Name _____ Date _____ Per _____
preAP Biology

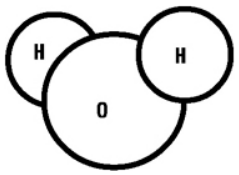
Nutrient Molecules: Chemistry and Identification of Carbohydrates

Today, scientists use a combination of biology and chemistry for their understanding of life and life processes. Thus, an understanding of some chemistry of living things is necessary. In this activity, you will construct models that represent three major molecules of biology.

Remember: Models do not represent the actual three-dimensional shapes of the molecules. Models serve to help you learn how smaller molecules can be grouped into larger, more complex molecules.

Procedure

Part A. Water Model

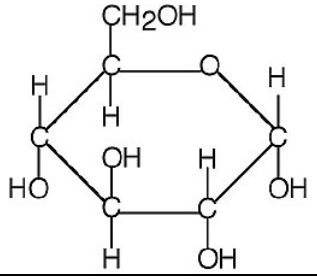
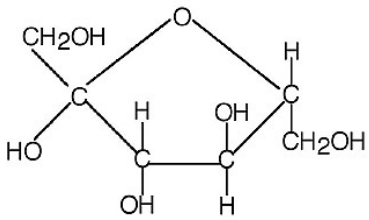
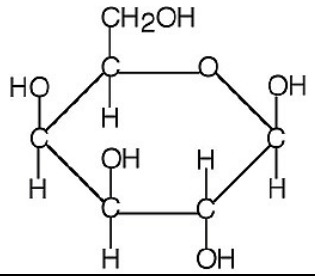


1. What is the molecular formula for water? _____
2. What elements make up water? _____
   _____
3. How many Hydrogen atoms are present in a molecule of water?_____
4. How many Oxygen atoms are present in a molecule of water?_____

Part B. Carbohydrate Models

Group 1. Monosaccharide (single molecule sugars)

A single molecule sugar is called a monosaccharide. The prefix "mono" means one. However, the one molecule can have different shapes due to a different arrangement of atoms. Three monosaccharides are glucose, fructose, and galactose.

Glucose	Fructose	Galactose
		

Examine the structural formulas of these three sugars SHOWN ABOVE and answer questions 1 to 6.

1. What three chemical elements are present in all three monosaccharides shown?
   _____
2. How many atoms of carbon are present in a molecule of
   Glucose _____Fructose _____Galactose _____
3. Add <u>subscripts</u> to the following to indicate the proper molecular formula. Fill in the blanks by counting the total number of carbon, hydrogen, and oxygen atoms in each molecule.

   Glucose: C___H___O___

   Fructose: C___H___O___

   Galactose: C___H___O___

4. What is the ratio of hydrogen atoms to oxygen atoms in a monosaccharide? _____

5. What is the ratio of hydrogen atoms to oxygen atoms in a molecule of water? _____

6. Compare the structural formula of glucose and fructose
    a. Are they exactly the same in shape? _____
    b. Are they both monosaccharides? _____

Group 2. Disaccharides (double molecule sugars)

Two monosaccharide sugar molecules can join chemically to form a larger carbohydrate molecule called a double sugar, or disaccharide. The prefix "di-" means two. By chemically joining a glucose molecule with a fructose molecule, a double sugar called sucrose is produced.

<u>Use the page of paper models given to you by your teacher to complete this section</u>.

Sucrose

Cut out a model of **ONE** glucose and **ONE** fructose molecule. **<u>Cut along SOLID LINES ONLY</u>**.

In order to join the molecules, remove an –OH end from **ONE** molecule and an –H end from **THE OTHER** molecule. **<u>Cut along the dotted lines.</u>**

Fit the fructose and glucose together. Glue on the space below and label the molecule **<u>sucrose</u>**.

7. The –H and –OH ends that were removed can also fit together with each other to form a molecule. This new molecule has a molecular formula of _____ and is called _____.

Fit together and glue the –H and –OH next to the sucrose and **<u>label it</u>**.

GLUE HERE:

8. Write the molecular formula for sucrose by adding together the molecular formulas of glucose and fructose FROM QUESTION #3 and then subtracting water, H_2O

Molecular Formula for Glucose _____
+ Molecular Formula for Fructose _____
= _____
- H_2O
Molecular Formula for Sucrose = _____

Maltose

Different disaccharide molecules can be made by joining other monosaccharides in different combinations. By chemically joining a glucose molecule to another glucose molecule, a double sugar called maltose is formed.

