

Name \_\_\_\_\_ Mods. \_\_\_\_\_

## Organic Molecules Lab

**Introduction:** Organic molecules are the chemicals that sustain biological processes in all living things. These compounds are always made up of more than one type of element and must be synthesized by living organisms.

What makes an organic molecule different from an inorganic molecule is that organic molecules **MUST** contain carbon-hydrogen bonds, whereas inorganic molecules do not.

The four major types of organic molecules are carbohydrates, lipids, proteins, and nucleic acids. In this lab you will construct and study carbohydrates, lipids and amino acids (which are the building blocks of protein).

**Materials:** Model building set:

- White plastic tubes = covalent bonds
- **H** (Hydrogen) = white spheres
- **O** (Oxygen) = blue spheres
- **N** (Nitrogen) = red spheres
- **C** (Carbon) = black spheres

**Procedure:** *Follow the steps outlined for each type of molecule below and answer the questions associated with each molecule.*

**Molecule # 1 Water (H<sub>2</sub>O)** ~ *An **INORGANIC** molecule necessary for life.*

- Use the modeling kit to build a molecule of water.
- Draw a colored picture of the water molecule in the space provided below.



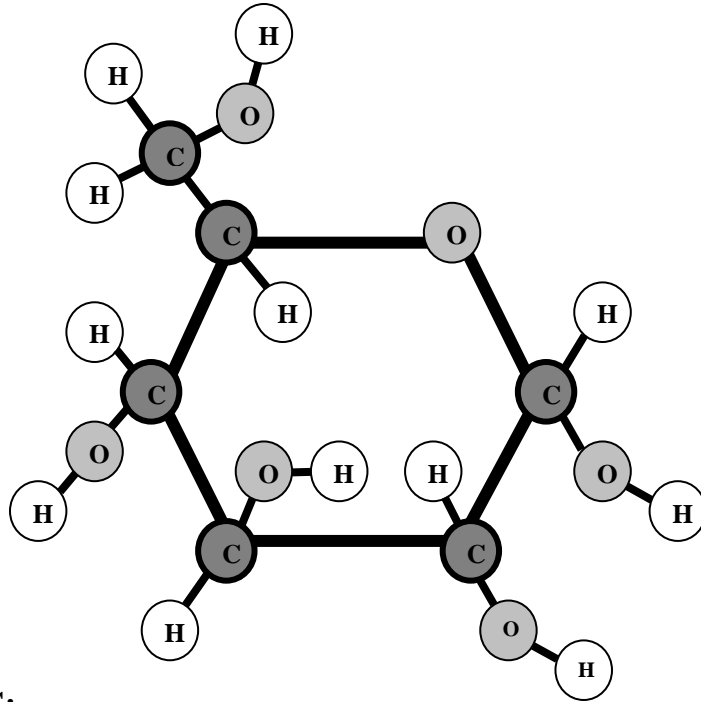
### QUESTIONS:

1. What elements (atoms) make up a molecule of water?
2. What do the white straws represent in the model?
3. In the formula for water, what does the small 2 (subscript) following the H mean?
4. In the formula for water, why is there no subscript following the O?
5. Even though water contains two of the elements found in organic compounds why isn't it considered to be an organic compound?
6. What is the ratio of hydrogen to oxygen in a water molecule?

## Molecule #2 Carbohydrates

### A. Simple sugars (a.k.a. *monosaccharides*)

Below is a diagram of glucose (a common monosaccharide). Use your modeling kit to make TWO separate molecules of glucose.



