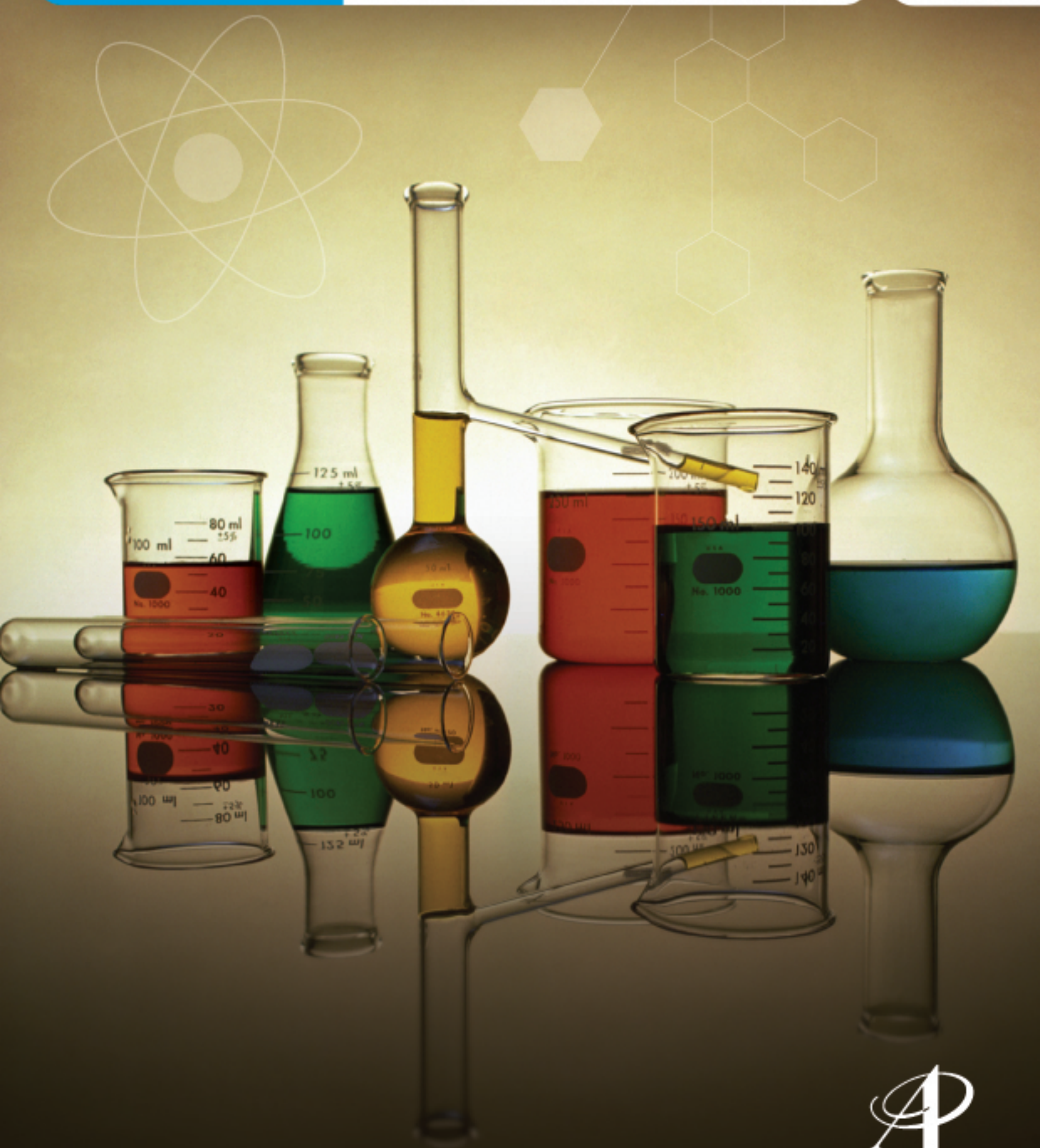
LIFEPAC®

Science



Alpha Omega Publications®

SCIENCE 1108
CARBON CHEMISTRY: HYDROCARBONS

CONTENTS

Author: **Harold Wengert, Ed.D.**
Editor: Alan Christopherson, M.S.
Illustrators: Alpha Omega Graphics

Alpha Omega Publications®

804 N. 2nd Ave. E., Rock Rapids, IA 51246-1759

© MM by Alpha Omega Publications, Inc. All rights reserved.
LIFEPAC is a registered trademark of Alpha Omega Publications, Inc.

