Biochemistry Macromolecules – POGIL

Objective: To determine and understand the chemical differences between the four different types of macromolecules and to understand their importance.

INFORMATION SECTION 1:

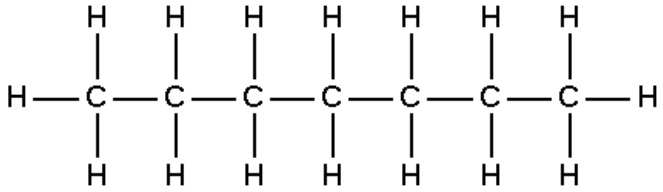


FIGURE 1:

Questions:

1. Look at the picture above, how many bonds can carbon form?

2. Using prior knowledge, define each of the following prefixes:
   a. Mono –
   b. Poly –
   c. Macro –

FIGURE 2:

3. Look at Figure 2 above, which letter would you label as a MONO, and which would you label POLY?

Brainstorm:

In your groups, discuss and record answers to the following questions based on prior knowledge.

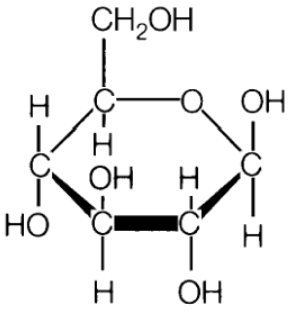
1. Why does your body need carbohydrates, what is its purpose? What are three foods that provide you with carbohydrates?

2. Why does your body need fat (lipids), what is its purpose? What are three foods that contain fats?

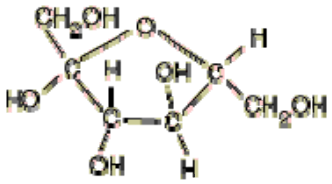
3. Why does your body need protein, what is its purpose? What are three foods that provide protein?

INFORMATION SECTION 2:

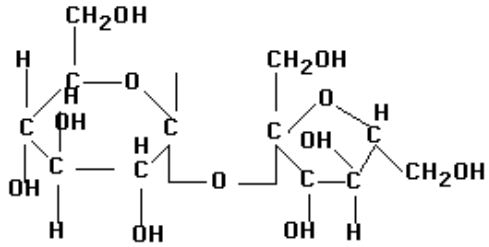
Carbohydrates



Glucose



Fructose



Sucrose

FIGURE 3:

Fill in the table below using the images above. Some of the boxes are already filled in to help you complete the table.

Carbohydrate	Elements Present	Molecular Formula
Glucose	C, H, O	$C_6H_{12}O_6$
Fructose		
Sucrose		

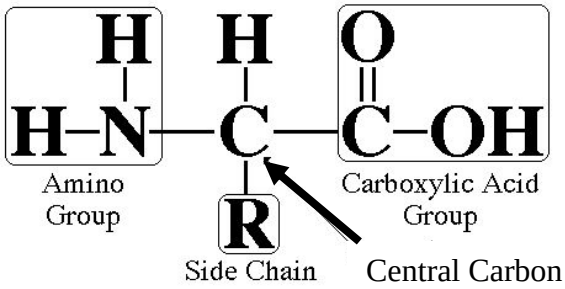
1. What do you notice that is common between the naming of carbohydrates (hint: look at the suffix)?

2. Look at the picture of sucrose,which is a disaccharide. Looking at the structure, write a brief definition of what a "disaccharide" is.

3. Glucose and fructose are all isomers of one another. Based on their molecular formula and structure, write a definition for "isomer."

INFORMATION SECTION 3:

Proteins are built from monomers called amino acids. Below is the general structure of an amino acid.