#### QUESTIONS:

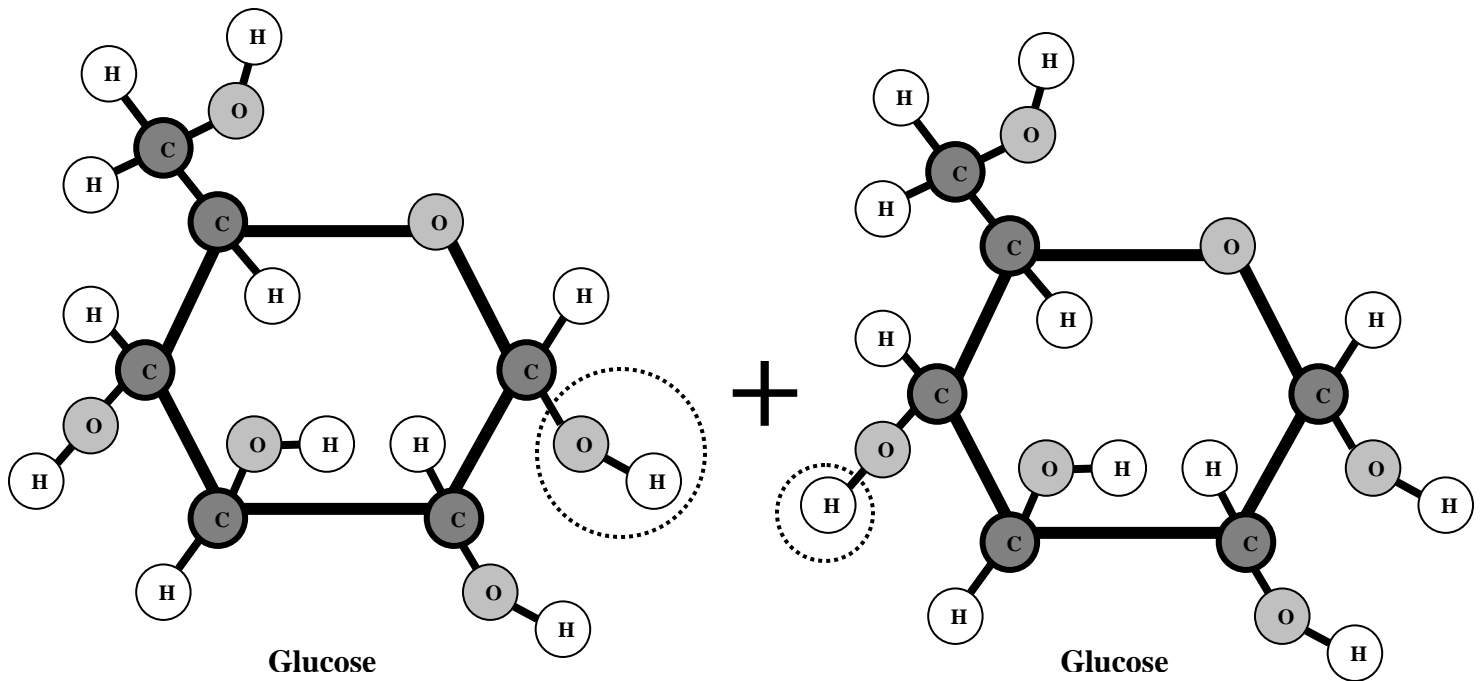
1. What elements make up a molecule of glucose?
2. What is the chemical formula for glucose?
3. What is the ratio of Hydrogen atoms to Oxygen atoms in glucose?
4. How does the ratio of Hydrogen atoms to Oxygen atoms in glucose compare to the ration of H:O in water?

### B. Disaccharides (“Two sugars”):

- Disaccharides are formed when two monosaccharides bond together
- The type of *reaction* that bonds the sugars together is called ***dehydration synthesis***.

