EDITION 2

# Fundamentals of Organic Chemistry

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# Preface

As I stated in the first edition of this text, my goal has been to write a readable and effective teaching text that presents only those subjects needed for a one-semester or two-quarter course in organic chemistry but that keeps the important pedagogical tools commonly found in larger books. I have taken particular care to incorporate clear explanations of difficult subjects, effective artwork, repetition of important points, and varied end-of-chapter learning tools. The result, I believe, is a book that is easier to learn from than other short organic chemistry texts.

All of the features that made the first edition a success have been improved, and many new ones have been added.

The writing, already clear and accessible, has been further refined at the sentence level on every page.

The artwork has been redone with the use of computer-generated structures to ensure accuracy.

Text and reaction summaries have been added at the end of each chapter, and problem sets have been expanded.

Other changes include expanded treatments of resonance, isomerism, and enzyme structure and function.

## Organization

The primary organization of this book is by functional group, beginning in Chapter 2 with alkanes and going on to more complex compounds. Within this primary organization, more emphasis is placed on explaining the fundamental mechanistic similarities of organic reactions than is common in other short texts. Chapter 11, "Carbonyl Alpha-Substitution and Condensation Reactions," for example, helps to remove the artificial lines between ketones and esters by showing how all carbonyl compounds undergo similar reactions.

Organic molecules and organic reactions are presented as early as possible. After a brief review of structure and bonding in Chapter 1, organic molecules and functional groups are introduced in Chapter 2, followed by an initial discussion of organic reactions in Chapter 3.

## The Lead-off Reaction: Addition of HCl to Ethylene

An important yet simple polar reaction—the addition of HCl to ethylene—is used as the lead-off to illustrate general principles of organic reactions. This choice has the advantage of relative simplicity (no prior knowledge of stereochemistry and kinetics is required), yet it is also a broadly applicable reaction of a common functional group. Many students attach great importance to a text's lead-off reaction, and I believe that the choice of an important polar reaction serves to introduce students to functional-group chemistry better than a lead-off such as free-radical alkane chlorination.

## Spectroscopy

Spectroscopy is treated as a tool, not as a specialized field of study. Infrared, ultraviolet, $^{13}C$ NMR, and $^{1}H$ NMR spectroscopies are all covered by showing the kind of information that can be derived from each and how each can be used to answer specific structural questions.

## Nomenclature

The IUPAC system of nomenclature is used throughout. For the most part, this involves the use of systematic names, although a few IUPAC-approved nonsystematic names such as acetic acid, acetone, ethylene, and phenol are also employed. Since it's unlikely that these few common names will disappear from everyday use in the near future, it's probably best for students to learn them.

## Coverage

The coverage in this book is up to date, reflecting important advances of the past decade. For example, $^{13}C$ NMR is introduced as a routine spectroscopic tool, equal in importance to $^{1}H$ NMR. Similarly, the chemistry of nucleic acids is covered, including a section on DNA sequencing by the Maxam-Gilbert method.

## Interludes

Brief "interludes" are included at the end of each chapter. Meant to serve as short breathers between chapters, these interludes show interesting applications of organic chemistry to industrial and biological systems. They can be covered by the instructor or left for student reading.

## Practice Problems

Each chapter contains many worked-out examples that illustrate how problems can be solved. Each practice problem and solution is then followed by a similar problem for the reader to solve. These worked-out examples are valuable because of their appearance in the text, but they are not meant to serve as a replacement for the accompanying *Study Guide and Solutions Manual.*

## Pedagogy

In addition to the features mentioned above, every effort has been made to make this book as effective, clear, and readable as possible—in short, to make it easy to learn from.

Paragraphs usually start with summary sentences.

Transitions between paragraphs and between topics are smooth.

Extensive use is made of computer-generated, airbrushed art and carefully rendered stereochemical formulas.

Extensive cross-referencing to earlier material is used.

A second color is used to indicate the changes that occur during reactions.

