * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | -Two atoms combine by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons  -\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge  -Strength of bond depends on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**

Ionic Bond 🡪

**

Covalent Bond 🡪

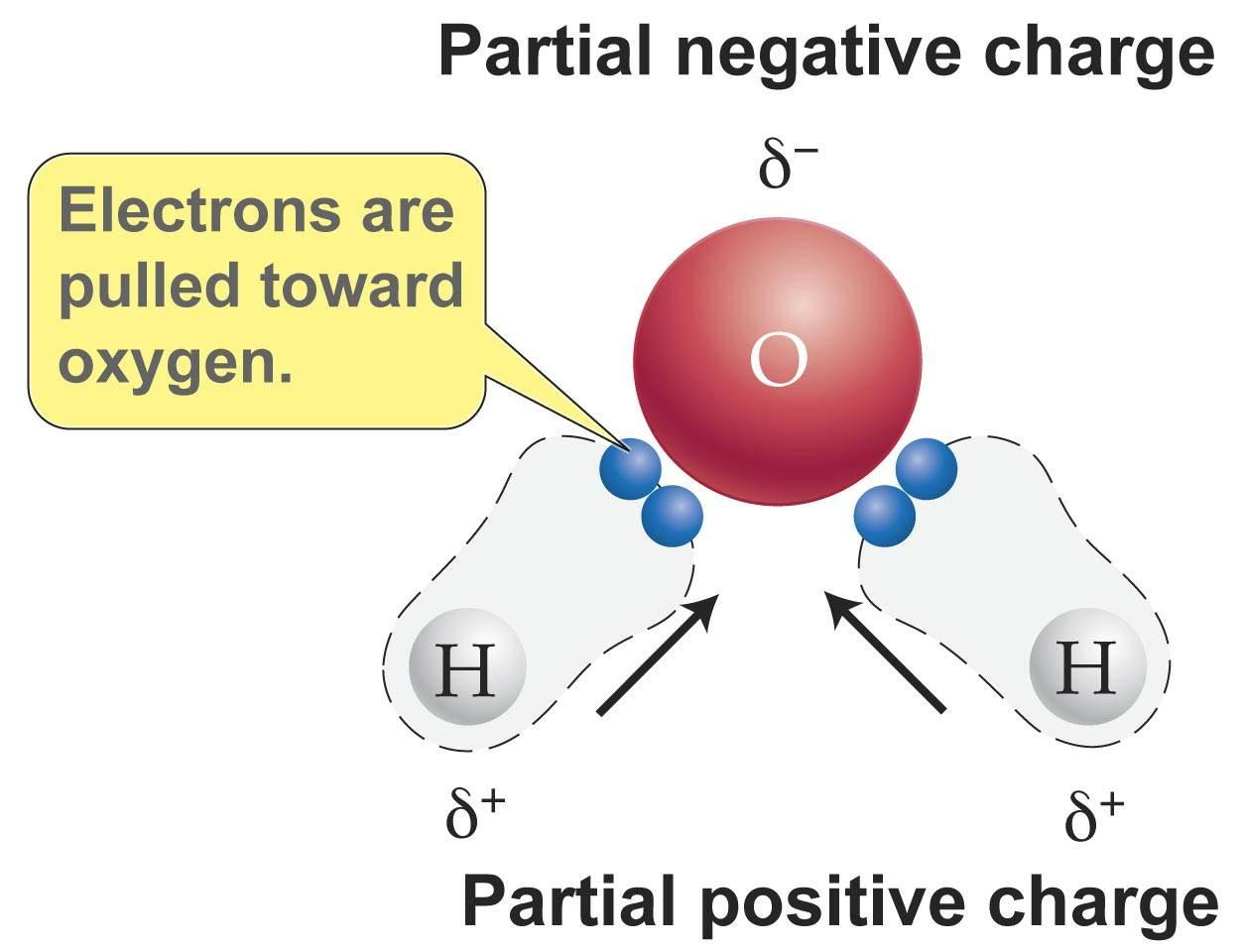
**[[*Language Target for Topic 1: I can draw and label an atom, identifying the key subatomic particles and their charge; I can compare and contrast covalent and ionic bonds; I can list the six main elements in living things.*]]**

*This language target is addressed in the Unit 1 Topic 1 Practice Worksheet.*

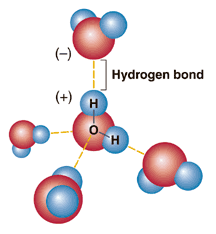
***Topic 2: Properties of Water***

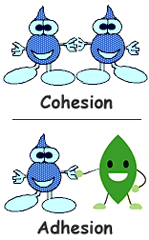
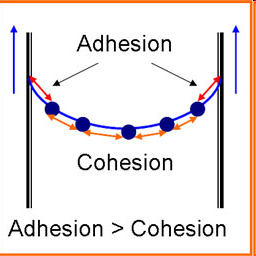
**Topic 2 Objectives:**