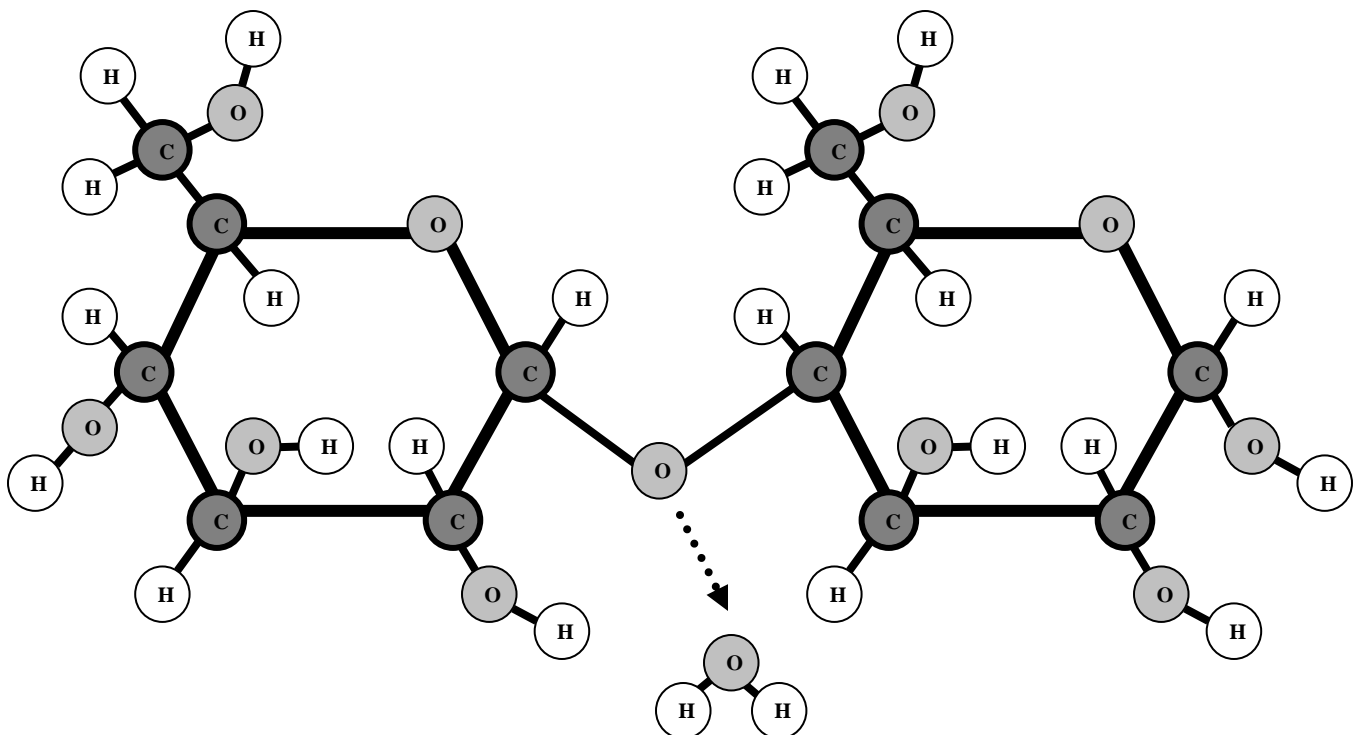
→ Use your text to find a definition of ***dehydration synthesis***:

The following diagram shows two molecules of glucose bonding together to become a *disaccharide* through the process of *dehydration synthesis*:



*Carefully study the diagram above* and notice that an O-H of the glucose on the left is circled and that an H is circled on the glucose on the right. ***This is where the bonding will take place to join these two molecules.***

When the two molecules are joined together they are called *Maltose* which is a *disaccharide*.



### QUESTIONS:

1. What is the molecular formula for your disaccharide?
2. How does the ratio of H:O atoms in your disaccharide compare to the H:O ratio in glucose and in H<sub>2</sub>O?

### C. Polysaccharides (“Starch” ~ 100’s of bonded monosaccharides)

→ Join up with another group and, using the process of *dehydration synthesis* bond your maltose molecules together.

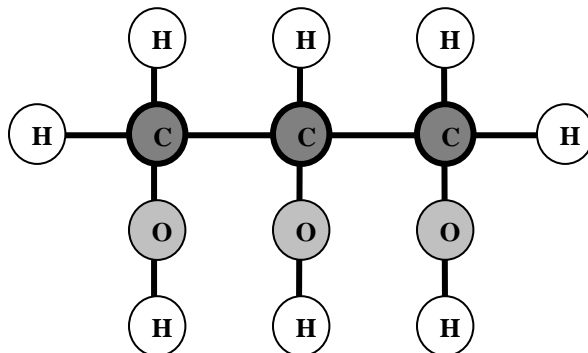
### QUESTIONS:

1. What is the molecular formula for your polysaccharide?
2. What is the H:O ratio in your polysaccharide?
3. Monosaccharides, disaccharides and polysaccharides are all *carbohydrates*. Considering the ration of H:O in all of these types of molecules, *why is carbohydrate a fitting name for these type of molecules?*

### Molecule #3 Lipids (fats and oils):

Background: Lipids are made up of two building blocks (**glycerol** and **fatty acids**). Study the diagram of both of these building blocks below and then create a lipid molecule using your modeling kit.