More than 800 problems are included, both within the text and at the end of every chapter. These include both drill and thought problems.

Key terms are defined in the margin next to where they are first used.

An innovative vertical format is used to explain reaction mechanisms. The mechanisms are printed vertically, while explanations of the changes taking place in each step are printed next to the reaction arrow. This format allows the reader to see easily what is occurring at each step in a reaction without having to jump back and forth between the text and structures.

## Study Guide and Solutions Manual

A carefully prepared *Study Guide and Solutions Manual* accompanies this text. Written by Susan McMurry, this companion volume answers all in-text and end-of-chapter problems and explains in detail how answers are obtained. In addition, many valuable supplemental materials are given, including: a list of study goals for each chapter, a glossary, a summary of name reactions, a summary of organic reaction mechanisms, a summary of the uses of important reagents, tables of spectroscopic information, a list of suggested readings, and a discussion on the rules of nomenclature for polyfunctional molecules.

# Acknowledgments

I sincerely thank the many people whose help and suggestions were so valuable in the creation of this book. Foremost is my wife Susan who read, criticized, and improved all aspects of the text, and who authored the accompanying *Study Guide and Solutions Manual.* Among the reviewers providing thoughtful comments were R. A. Abramovitch, Clemson University; Orville L. Boge, Mesa State College; Gerald Caple, Northern Arizona University; George B. Clemans, Bowling Green State University; Donald Grant, University of Saskatchewan; George Kraus, Iowa State University; Gordon L. Lange, University of Guelph, Ontario, Canada; Anne G. Lenhert, Kansas State University; Barbara J. Mayer, California State University at Fresno; and Daniel O'Brien, Texas A & M University.

Special thanks are due Mary Douglas, Harvey Pantzis, Joan Marsh, and others of the Brooks/Cole staff for their usual fine work.

# A Note for Students

We have similar goals. Yours is to learn organic chemistry; mine is to do everything possible to help you learn. It's going to require work on your part, but the following suggestions should prove helpful:

**Don't read the text immediately.** As you begin each new chapter, look it over first. Read the introductory paragraphs, find out what topics will be covered, and then turn to the end of the chapter and read the summary. You'll be in a much better position to understand new material if you first have a general idea of where you're heading. Once you've begun a chapter, read it several times. First read the chapter rapidly, making checks or comments in the margin next to important or difficult points; then return for an in-depth study.

**Keep up with the material.** Who's likely to do a better job—the runner who trains five miles per day for weeks before a race, or the one who suddenly trains twenty miles the day before the race? Organic chemistry is a subject that builds on previous knowledge. You have to keep up with the material on a daily basis.

**Work the problems.** There are no shortcuts here. Working problems is the only way to learn organic chemistry. The practice problems show you how to approach the material, the in-text problems provide immediate practice, and the end-of-chapter problems provide additional drill and some real challenges. Answers and explanations for all problems are given in the accompanying *Study Guide and Solutions Manual.*

**Ask questions.** Faculty members and teaching assistants are there to help you. Most of them will turn out to be extremely helpful and genuinely interested in seeing you learn.

**Use molecular models.** Organic chemistry is a three-dimensional science. Although this book uses many careful drawings to help you visualize molecules, there's no substitute for building a molecular model, turning it in your hands, and looking at it from different views.

**Use the study guide.** The *Study Guide and Solutions Manual* that accompanies this text gives complete solutions to all problems and provides a wealth of

supplementary material. Included are a list of study goals for each chapter, outlines of each chapter, a large glossary, a summary of name reactions, a summary of methods for preparing functional groups, a summary of the uses of important reagents, tables of spectroscopic information, a list of suggested readings, and a discussion on the naming of polyfunctional compounds. Find out ahead of time what's there so that you'll know where to go when you need help.

Good luck. I sincerely hope you enjoy learning organic chemistry and that you come to see the logic and beauty of its structure. I would be glad to receive comments and suggestions from any who have learned from this book.

# Brief Contents

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