* I can explain what “water is polar” means
* I can explain the importance of hydrogen bonds in water
* I can list the properties of water
* I can discuss the pH scale and identify substances as acids, bases, or neutral

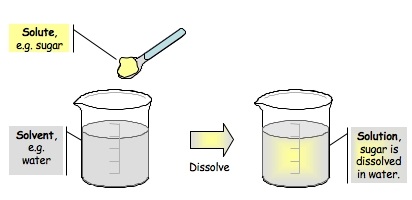
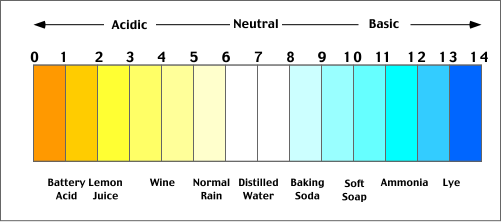
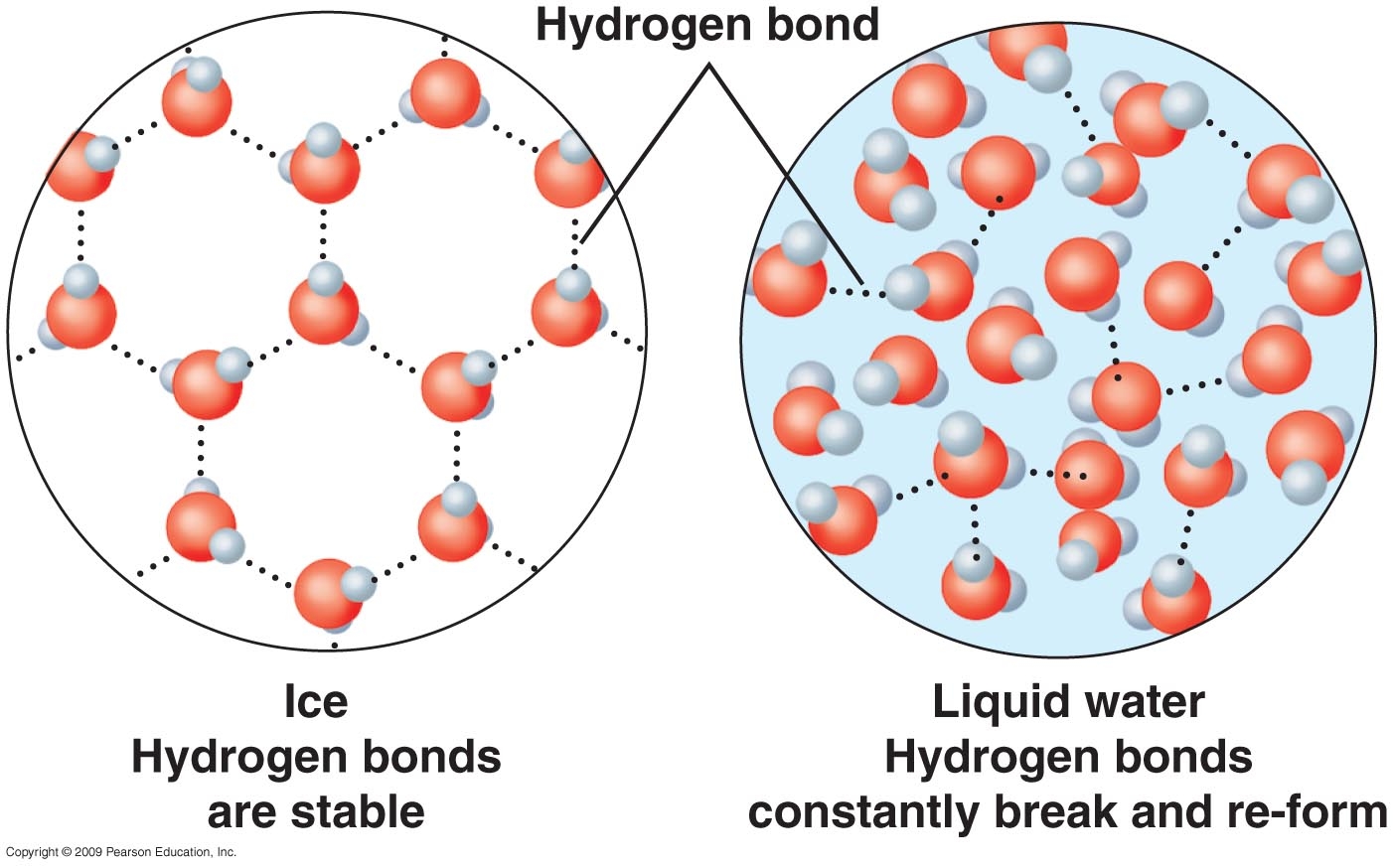
1. **A Water Molecule**
   1. Water is not alive, but understanding water is essential
      * ~2/3 the mass of a cell is water
      * Most life-sustaining reactions take place in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. 2 atoms of hydrogen linked by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to 1 atom oxygen (H2O)
2. **PROPERTIES OF WATER**
3. **Water is** **Polar (and thus can make hydrogen bonds)**
   1. The electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ distributed between the oxygen and the two hydrogen atoms.
      * This leads to positive and negative ends (opposites attract!)
   2. Oxygen has \_\_\_\_\_\_\_\_\_\_\_ protons. Each hydrogen has \_\_\_\_\_\_\_\_\_\_\_.
   3. The atom with more protons, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (8), pulls electrons \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* + - This makes oxygen slightly \_\_\_\_\_\_\_\_\_\_\_ & hydrogen slightly \_\_\_\_\_\_\_\_\_\_
  1. Molecules of water are attracted to one another and form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_
     + Opposites \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     + Water can form up to \_\_\_\_\_\_\_\_ hydrogen bonds at once.
       - Hydrogen bonds are \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_; Much weaker than ionic or covalent bonds.
  2. Draw your own diagram of what is going on in a hydrogen bond:

1. **Water Participates in Cohesion & Adhesion**
2. **Cohesion**: attraction between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules (water to \_\_\_\_\_\_\_\_\_\_\_\_\_\_)
   1. Results in **surface tension** (measure of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
   2. The surface acts like an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Explains why:
      * Water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can walk on water
3. **Adhesion**: attraction between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules (water to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
   1. Ex: Measuring water in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * Water adheres (sticks) to the glass \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * That’s why there is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_when you read the volume.
4. Cohesion (water sticking to water) and adhesion (water sticking to other substances) work together to form **capillary action**
   1. Water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Real life example: water is absorbed by the roots of plants and travels upward!*

1. **Water is a Universal Solvent**
   1. Water is often found as part of a solution which is when one substance (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) is dissolved into another (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
   2. **Universal solvent**: water dissolves more substances than \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * Again, because water is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and has hydrogen with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ends and oxygen with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ends, water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ many other substances and is able to dissolve these substances it attracts
      * General rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, so being polar, water dissolves other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ substances
      * It cannot dissolve nonpolar substances, like oils!
   3. Relevant Vocabulary
   * Solute: substance that is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (sugar)
   * Solvent: substance that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (H2O)
   * Mixture: combination of substances in which individual substances retain their own properties (sand + sugar)
   * Solution: mixture of 2+ substances in which the molecules of these substances are evenly distributed (sugar water)
   * Suspension: no dissolving occurs, but one substance separates into small pieces and remains suspended
2. **Water has a Neutral pH (7)**
3. **pH**: measure of how \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a solution is
4. pH scale ranges from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * 1. ***Acids*** form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions (H+) in water. The pH of acids is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
        + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the pH (when under 7), the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the acid
        + Examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. ***Bases*** form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions (OH-) in water. The pH of bases is \_\_\_\_\_\_\_ than 7
     + The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the pH (when above 7), the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the base
     + Examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     1. ***Neutral:*** pH is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     + ***Water has a pH of \_\_\_\_\_\_\_***
5. **Density of Water**
   1. Water is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** in its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form (ice) than its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form
      * The orientation of hydrogen bonds pushes the molecules to push further apart, lowering the density
      * Because ice is less dense, it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on liquid water
   2. Why would it be a bad thing for ice to sink in a pond?
6. **Water Has a High Heat Capacity (specific heat)**

* Water absorbs a lot of heat from the air without having a large \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Lakes and oceans often \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ air temperatures
* Water absorbs heat when it evaporates, which is why sweating helps \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* It takes a lot of heat to change the temperature of water because the hydrogen bonds between the water need to be broken!

**[[*Language Target for Topic 2: I can relate the properties of oxygen and hydrogen to the polarity of water; I can explain how water’s polarity and hydrogen bonding give it unique properties and differentiate between the listed properties of water; I can draw and label a pH scale with acid, base, and neutral.*]]**

**Part 1:**

1. Draw and label a molecule of water. Explain how many atoms are in a single molecule of water and what bonds hold these atoms together, being sure to use the term polar in your response.

**Drawing: Explanation:**

**Part 2:**

1. Explain how molecules of water stick together: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Choose three properties of water and illustrate/explain them:

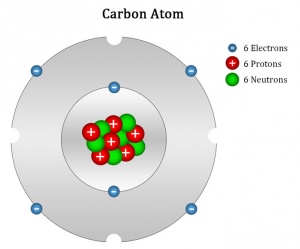


**Part 3:**

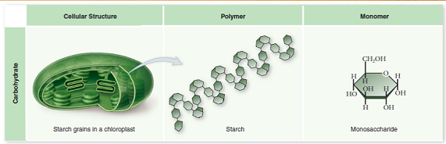
1. Draw and label a pH scale, giving at least one example of an acid/base/neutral substance.