All trademarks and/or service marks referenced in this material are the property of their respective owners. Alpha Omega Publications, Inc. makes no claim of ownership to any trademarks and/or service marks other than their own and their affiliates', and makes no claim of affiliation to any companies whose trademarks may be listed in this material, other than their own.

CARBON CHEMISTRY: HYDROCARBONS

Our Creator in His wisdom made a universe that is unique. No length of time nor combination of circumstances could have produced such a world as ours. The study of carbon chemistry is truly a study of God's creation. You will learn that the uniqueness of the carbon atom is the basis of all life. The choice of this atom with its designed characteristics is indeed a mark of an omnipotent Creator. No work of chance could have happened upon the combination necessary to produce life. David proclaimed in Psalm 19:1, "The heavens declare the glory of God and the firmament sheweth his handywork."

Science LlFEPACs 1108 and 1109 will be a study of the carbon atom and the chemistry of life. The study of functional groups of organic compounds will help you to see the glory of God in creation. In this LIFEPAC® you will review the atomic nature of carbon and the molecular structure of carbon compounds. You will also learn more about hydrocarbons, their sources, and their chemistry. For anyone interested in medicine, nursing, biology or chemistry as a career, these two LlFEPACs should be of special interest.

OBJECTIVES

Read these objectives. The objectives tell-you what you will be able to do when you have successfully completed this LIFEPAC.

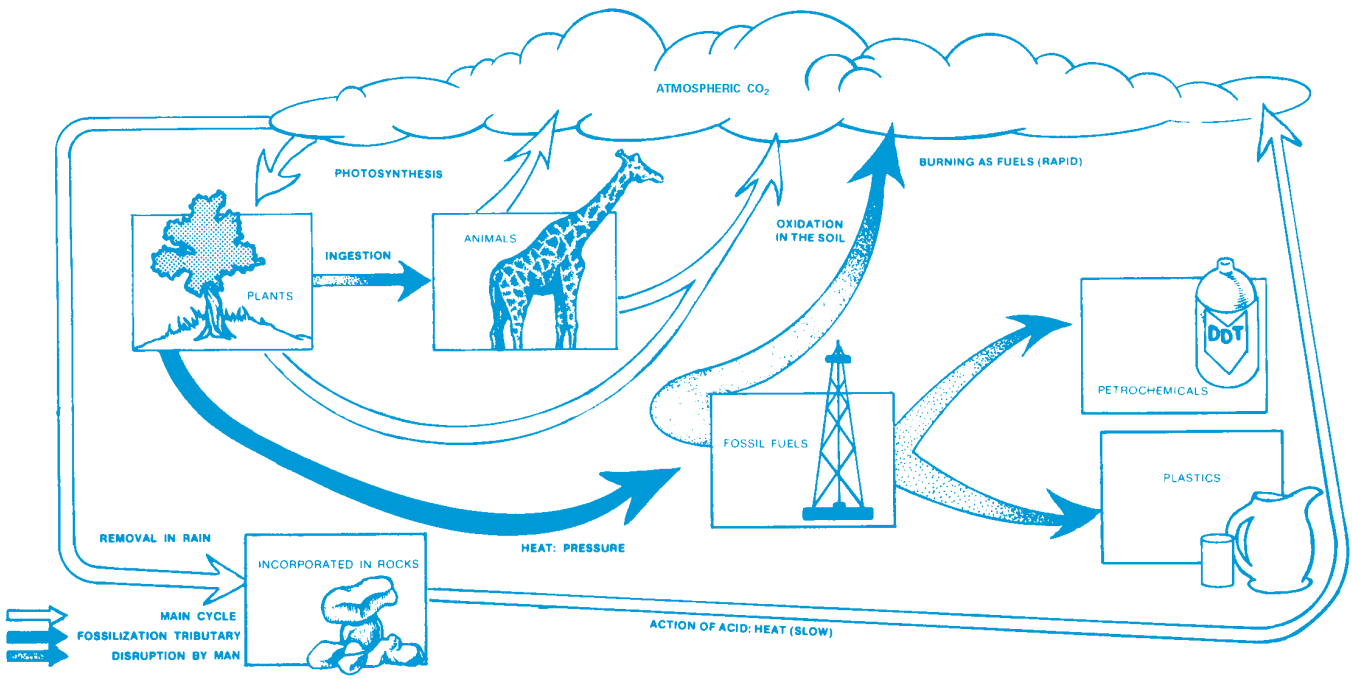
When you have finished this LIFEPAC, you should be able to:

1. Classify compounds as organic or inorganic.
2. Identify the three major sources of organic compounds.
3. Describe the structure of the carbon atom.
4. Identify and to describe the three forms of carbon.
5. Describe carbon bonding.
6. Classify alkanes, alkenes, and alkynes.
7. Describe alkanes, alkenes, and alkynes.

Survey the LIFEPAC. Ask yourself some questions about this study. Write your questions here.

I. CARBON COMPOUNDS

Carbon compounds are a part of the familiar carbon cycle. The carbon cycle was part of God's natural balancing of nature. At the time of the Flood, nearly all of our coal and petroleum resources were buried and formed. These carbon compounds are the basis of all the synthetic plastics and petrochemicals man has made for his comfort. As a result of man's greed and search for "the better life," he has disrupted the carbon cycle and polluted God's creation. In this section you will study the sources and classification of carbon compounds.



SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. Classify compounds as organic or inorganic.
2. Identify the three major sources of organic compounds.

CLASSIFICATION OF ORGANIC COMPOUNDS

All substances can be classified into either of two categories, *organic* and *inorganic*. This classification scheme was used by the early chemists in a slightly different manner than it is being used today.

Originally, the term *organic* was used in its general sense in that rocks and minerals are inorganic; but plants, animals, and the substances they produce are organic. In this sense, the adjective *organic* tells you that a substance is, or has at one time been, a part of a living organism. An organic substance according to this classification scheme is derived from things that are, or have been, alive.

Early definition. This system of classification was set up because prior to the year 1800, organic substances were believed to contain a "vital spirit." Since no chemist possessed, nor could ever hope to attain, a "bottle of vital spirit," laboratory production (except by living things) of organic compounds was believed to be impossible. Thus two separate and distinct types of substances were thought to

exist: organic substances, which were impossible to synthesize, and inorganic substances, which could be synthesized. Therefore, originally organic chemistry was founded as the study of compounds from living things that contained a vital spirit" (acquintessance). Historians of science refer to this theory as the *Theory of Vitalism.*

Considerable doubt had begun to cloud this theory when in 1928, the German chemist Friedrich Wohler synthesized urea, a compound normally produced by animal metabolism. While working with the inorganic compound ammonium cyanate, he surprisingly discovered crystals of urea in his beakers. Since then, thousands of organic compounds have been synthesized, and the *Theory of Vitalism* has passed into oblivion.

Modern definition. The terms *organic chemistry* or *organic compound* have a slightly different meaning in chemistry today. To illustrate, study the following exercises with special attention to the products of these reactions. A student did the following experiment to collect the data for your study.

One sugar cube (sucrose) was added to a 100 ml beaker. Enough concentrated H_2SO_4 (HIGHLY CAUSTIC) was added to soak the cube completely (about 2 ml). The mixture was allowed to set for several minutes. One of the products of the reaction was a gas which he was able to detect by condensing it on the surface of a cool watch glass set on top of the beaker. The liquid was tested with cobalt chloride paper (detects H_2O) and the paper turned colors. A solid residue product of the reaction resembled charred wood or carbon. The reaction became hot.