Glycerol can only take one form as shown here:

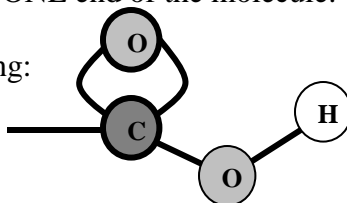


#### QUESTIONS:

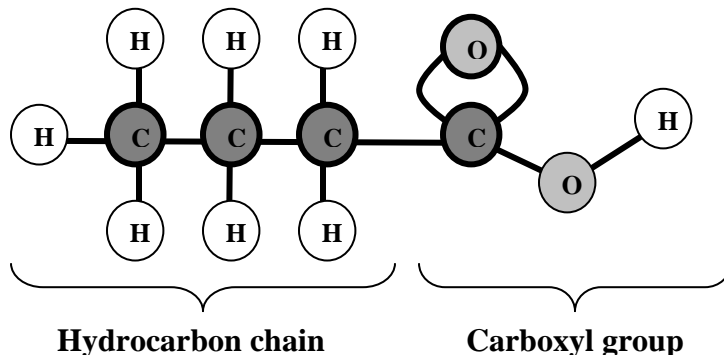
1. What is the chemical formula for glycerol?
2. What is the ratio of H:O in glycerol?
3. How does this ratio of H:O atoms in glycerol compare to the ratio of H:O atoms in carbohydrates?

Fatty Acids can take on a variety of forms. The distinguishing characteristic of ALL fatty acids is a **carboxyl group** found on ONE end of the molecule.

A **carboxyl group** looks like the following:



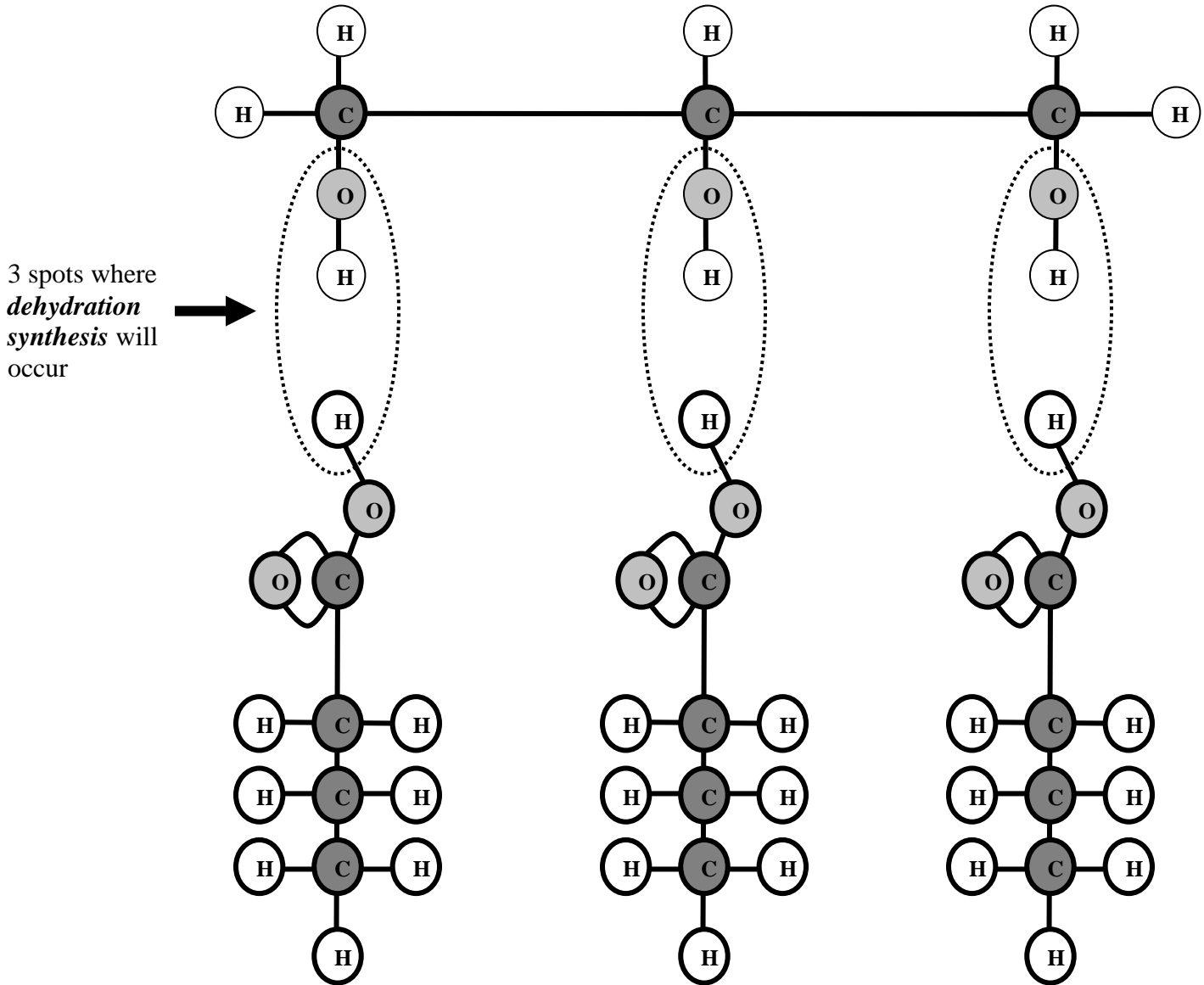
A **fatty acid** looks like the following:



It may help you to think of a **fatty acid** as a **hydrocarbon chain** with a **carboxyl group** on one end.

**To make** a lipid molecule:

1. Create three fatty acid molecules – Your lab group may have to work with another group - there aren't enough of some elements for each group to construct their own lipid.
2. Create one glycerol molecule
3. Using *dehydration synthesis* (3x) link each of the fatty acid molecules to the glycerol in the PROPER locations as shown below:

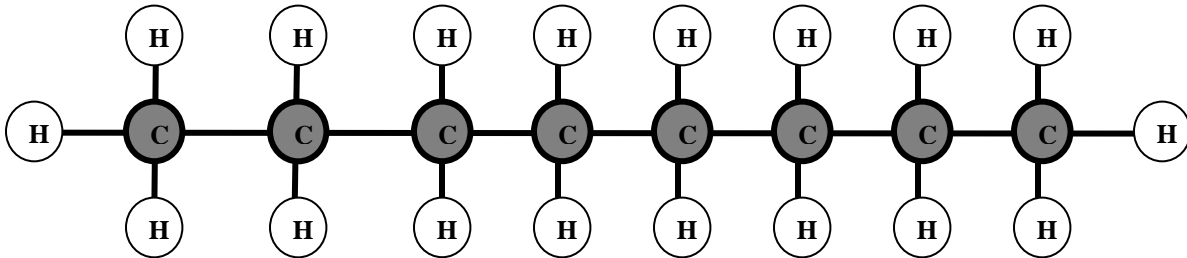


Refer to your completed lipid molecule to complete this section of the lab:

**QUESTIONS:**

1. How many molecules of water are formed in the *dehydration synthesis* needed to create one lipid molecule?
2. What is the chemical formula for the lipid you created?