***Topic 3: Macromolecules***

**Topic 3 Objectives**

* + I can explain what the term “organic” means
  + I can define monomer and polymer and explain how polymers are made/broken
  + I can explain what happens to molecules during the processes of hydrolysis and dehydration synthesis
  + I can identify the monomer for each class of organic compounds
  + I can identify which class of organic compounds a compound falls into when given an image
  + I can explain the function of each of the four classes of organic compounds

1. **CARBON**
2. *Revisit:* What 6 elements are most common in our cells?
3. Carbon is the backbone of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds.
   * Organic means something contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is the study of all compounds that contain bonds between carbon atoms.
4. A carbon atom contains \_\_\_\_\_\_ valence electrons in its outer shell, which means it can make up to \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ with other atoms.



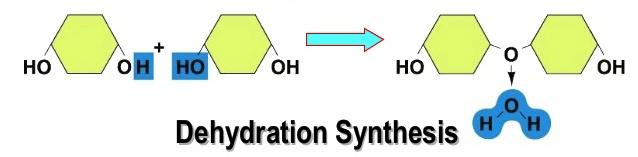
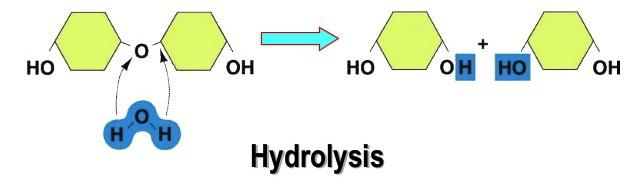
1. **MACROMOLECULES**
2. “Macro-“ means \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. In the space below, provide the definition of ***macromolecules.***

* **Macromolecules** are so large because they are made up of smaller units.
  + - **Monomer**: the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a polymer (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
    - **Polymer**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of repeating units (monomers)
    - **Polymerization**: process of linking monomers together to produce polymers

1. ***Polymerization:*** in the space below, draw a chain of monomers forming a polymer.
2. ***Dehydration/Condensation Synthesis:*** monomers are joined \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; molecules of water are released

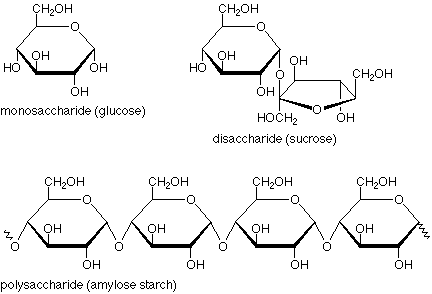
* **Dehydrate** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **Synthesis *–*** *to produce/make/combine*

1. ***Hydrolysis:*** a polymer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_into monomers when water molecules are added
   * **Hydro - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
   * **Lysis - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**



1. List the four types of macromolecules found in living things.

1) 3)

2) 4)

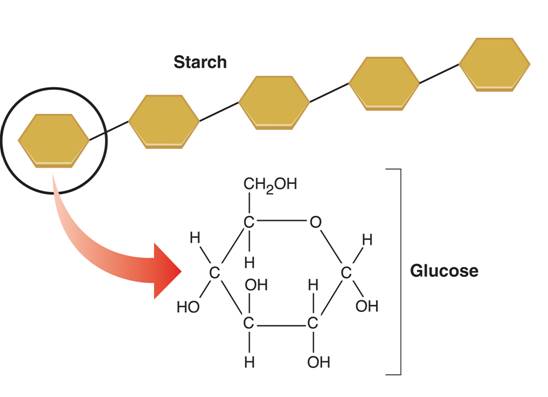
1. **Macromolecules: CARBOHYDRATES (aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)**
   1. Carbohydrates are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * Carbo – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * Hydrate – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * So, carbohydrates are made of: carbon, hydrogen, and oxygen (1:2:1 ratio)
   2. Provide the function of ***carbohydrates (sugars)***, and list the elements found in carbohydrates.

Function:

Elements:

* 1. Explain the difference between a ***monosaccharide, disaccharide and polysaccharide.*** Provide an example of each.

|  |  |  |
| --- | --- | --- |
| Monosaccharide  (MONOMER) | Disaccharide | Polysaccharide  (POLYMER) |
| Definition:  *Example (2):* | Definition:  *Example (1):* | Definition:  *Example (3):* |

* 1.  List the ***functions*** of the following three polysaccharides:

**Starch**: food storage in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (think potatoes)

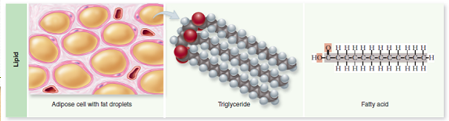
**Glycogen:** food storage in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (us!)