Cut out two molecules of glucose. **Cut along SOLID LINES ONLY**.

9. What must be removed from the glucose models so that they easily fit together? _____

Remove the necessary pieces for the two glucose models to fit together.

Fit together the two glucose molecules and glue on the space below. Label the molecule **maltose**.
Fit together and glue the –H and –OH next to the maltose and **label it**.

GLUE HERE:

10. Write the molecular formula for maltose using the molecular formulas FROM QUESTION #3.

Molecular Formula for Glucose _____

+ Molecular Formula for Glucose _____

= _____

- H_2O

Molecular Formula for Maltose = _____

11. How does the molecular formula for **sucrose** compare to **maltose**? _____
12. What is the ratio of hydrogen atoms to oxygen atoms in a disaccharide? _____
13. How many monosaccharide molecules are needed to form one sucrose molecule? _____
14. How many monosaccharide molecules are needed to form one maltose molecule? _____

Group 3. Polysaccharides (many molecule sugars)

Just as double sugars were formed from two single sugar molecules, polysaccharides are formed when many single sugars are joined chemically. The prefix "poly-" means many. Starch, glycogen, and cellulose are the three most common polysaccharides in biology. They consist of long chains of glucose molecules joined together.

Construct a **starch** molecule by joining three glucose molecules. This model will represent only a small part of a starch molecule because starch consists of hundreds of glucose molecules.

15. What must be removed from the glucose models in order to have them easily fit together? _____

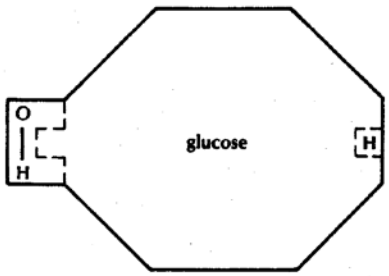
Fit together and glue the glucose molecules in the space below. Label the molecule **starch**.

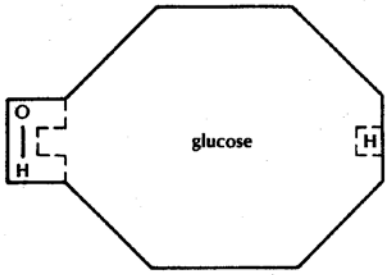
Fit together and glue each of the two water molecules next to the starch molecule and **label them**.

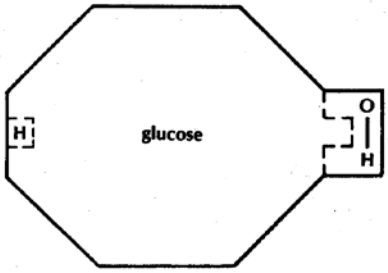
GLUE HERE:

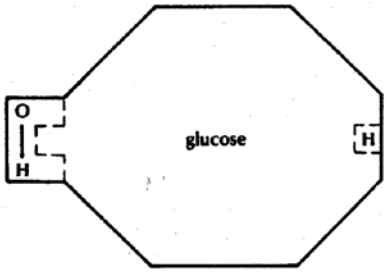
MODELS FOR INVESTIGATION 6, "CARBOHYDRATES: CHEMISTRY AND IDENTIFICATION"

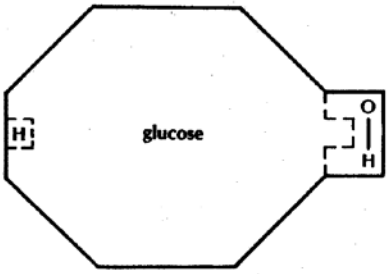
models of glucose

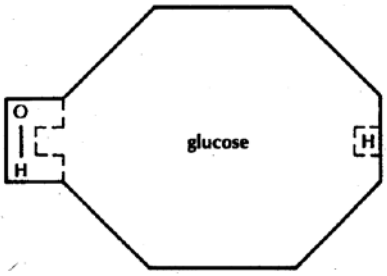




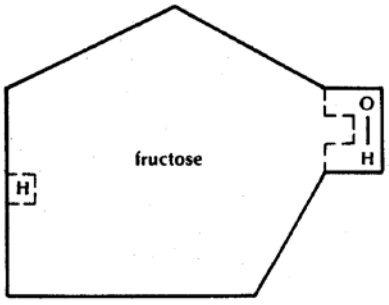








model of fructose



(only end atoms of hydrogen and oxygen are shown in models)