Do these activities.

1.1 On the basis of the student's data and observations, complete these activities.

a. What does concentrated H_2SO_4 do to sucrose? Complete the equation for this reaction.
$C_{12}H_{22}O_{11} + 11\ H_2SO_4 \rightarrow 12$ _____ + 11 H_2SO_4 + 11 _____

b. Is the concentrated H_2SO_4 a catalyst in this reaction? _____

c. Explain your answer in b. _____
_____

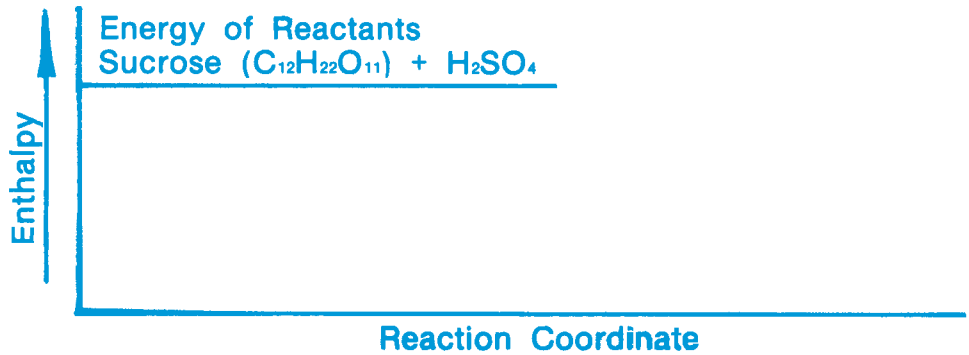
d. What was the gaseous product of this reaction? _____

e. Did the reactants give off energy when they formed the products? _____

f. Is the reaction exothermic or endothermic? _____

g. Do the products or the reactants have more enthalpy? _____

h. On the basis of these observations, complete the following diagram.



1.2 What is urea? _____

_____

1.3 Describe the Theory of Vitalism. _____

_____

_____

1.4 Descirbe Friedrich Wohler's contribution to science. _____

_____

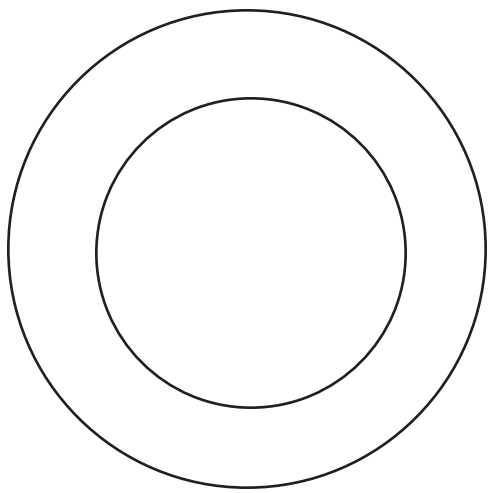
_____

_____

Many plastic materials burn and leave a charred, black residue like that of the H_2SO_4-sugar reaction. The products of the preceding reaction are similar to the results of leaving bread in the toaster or meat and potatoes in the oven too long. A hot flatiron left on a piece of cloth yields the same charred products. Sugar, plastics, food, and cloth are part of a large group of substances which have two things in common: (a) they all contain organic compounds and (b) they all contain the element carbon. Examination of the compounds from living things shows an abundance of this element. Organic chemistry is the study of compounds made of carbon. Many compounds of this element, although *not products of living things*, are classified as organic compounds. Exceptions to the rule are oxides of carbon (CO and CO_2), metal carbonates, and metal cyanides. All of these exceptions are considered to be inorganic compounds.

Do this activity.

1.5 The following circle represents all chemical compounds. Crosshatch organic compounds vertically and inorganic compounds horizontally on the drawing.



Write *true* **or** *false*.

1.6 _____ Compounds of carbon are organic.

1.7 _____ Organic compounds can not be synthesized.