**Cellulose**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in plants

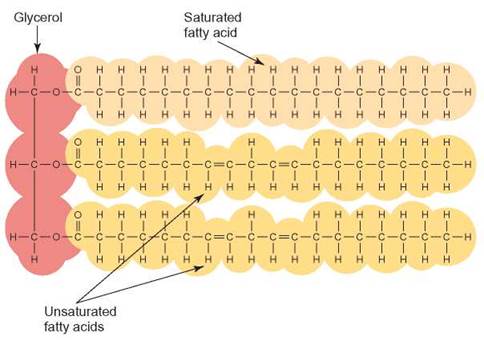
**Chitin**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in animals (insect exoskeleton!)

1. **Macromolecules: LIPIDS**
2. Provide the function of ***lipids (fats)***, and list the elements found in lipids.

Function:



Elements:



1. List 4 ***examples*** of lipid molecules (polymers):
2. Describe or draw the ***structure*** of a lipid monomer. (Triglyceride)

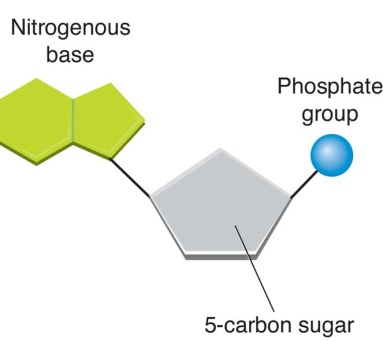
GLYCEROL AND FATTY ACIDS

1. Are ***saturated*** or ***unsaturated*** fats worse for your health? Why?
2. **Macromolecules: NUCLEIC ACIDS**
3. Provide the function of ***nucleic acids***, and list the elements found in nucleic acids.

Function:

Elements:



1. Explain how a ***nucleotide*** relates to ***DNA*** and ***RNA.***
2. Nucleotides are the building blocks, or **monomers,** of nucleic acids. Label the parts of a nucleotideon the diagram below.

4. List the functions of the **polymers** ***DNA*** and ***RNA.***

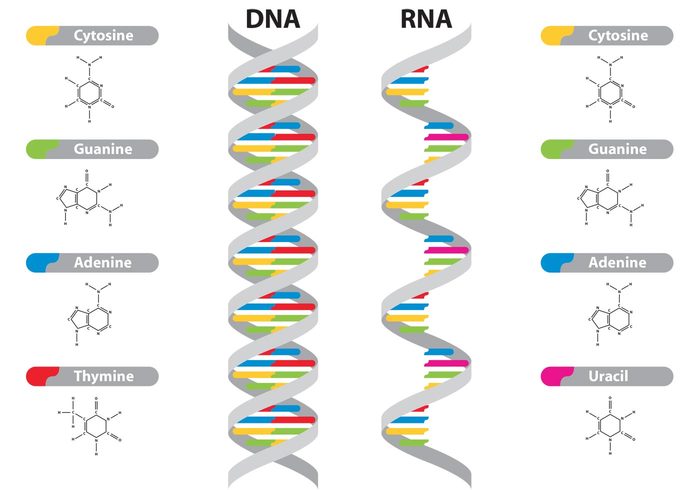
**DNA**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ acid
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an organism’s genetic code

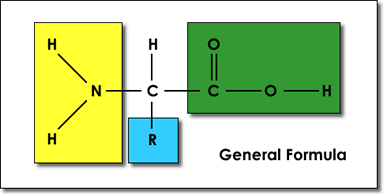
**RNA**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ acid
* Copy of DNA (able to leave nucleus)
* Plays major role in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Look at the DNA and RNA molecules below. List two differences between these two molecules.



1. **Macromolecules: PROTEINS**
   1. List the **elements** founds in proteins:
   2. **Functions** of proteins:
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (hail, nails)
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (hemoglobin)
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (muscle fiber)
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (antibodies)
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (hormones and enzymes)
   1. What is the ***monomer of proteins*** and what is its general structure?
   2. There are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ different amino acids that can be bonded together in many different ways to make all of our proteins!
   3. Label the diagram to the right with the ***4 parts of an amino acid*** that are bonded to a ***central carbon atom***