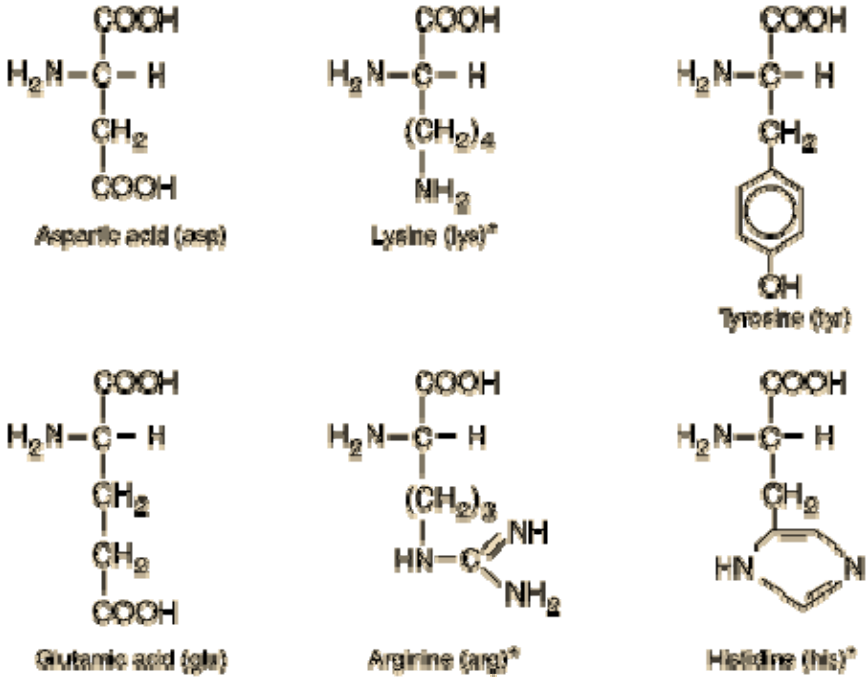


FIGURE 4:

1. Looking at the general amino acid structure, notice that there is one central carbon to which four groups are attached. Name the four groups attached to the central carbon.

2. In the six amino acids above, please circle the central carbon.

3. For each of the six amino acids, draw a circle around the amino group and draw a square box around the carboxyl group.

4. What elements are present in the amino acids? How is this different from carbohydrates?

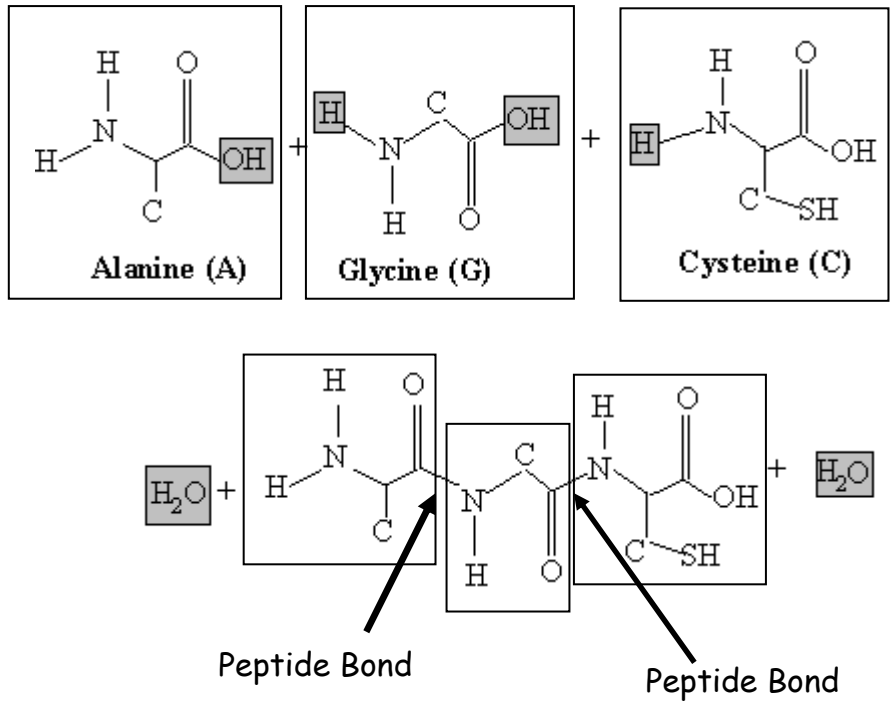


FIGURE 5:

5. Figure 5 shows three amino acids (alanine, glycine, and cysteine) being bonded together to form a polypeptide (protein) in the bottom of the figure. What was removed in order to create the bonds between these amino acids?

