NAME_____
HOUR_____

WHY IS CHEMICAL BONDING IMPORTANT IN BIOLOGY?

Biologists today depend on chemists for much of their understanding of life and life processes. Thus, an understanding of chemistry of living things is necessary. Carbohydrate make up a large group of chemical compounds found in cells. Carbohydrates are an energy source or are used in making cell structures.

IN THIS INVESTIGATION YOU WILL:

1. Learn to interpret the molecular formula of some carbohydrates.
2. Use models to learn to interpret the structural formulas of some carbohydrates.

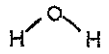
Models do not represent the actual three dimensional shapes of the molecules. Models serve to help you learn how smaller molecules can be grouped into larger, more complex molecules.

WATER

Examine the molecular formula for water. H_2O

1. What elements make up water?_____
2. What does the number 2 following the letter H mean? This number is called a SUBSCRIPT.
   _____
3. Why does the letter O have no subscript?_____
   _____
4. How many molecules of water are represented by the molecular formula H_2O?
   _____

A structural formula attempts to show the three dimensional organization of the molecule. The structural formula for water is



5. What do the lines between the O and the H in the structural formula of water represent?
   _____

CARBOHYDRATES

Carbohydrates contain three different elements: Carbon (C), Hydrogen (H), and Oxygen (O). There are many different types of carbohydrates. They may be grouped into either monsaccharides, disaccharides, or polysaccharides.

MONOSACCHARIDES

The prefix mono means "one", so monosaccharides are sugars that are made up of only one sugar group. Thus, they are called single or simple sugars. All simple sugars have the same molecular formula ($C_6H_{12}O_6$), but may have different structural formulas due to different shapes caused by different arrangement of atoms. Three examples of monosaccharides are glucose, fructose, and galactose. Please note the structural formulas on the back page.

6. What three elements are present in glucose, fructose, and galactose?_____
   _____
7. How many atoms of carbon are present in glucose?_____fructose?_____galactose?_____
8. Using the structural formulas, add subscripts to the following to give the correct molecular formula for each.
   glucose C_____H_____O_____
   fructose C_____H_____O_____
   galactose C_____H_____O_____
9. How many times larger is the number of hydrogen atoms than oxygen atoms in glucose?_____fructose?_____galactose?_____water?_____
10. Compare the structural formula of glucose to fructose. Are they the same in shape?_____ Are they both monosaccharides?_____ Why?
    _____

DISACCHARIDES

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

Cut out a glucose and fructose paper model molecules from the last page. Cut along the SOLID lines only. Attempt to join the molecules together to form a bond.

11. Do the glucose and fructose fit together to form a sucrose molecule?_____

In order to join the molecules together remove an -OH from one molecule and an -H from the other. Cut along the dotted lines.

12. Do the glucose and fructose now fit together to form a sucrose?_____

The -H and -OH ends that were removed can also fit together to form a molecule

13. What is the molecular formula of the new molecule formed?_____
    What is the name of this new molecule?_____

14. _____ is the bonding of two small molecules to form a larger molecule by removing a water molecule.

15. Write the molecular formula for sucrose by adding the molecular formulas for glucose and fructose and subtracting the molecular formula for water.

_____

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

Cut out and attempt to join the two new glucose model molecules like puzzle pieces

16. Do the molecules fit easily together to form maltose?_____

17. What must be removed from the glucose model molecules so that they easily fit together?_____

18. Write the molecular form of maltose._____

19. How does the molecular formula for sucrose compare to maltose?_____

_____

20. How many times larger is the number of hydrogen atoms than oxygen atoms in a dissacharide?_____

21. How many monosaccharide molecules are needed to form one sucrose molecule?_____

22. How many monosaccharide molecules are needed to form one maltose molecule?_____

23. How do the molecules of sucrose and maltose differ? (Use models in order to answer)_____

_____

POLYSACCHARIDES

Just as double sugars were formed from two single sugar molecules; polysaccharides are formed when many single sugars are joined together 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 will represent only a small part of a starch molecule because starch consists of hundreds of glucose molecules.

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

25. What is the smallest number of glucose molecules which can form a polysaccharide?_____

26. How many times larger is the number of hydrogen atoms than the number of oxygen atoms in a polysaccharide molecule?_____

ANALYSIS

27. Name the three categories of carbohydrates._____

_____

28. What three elements are present in all carbohydrates?_____

_____

29. Name two monosaccharides._____

30. Name two disaccharides._____

31. Name one polysaccharide._____

32. How many times larger is the number of hydrogen atom than oxygen atoms in carbohydrates?_____
water?_____

33. When forming disaccharides or polysaccharides what must be removed from monosccharides?_____
What is this process called?_____
What is formed from these removed atoms?_____

34. The word carbohydrate is derived from carbon and hydra (water). Why does this combination properly describe this group of chemical compounds?