1) Carboxyl Group

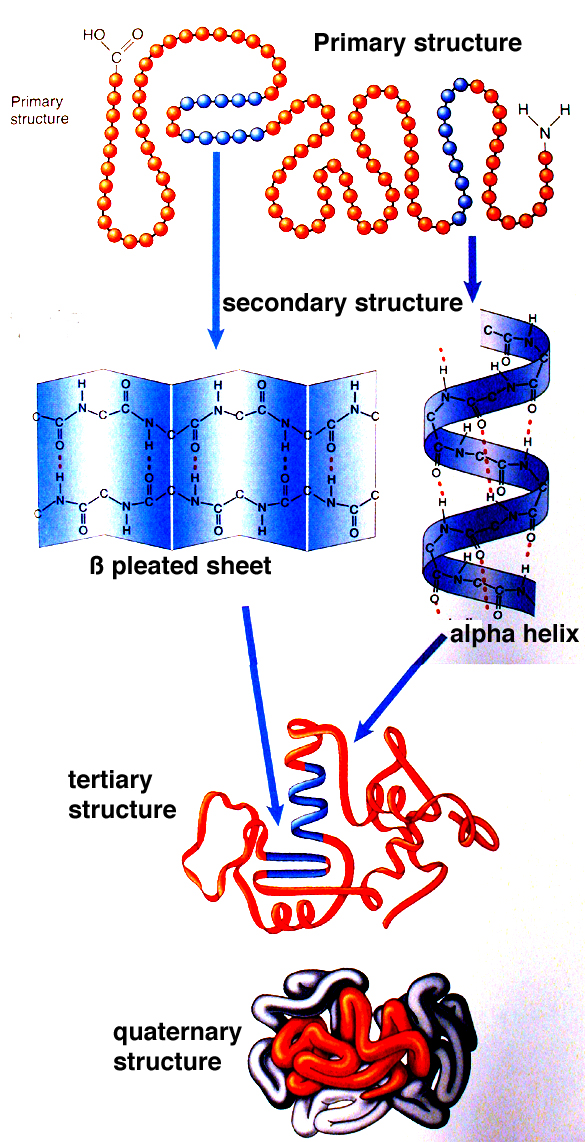
2) Amino Group

3) Hydrogen Atom

4) R-Group (changes!)

1. What is the **polymer** of proteins?
2. ***Polypeptide***: a chain of amino acids linked together (polymer)

* Amino acids are connected through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds
* **Proteins** are made of two or more polypeptides folded around each other into complex structures

1. ******Four levels of protein structure (draw a line to match each one with the picture)
2. Primary
3. Secondary
4. Tertiary
5. Quaternary

**[[*Language Target for Topic 3: I can identify an organic compound as one containing carbon; I can create a table identifying the function, structure, polymers, and monomers for each of the four classes of macromolecules.*]]**

**Part 1:**

1. Define the term “organic,” and provide examples of organic compounds: Organic means containing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The four classes of organic compounds are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