6. Would this be considered a hydrolysis reaction or a dehydration synthesis reaction?

7. The specific type of bond that forms between amino acids is called what? Where does it form?

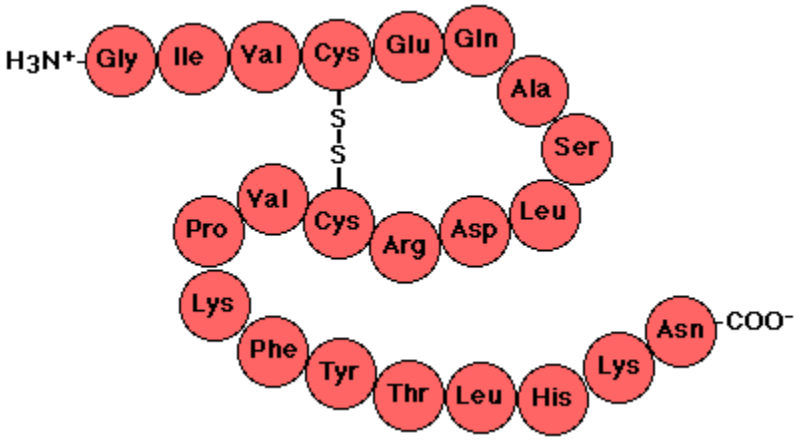


FIGURE 6:

8. Figure 6 shows a **chain of amino acids** which forms a polypeptide/protein. What would be the monomer for protein?

INFORMATION SECTION 4:

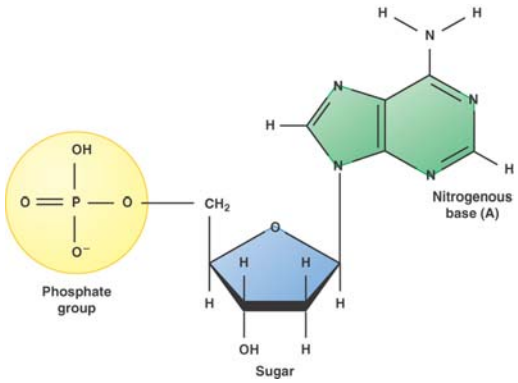


FIGURE 7:

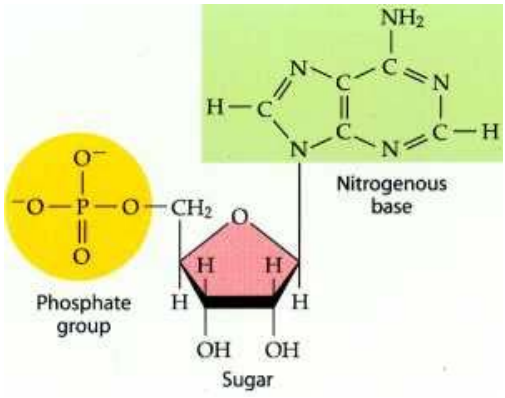


FIGURE 8:

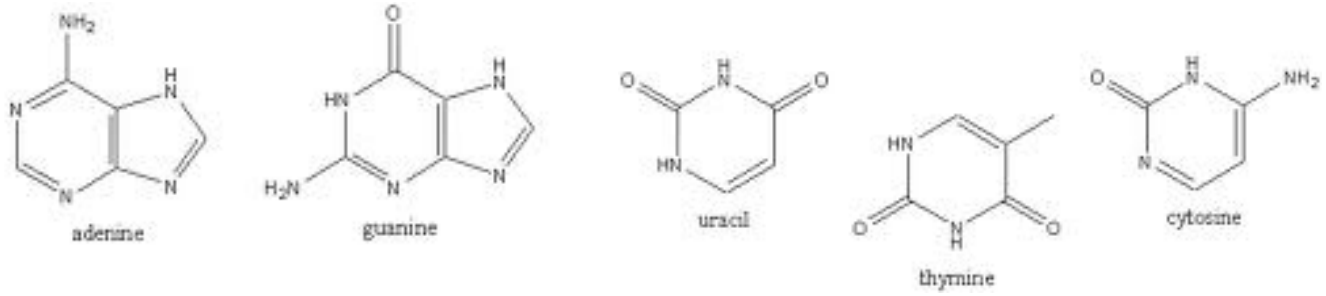


FIGURE 9:

1. Figure 7 above depicts a DNA nucleotide, which is the monomer of a nucleic acid. Name the three parts that make up a nucleotide.