3. What is the ratio of H:O in the lipid molecule you created?
4. How does the H:O ratio in lipids compare to the H:O ratio in carbohydrates?
5. The chemical formula for gasoline is C<sub>8</sub>H<sub>18</sub>

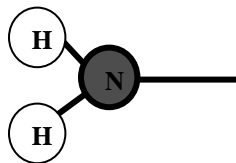


6. Which molecule appears to be more similar to gasoline, glucose or a fatty acid?
7. Considering that gasoline is a molecule that stores a TREMENDOUS amount of energy, what does this suggest about the amount of energy stored in glucose, compared to a fatty acid (and a fat)?

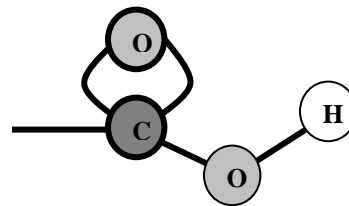
#### Molecule #4 Proteins:

**Background:** Proteins are large organic molecules made up of long chains of *amino acids*. There are only 20 *amino acids* in all proteins found in living things.

Amino acids are identified by a *carboxyl group* on one end of the molecule and an *amino group* on the other end of the molecule.



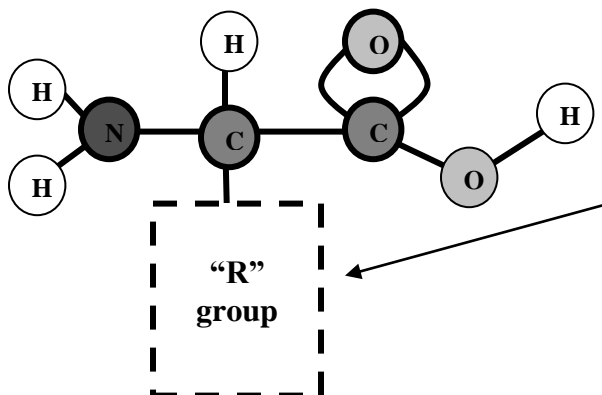
**Amino group**



**Carboxyl group**

Every amino acid has an amino group on one end and a carboxyl group on the other.

An amino acid then looks like the following:



**Note:**

There are 20 different "R" groups.

