



## CHAPTER 2

# ALKANES AND CYCLOALKANES

Now that we've reviewed the various bonding models, we are ready to examine organic compounds in respect to their structure, reactions, properties, and applications. Were we to list the physical and chemical properties of each of the more than 8 million organic compounds separately, it would tax the capacity of even a powerful computer. Yet someone who is trained in organic chemistry can simply look at the structure of a substance and make reasonably confident predictions about its properties, including how it will behave in a chemical reaction.

Organic chemists associate particular structural units, called **functional groups**, with characteristic patterns of reactivity; they look at large molecules as collections of functional groups attached to nonreactive frameworks. Not only does this “functional group approach” have predictive power, but time and experience have shown that it organizes the material in a way that makes learning organic chemistry easier for most students.

We'll begin the chapter with a brief survey of various kinds of hydrocarbons—compounds that contain only carbon and hydrogen—introduce some functional groups, then return to hydrocarbons to discuss alkanes in some detail. The names of alkanes may seem strange at first, but they form the foundation for the most widely accepted system of organic nomenclature. The fundamentals of this nomenclature system, the **IUPAC rules**, constitute one of the main topics of this chapter.

### 2.1 CLASSES OF HYDROCARBONS

**Hydrocarbons** are compounds that contain only carbon and hydrogen and are divided into two main classes: **aliphatic** hydrocarbons and **aromatic** hydrocarbons. This classification dates from the nineteenth century, when organic chemistry was almost

#### CHAPTER OUTLINE

- 2.1 Classes of Hydrocarbons
- 2.2 Reactive Sites in Hydrocarbons
- 2.3 The Key Functional Groups
- 2.4 Introduction to Alkanes: Methane, Ethane, and Propane
- 2.5 Conformations of Ethane and Propane
  - Methane and the Biosphere**
- 2.6 Isomeric Alkanes: The Butanes
- 2.7 Higher Alkanes
- 2.8 IUPAC Nomenclature of Unbranched Alkanes
- 2.9 Applying the IUPAC Rules: The Names of the C<sub>6</sub>H<sub>14</sub> Isomers
- 2.10 Alkyl Groups
- 2.11 IUPAC Names of Highly Branched Alkanes
- 2.12 Cycloalkane Nomenclature
- 2.13 Conformations of Cycloalkanes
- 2.14 Conformations of Cyclohexane
- 2.15 Conformational Inversion (Ring Flipping) in Cyclohexane
- 2.16 Conformational Analysis of Monosubstituted Cyclohexanes
- 2.17 Disubstituted Cycloalkanes: Stereoisomers
- 2.18 Polycyclic Ring Systems
- 2.19 Physical Properties of Alkanes and Cycloalkanes
- 2.20 Chemical Properties: Combustion of Alkanes
  - Learning Objectives**
- 2.21 Summary
  - Additional Problems**