

**Introduction:**

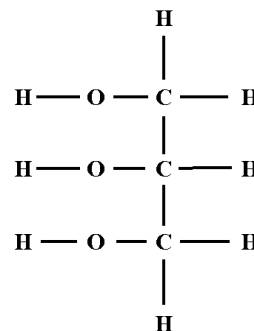
All living things are composed of many chemical compounds. Two such compounds are fats and proteins. Fats are a part of all cellular membranes. They may also be stored within a cell as energy. Proteins form part of almost all structures within a cell. Therefore, they are essential for cell growth and repair.

**Procedure: Fats - a type of lipid**

On a molecular basis all fats are somewhat similar. Just as carbohydrates are composed of monosaccharide molecules, all fats are composed of smaller molecules. The smaller molecules in fats are glycerol and three fatty acids. Use the structural formulas to answer the following questions:

**Glycerol - the backbone of the fat molecule:**

1. What atoms are present in glycerol?
2. Are there any atoms in glycerol that are not in carbohydrates?
3. What is the molecular formula for glycerol? Add the correct subscripts  
C H O



4. a) What is the ratio of hydrogen atoms to oxygen atoms in the glycerol molecule?
- b) How does this ratio compare with the ratio in carbohydrates? Same or different? Explain your answer.

**Fatty Acids**

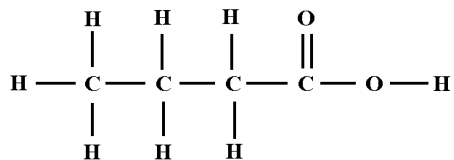
The second molecule which contributes to forming fat is a long molecule called a fatty acid. Many different fatty acids exist, but all are similar in several ways. Their main body is composed of carbon atoms bonded to several hydrogen atoms. This C-H formation is referred to as the hydrocarbon body. Because one of the carbon atoms is bonded to an acid group (COOH), the whole molecule is known as an acid, thus the name fatty acid. It is in the bonding of H-C that great amounts of energy are stored. The three fatty acids in this worksheet are all said to be saturated. Therefore when they combine with a glycerol, the fat molecule is said to be saturated. These types of fats are usually called animal fats and are solid at room temperature. Unsaturated fats will have fatty acids that are unsaturated and tend to form liquid fat, or more commonly called oils.

**Procedure:** Examine the structural formulas of the three fatty acids found on the next page and then answer the following questions.

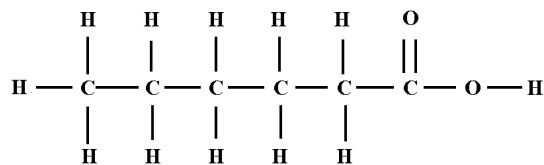
5. What elements are present in all fatty acids?