***Part 2:*** *The chart for part two will be completed on a separate worksheet.*

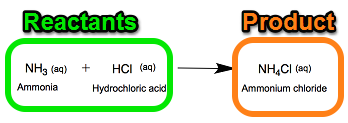
***Topic 4: Enzymes***

**Topic 4 Objectives**

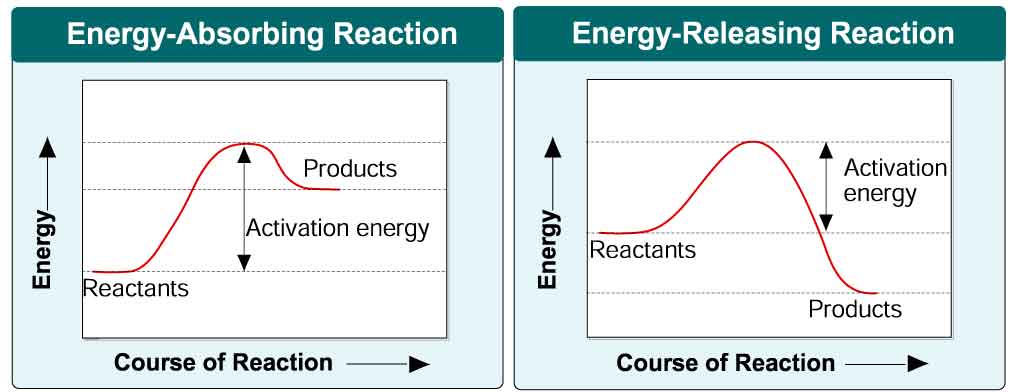
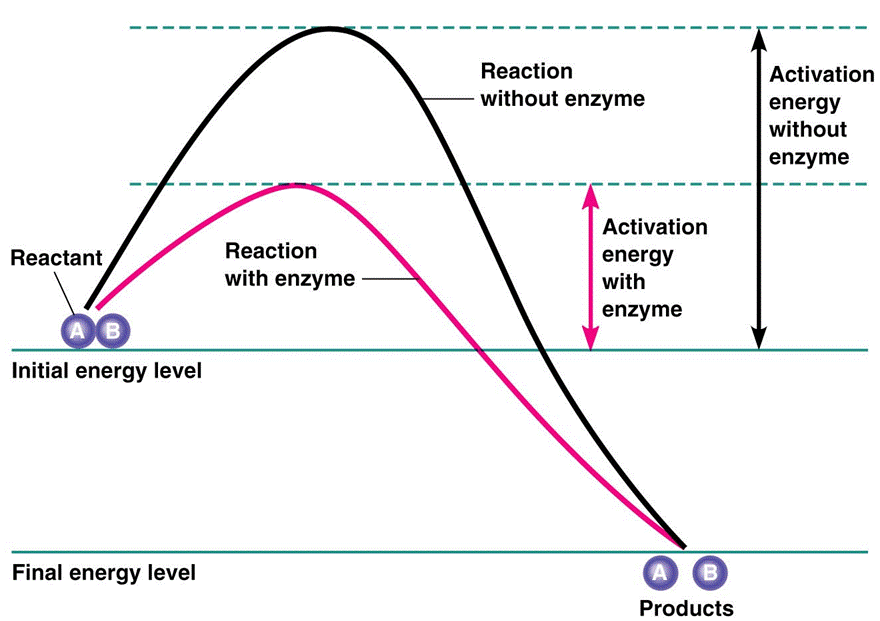
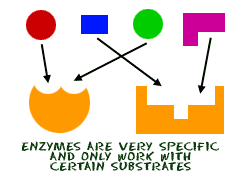
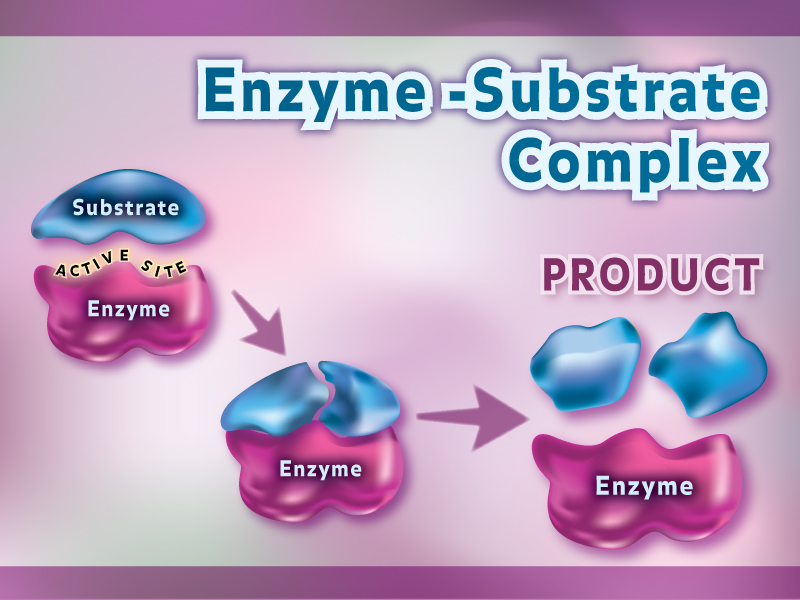
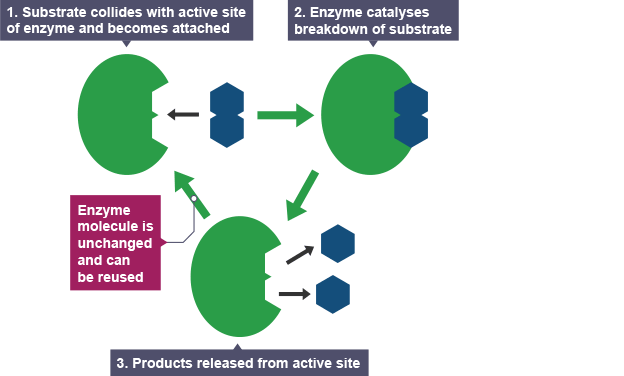
* + I can identify the components of a chemical reaction (products and reactants/substrates)
  + I can construct a graph detailing enzyme reaction data
  + I can describe the function of an enzyme
  + I can explain the importance of shapes in active sites on an enzyme
  + I can explain how enzymes speed up chemical reactions (act as biological catalysts)

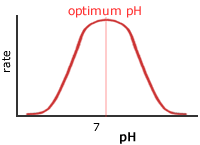
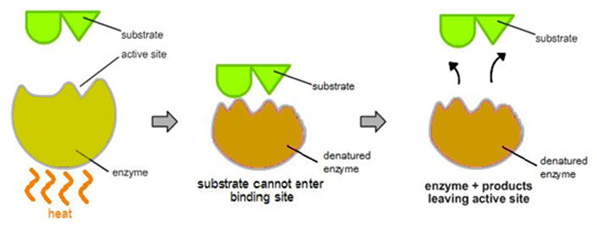
1. ***Why Study Chemistry in Biology?***

* In order to understand how an organism functions, we need to understand the reactions that take place in that organism.
  + Growth, response to stimuli, sensing, taking medicine to control regulation… all of this is chemistry!

1. ***Chemical Reactions***
   1. A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a process that changes one set of chemicals (the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) into another set of chemicals (the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
      * *Reactants*: what you \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * *Products*: what you \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Chemical reactions always involve the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of bonds in the reactants and products.