2. Figure 8 depicts a RNA nucleotide. Study the structure and state what makes it different from the DNA nuclotide. HINT: Look at the sugar!!!

3. Both the DNA and RNA nucleotide contain 5 elements; name them.

4. Figure 9 depicts the 5 nitrogenous bases, one of the three parts of the nucleotide. In Figures 7 and 8 please circle the nitrogenous bases.

5. Adenine and guanine are considered to be purines. Uracil, thymine and cytosine are considered to be pyramidines. After looking over Figure 9, do your best to define purine and pyrimidine.

INFORMATION SECTION 5:

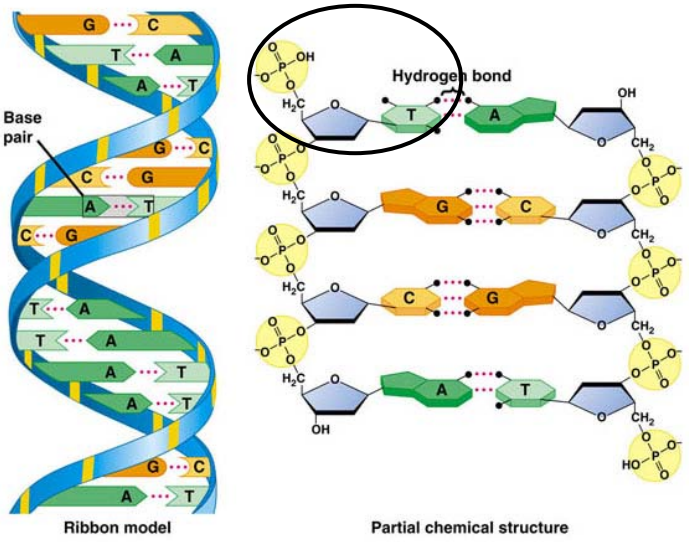


FIGURE 10:

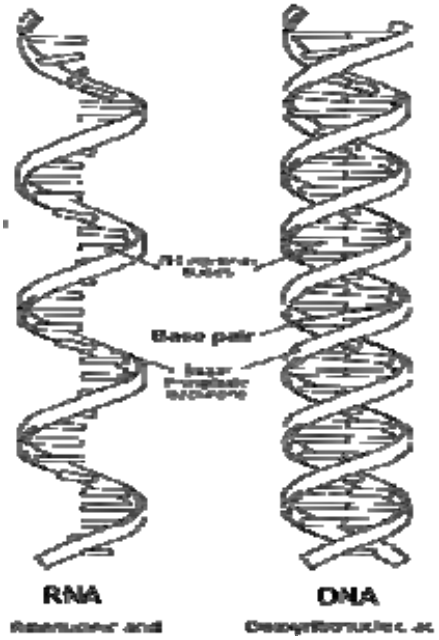


FIGURE 11:

1. Figure 10 above depicts a DNA molecule, one type of nucleic acid which is a polymer, made of several monomers linked together. Each monomer in a nucleic acid is a nucleotide. Recall that a nucleotide is composed of a sugar, a phosphate and a base. Circle the nucleotides (all three parts!) in the partial chemical structure in Figure 10. The first one has been done for you.

2. How many nucleotides are in the DNA strand in Figure 10?

3. In Figure 10, within your nucleotide cirlces, please circle all the phosphate groups and box the nitrogenous bases. How many of each of these do you see in Figure 10?

4. Some people call the DNA structure a "twisted ladder;" the sugars and phosphates make up the "outside support" of the ladder and the nitrogenous bases make up the "rungs." What does this suggest about their placement in the DNA molecule?

5. Figure 11 shows both a DNA and a RNA molecule. There are a few ways DNA and RNA differ…can you come up with one way using Figure 11?