## Structural Formulas for three Saturated Fatty Acids

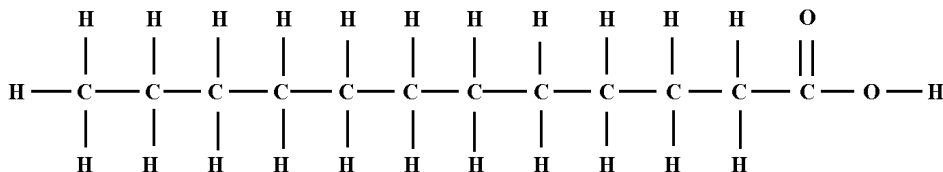
Butyric Acid



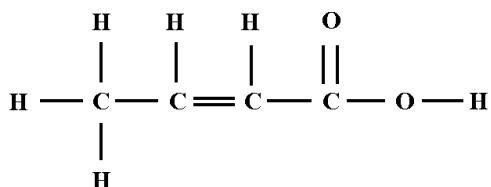
Caproic Acid



Lauric Acid



### Unsaturated Fatty Acid



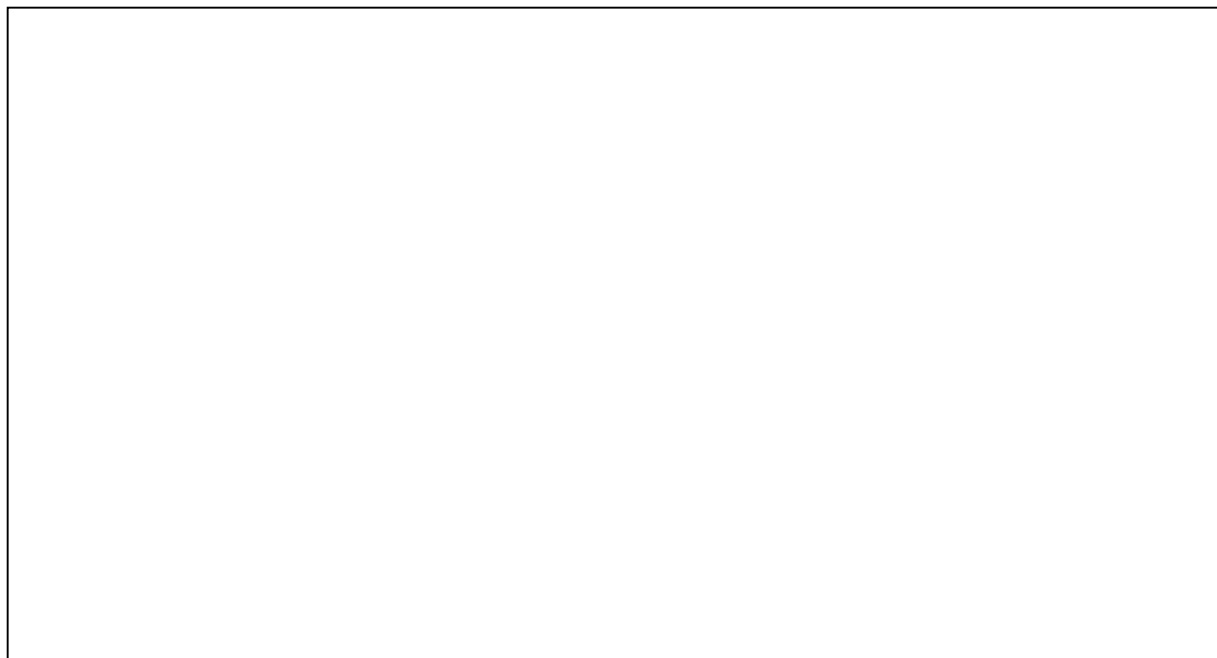
6. What is the molecular formula for butyric acid? Add the correct subscripts.    C   H   O
  
7. What is the molecular formula for caproic acid? Add the correct subscripts.    C   H   O
  
8. Does an exact 2 to 1 ratio of hydrogen atoms to oxygen atoms exist in fatty acids?
  
9. Is the ratio of hydrogen atoms to oxygen atoms the same in each fatty acid? Give specific examples in your answer.
  - a) The H to O ratio for butyric acid is \_\_\_\_\_
  - b) The H to O ratio for caproic acid is \_\_\_\_\_
  - c) The H to O ratio for lauric acid is \_\_\_\_\_
  
10. Note the end of butyric acid containing the oxygen atoms. This special end arrangement of carbon, hydrogen, and oxygen is called a carboxyl group. Is the carboxyl group present in all the fatty acids shown?

**Directions for Building a Fat Molecule:**

A fat molecule consists of one glycerol molecule and three fatty acids joined together. Cut out the glycerol and fatty acid paper models. Cut on the solid lines only. Try to join the pieces together.

11. Will the fat molecule stay together?

Remove three OH ends from the glycerol molecule and three H ends from the fatty acids. Now it is physically possible to join the molecules to form a fat. Attach both the fat molecule and the three water molecules in the space below. Remember to join the H and OH cut outs to form water molecules.



12. What chemical substance is formed when the H and OH ends are joined? Attach the models to a sheet of paper and title them.

Production of a fat molecule is a chemical reaction. A chemical shorthand way of expressing the formation of a fat is as follows:



13. How many water molecules are formed when one fat molecule is produced?

14. Many fats exist in living things. The wide variety of fats are formed by different combinations of fatty acid molecules. What molecule remains the same in almost all fats?

## Summary of Macromolecules

### Carbohydrates

### Lipids

Elements in?

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Ratio of H to O?

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Polymers?

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Polar?

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Building Blocks?

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Examples of?

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**Cut Out Models for Building a Fat Molecule**