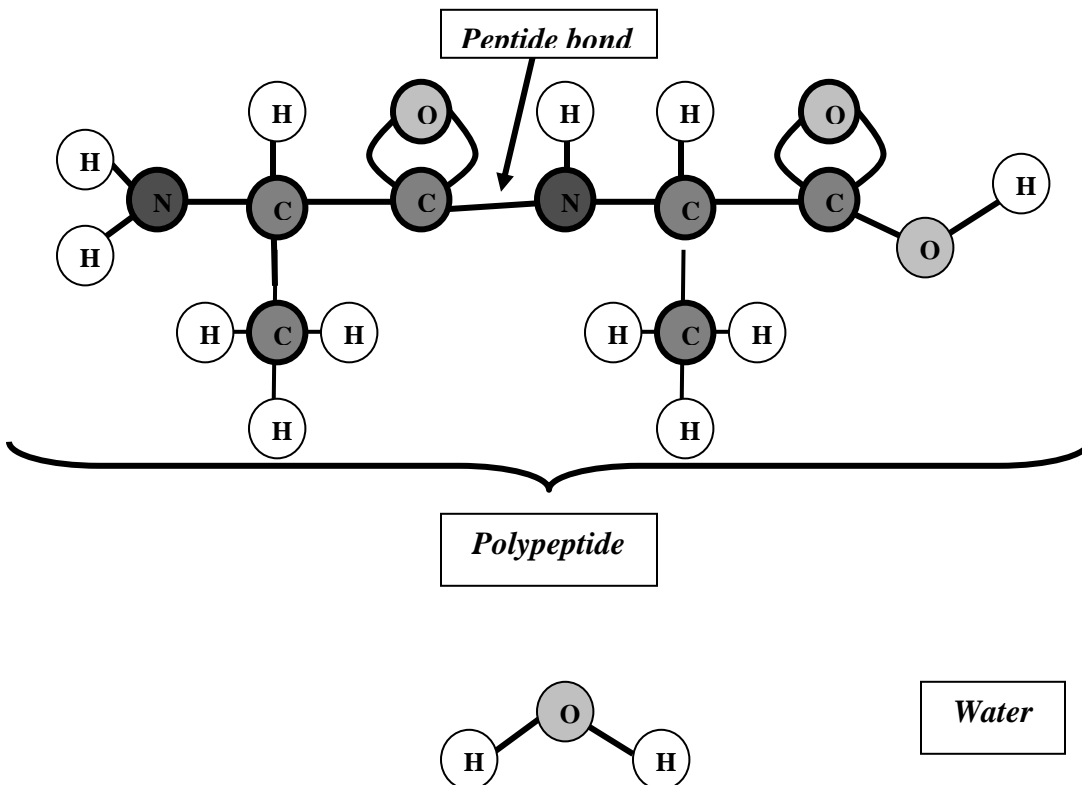
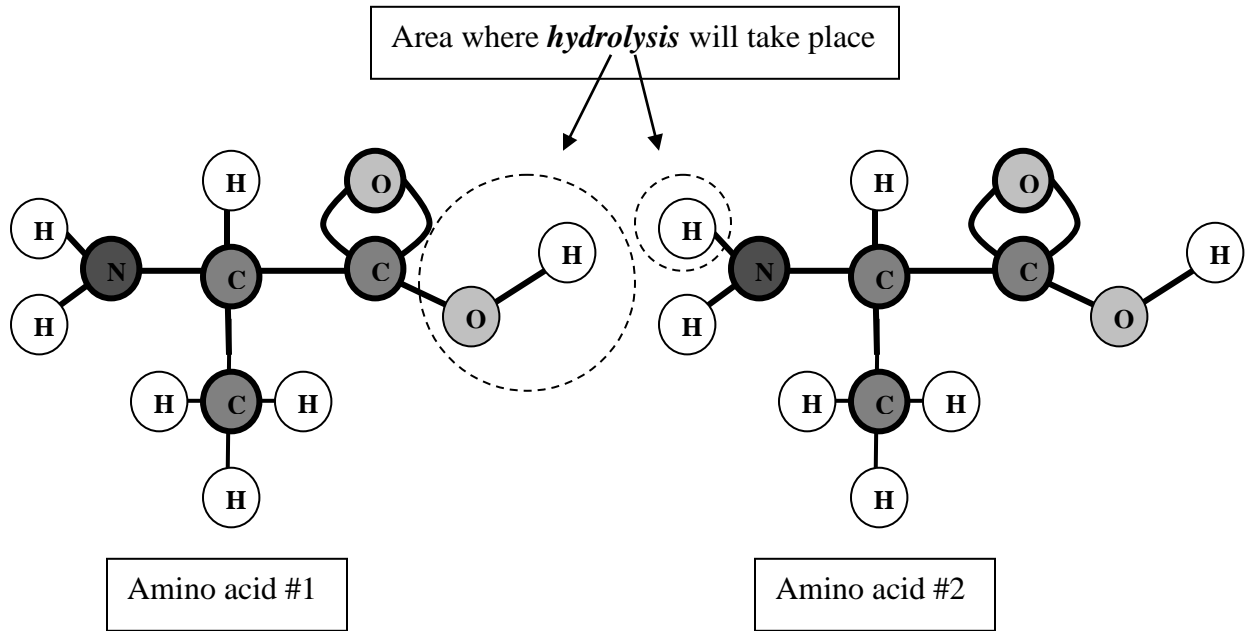
An "R" group is a "tree" of hydrogen and carbon atoms that attaches to the center of the amino acid





**Amino acids** are joined together by the process of dehydration synthesis to form long chains. Long chains of amino acids are referred to as **polypeptides** or **protein**. The word **polypeptide** refers to the bond created between amino acids. (This bond is called a **peptide bond**.)