\*Note: *In chemical reactions, you can either put reactants together or break them apart. Your product can be one final product or many individual pieces.*

1. ***Energy in Reactions***
2. Some chemical reactions \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy and others \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.
   * + *Exothermic:* energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (digestion)
     + *Endothermic:*energy is ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** (synthesis)
3. Most reactions will require a certain amount of energy to get started. This energy is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. *Highlight the* ***activation energy*** *on the energy diagrams below:*
5. ***Role of Enzymes***
6. Some chemical reactions that make life possible are too \_\_\_\_\_\_\_\_\_\_ or have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are too high to make them practical for living tissue.
7. The role of enzymes (a.k.a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) in our cells is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!
   * + Remember, **activation energy**: the amount of energy required to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a reaction
     + Enzymes names often end in --\_\_\_\_\_\_\_\_\_\_\_
8. In biology, we like to say “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”
   * + So, the form (shape) of an enzyme impacts its role. This is important for the next section.
9. *The diagram to the right shows the effect of enzymes on activation energy in a reaction. The higher line represents the reaction without an enzyme present, which requires more activation energy. The lower line represents the reaction with an enzyme, showing a lower activation energy which means the reaction can happen faster.*
10. ***Enzyme Action***
11. Enzymes provide a site where the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ can be brought together to react. This site reduces the energy needed for reaction.
12. In an enzyme-catalyzed reaction, the reactants are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
13. Each enzyme has a specific shape and a specific portion called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, where substrates bind.
14. The substrates must fit exactly into the active site. This is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ model.
15. When the substrates are fitted into the active site of the enzyme, the whole thing is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
16. Once the reaction (breaking or forming bonds) is complete, the enzyme releases the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the reaction.
    * + The enzyme is not “used up.” When the reaction is complete, the products are released and the enzyme is available to bind with another substrate again.
17. Enzymes can \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_ substrates into products.
18. List 4 Roles of Enzymes:
19. *In the space below, draw an* ***enzyme-catalyzed reaction****. Make sure to label the* ***enzyme, substrate, enzyme-substrate complex, active site, and products****.*
20. ***What happens if an enzyme changes shape?***
21. We call this a “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” enzyme/protein.
22. When the shape changes, the substrate(s) will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the active site, so the enzyme will no longer function.
23. Enzymes work best in certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ranges. The best pH or temperature is said to be “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”
24. Changing this optimum environment too much leads to enzyme \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

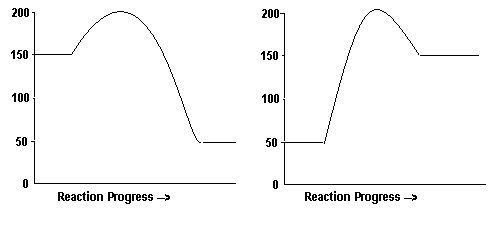
 

1. ***Factors that affect Reaction Speed***
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – compete for space in the active site
   * + Slow down reaction
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – higher temp = faster reaction speed (to a point)
   * + Can get too hot and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein structure
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – enzymes work best at a particular pH
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – higher substrate = faster reaction speed (to a point)
   * + There is a point where it levels off because all the enzymes are already working as fast as they can!

**[[*Language Target for Topic 4: I can construct an appropriate graph for enzyme reaction data and explain the role of enzymes on the reaction rates; I can explain the importance of enzymes and their role in reactions to a peer.*]]**

**Part 1:**

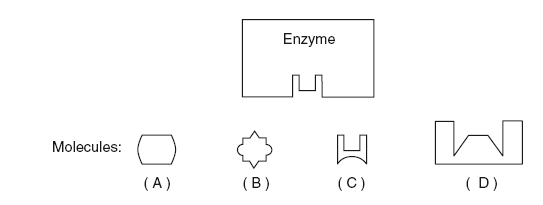
1. On the graph below, identify the products, reactants, activation energy, and amount of energy released/absorbed. Calculate the Activation Energy of each and identify it as endo- or exo- thermic. Then on each graph, sketch ***what the curve would look like if an enzyme was used.***



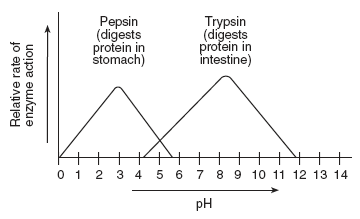
Activation Energy: Activation Energy:

Endothermic or Exothermic? Endothermic or Exothermic?

Draw the line for what an enzyme would do. Draw the line for what an enzyme would do.

**Part 2:**

1. The enzyme would most likely affect reactions involving which of the molecules pictured?
2. How does an enzyme work?
3. What is the optimal pH for both enzymes?



Pepsin:

Trypsin:

Definition of optimal:

1. Using the pepsin and trypsin graph above, compare the rate of the pepsin-catalyzed reaction at pH of 3 with the rate of the trypsin-catalyzed reaction at pH of 3.