INFORMATION SECTION 6:

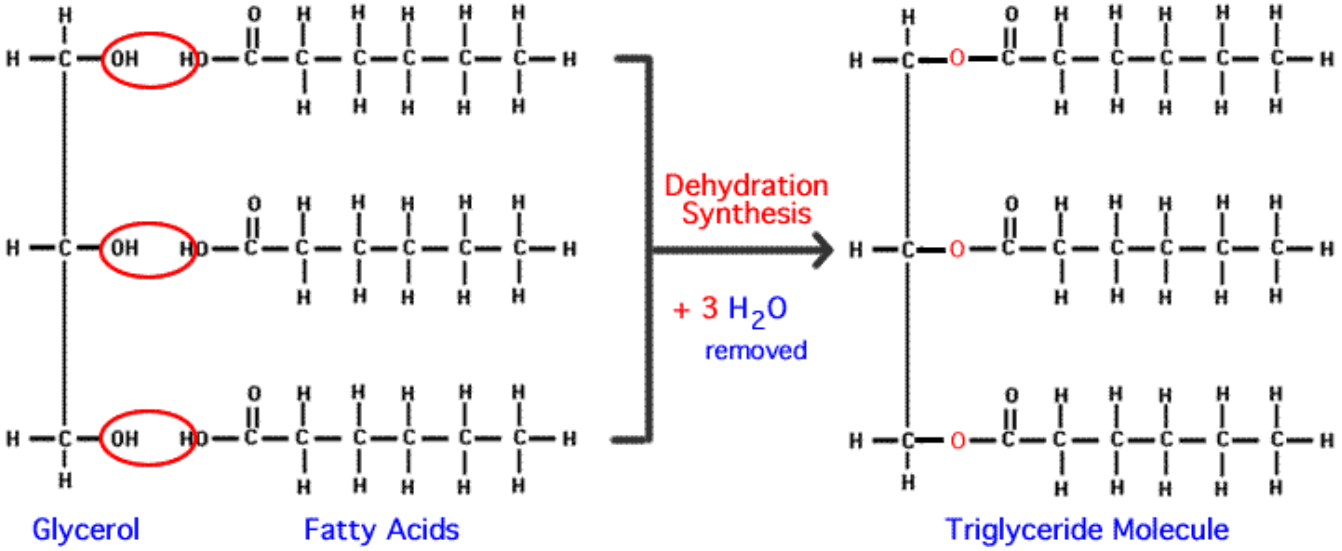
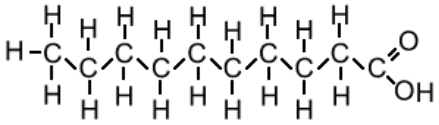


FIGURE 12:

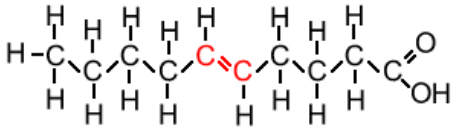
1. Figure 12 above shows the fomation of a triglyceride (aka lipid aka fat) from three fatty acid monomers and a glycerol. What elements are present in a lipid? Do lipids follow the 1:2:1 ratio of C, H, O that carbohydrates have?

2. In Figure 12, what is being removed to create the bonds to form the triglyceride? Is this a hydrolysis or dehydration synthesis reaction?

3. What does "hydro" mean? What does "phobia" mean? If lipids are "hydrophobic," write a definition for what you think this means.



Saturated Fatty Acid



Unsaturated Fatty Acid

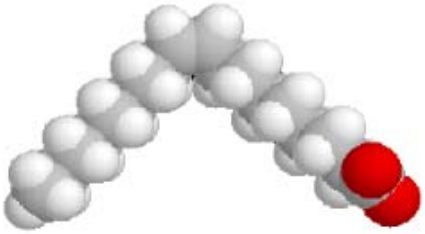


FIGURE 13:

4. Figure 13 shows a comparison between unsaturated and saturated fats. Looking at the drawings on the left, what is the main characteristic that differentiates these two types of fats? HINT: Look at the bonds between the carbon atoms!

5. The picture of the unsaturated fat is known more specifically as a "*mono*-unsaturated fat," what do you think would characterize a "*poly*-unsaturated" fat?

6. Looking at the 3-dimensional drawings of a saturated and unsaturated fat on the right, why do you think saturated fats cause a build-up of fat/plaque in arteries?