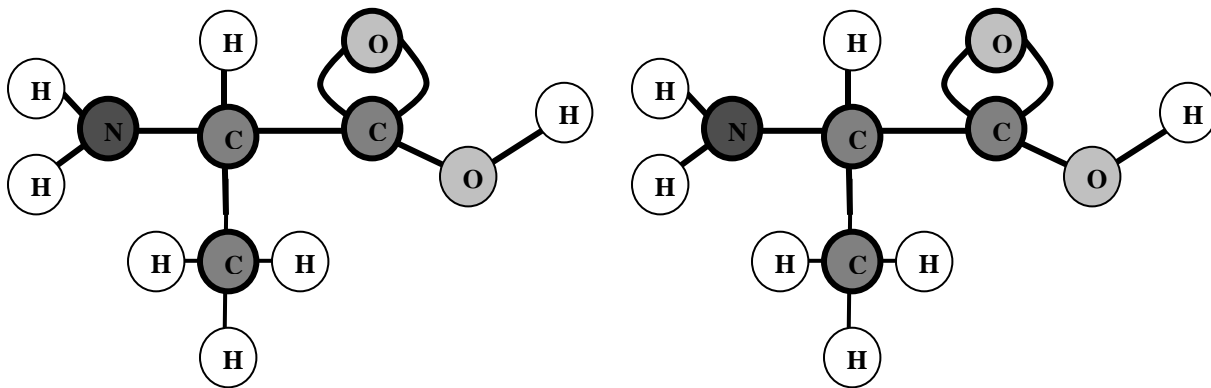
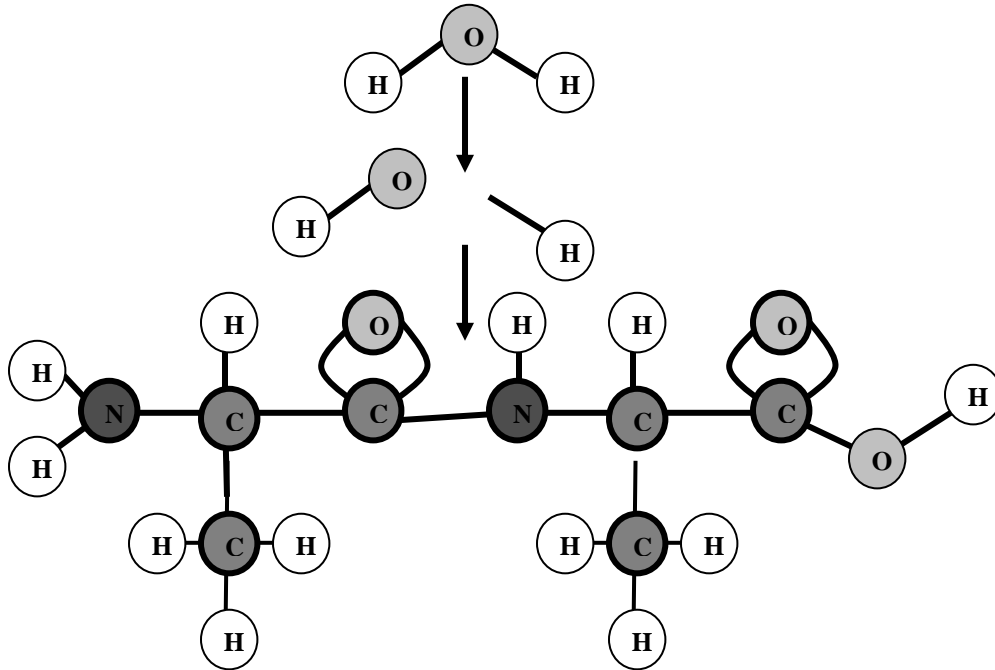
Combine your amino acid together with another group's amino acid by creating a **peptide bond** as shown below:



**HYDROLYSIS** is the opposite reaction to *dehydration synthesis*. Hydrolysis means literally “breaking with water.”

In this case, the molecule being *hydrolyzed* is split AND a molecule of water is split. The -H from the water is added to one of the “broken” ends of the molecule and the -OH from the water is added to the other “broken” end of the molecule.

Thus the *hydrolysis* of a polypeptide would look like the following:



**Hydrolyze** the polypeptide you created following the diagram above as a guide.

QUESTION:

Describe a biological process that occurs in humans where *hydrolysis* would be necessary.