_____

_____

_____

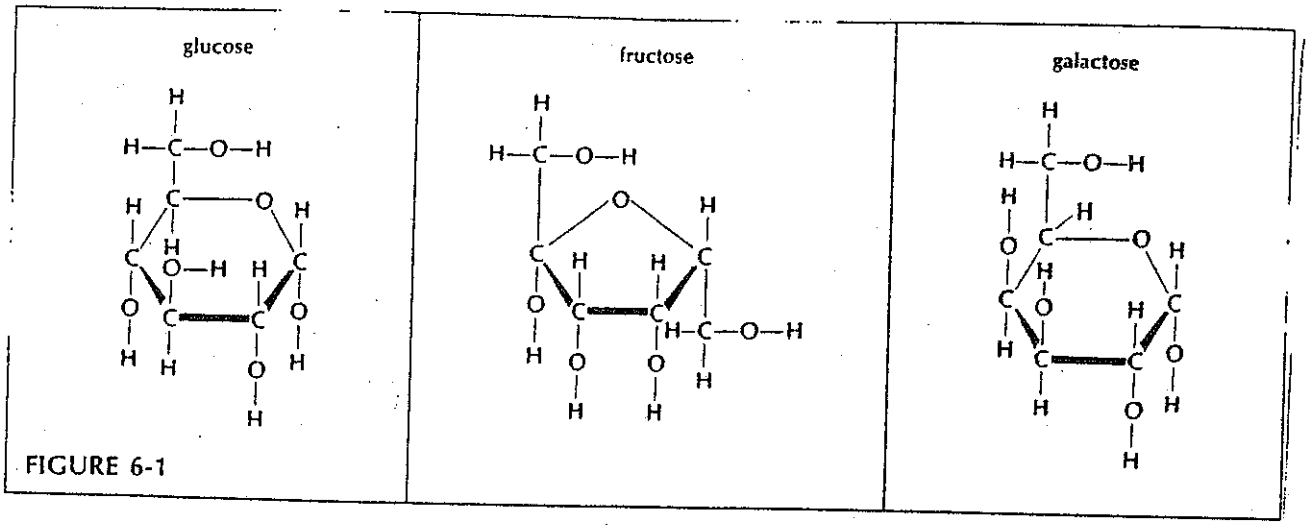
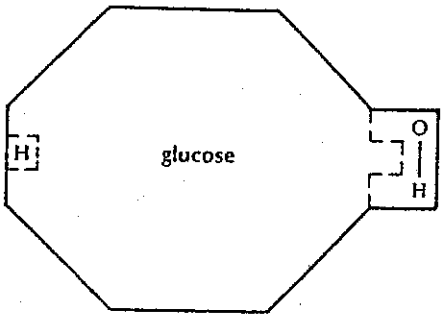
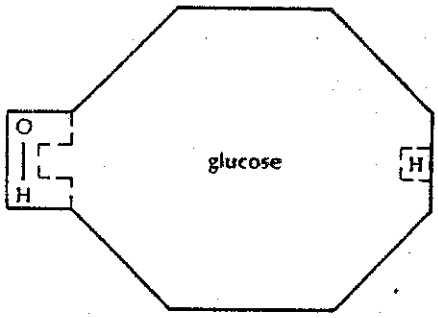
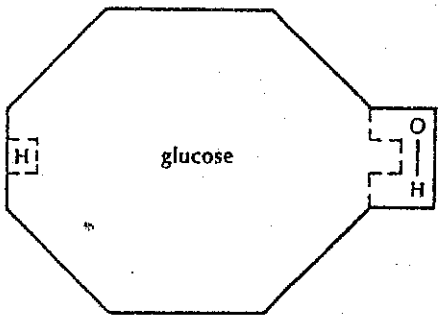
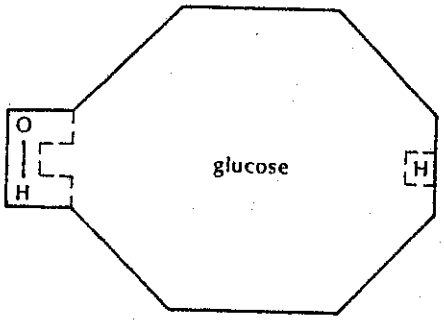


FIGURE 6-1

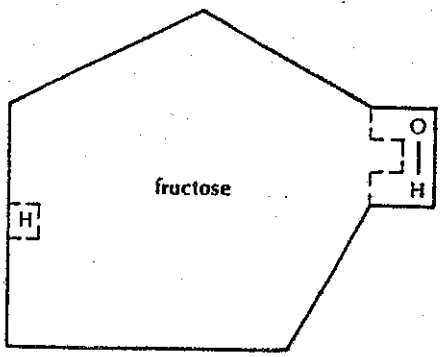








model of fructose



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