

## Fats: Chemistry and Identification

Fats are present in living organisms. These chemicals make up certain parts of your body. Fats are often stored when present in excess and also serve as an energy source. Fats are an important part of our diet.

In this investigation you will

- learn that all fat molecules are made up of two kinds of smaller molecules, glycerol and fatty acids
- use structural formulas and models of glycerol and fatty acids to determine how these molecules join to form fat molecules.

### Procedure:

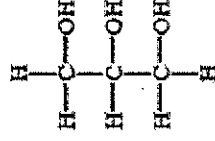
#### Part A: Models of Fats

##### 1. Building blocks of Lipids

To better understand the chemistry of fats, it is helpful to study first the small molecules which join to make up fats. Fat molecules are made up of two small "building blocks," or chemical molecules. These molecules are called glycerol and fatty acids.

Examine the structural formulas of glycerol

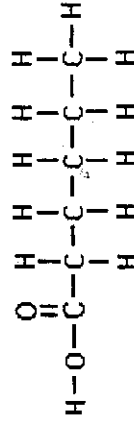
Figure 1. Structure of Glycerol



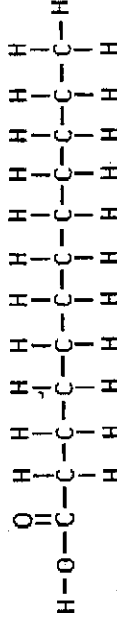
- What elements are present in glycerol? \_\_\_\_\_
- Are there any elements in glycerol that are not in carbohydrates? \_\_\_\_\_
- What is the molecular formula for glycerol? (Add the number of atoms of each element and record the totals)  
C \_\_\_\_\_ H \_\_\_\_\_ O \_\_\_\_\_
- Are there two times as many hydrogen atoms as oxygen in glycerol? \_\_\_\_\_

##### 2. Fatty Acids

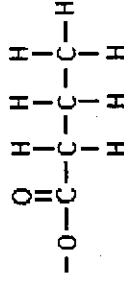
The second kind of molecule which is part of a fat is a fatty acid. Many different fatty acids exist, but all are similar in several ways. Butyric acid, caproic acid, and lauric acid are examples of fatty acids. Examine the structural formulas for these three fatty acids



Caproic Acid



Lauric Acid



Butyric Acid-VFA

5. What elements are present in all fatty acids? \_\_\_\_\_
6. What is the molecular formula for the fatty acid  
(a) butyric acid? C \_\_\_\_\_ H \_\_\_\_\_ O \_\_\_\_\_  
(b) caproic acid? C \_\_\_\_\_ H \_\_\_\_\_ O \_\_\_\_\_  
(c) Lauric acid? C \_\_\_\_\_ H \_\_\_\_\_ O \_\_\_\_\_
7. How do the number of hydrogen atoms compare to the number of oxygen atoms in each fatty acid? \_\_\_\_\_
8. How many oxygen atoms are present in each fatty acid? \_\_\_\_\_
9. List a similarity between glycerol and fatty acids \_\_\_\_\_

## 2. Combining Glycerol and Fatty acids to form Lipids

A fat molecule consists of one glycerol molecule and three fatty acid molecules joined.

Use the paper models given to complete this section

Cut out the glycerol and fatty acid paper models to complete this section. Cut along the solid lines only. Attempt to join the amino acids so they interlock.

10. Will the fat molecule fit together as pieces of a puzzle? \_\_\_\_\_

Remove three -OH ends from the glycerol molecule and three -H ends from the fatty acids. Now join the molecules to form a fat.

11. How many glycerol molecules are needed to form a fat molecule? \_\_\_\_\_

12. How many fatty acid molecules are needed to form a fat molecule? \_\_\_\_\_

Join the left over -H and -OH ends from your models.

13. What chemical substance is formed when the -H and -OH ends are joined? \_\_\_\_\_

Production of a fat molecule is a chemical reaction. A chemical shorthand way of expressing the formation of a fat is as follows... Glycerol + fatty acid  $\rightarrow$  Fat + water

14. How many water molecules are formed when one fat molecule is produced? \_\_\_\_\_

Many fats exist in living things. The wide variety of fats are formed by different combinations of fatty acid molecules

A change in the type of fatty acid results in different types of fat molecules. What molecule remains unchanged in all fats? \_\_\_\_\_