Preface to Second Edition

This book is a comprehensive introductory treatment of the organic chemistry laboratory. The student will be guided in doing numerous exercises to learn basic laboratory techniques. The student will then use many proven traditional experiments normally performed in the two-semester organic laboratory course.

Several trends in organic laboratory education have emerged since publication of the first edition. These trends are recognition of the pedagogical value of discovery experiments, the increased emphasis on molecular modeling and computer simulations, and the development of green experiments. All of these trends are incorporated into this book along with the use of traditional experiments.

Discovery Experiments

Discovery experiments are given a special label in the Table of Contents and in each chapter where they appear. Discovery experiments incorporate the pedagogical advantages of inductive inquiry experiments with the ease of design found in expository experiments. Discovery experiments (or guided inquiry experiments) have a specific procedure designed to give a predetermined but unspecified result. Students use a deductive thought process to arrive at a desired conclusion. Students are "guided" by inferring a general scientific principle. Discovery experiments have been employed successfully in large laboratory sections, as well as in small classroom environments. Student interest is increased during discovery experiments because the result of the experiment is unknown to the student. The desired goal of discovery experiments is increased student learning. Discovery experiments can also provide the opportunity for individual reflection and class discussion and may involve students in developing and interpreting laboratory procedures. These features and advantages of discovery experiments have caused your text authors to emphasize discovery experiments in this edition of the text.

Molecular Modeling

Molecular modeling by computer saw a revolution in the late 1990s with the advent of affordable, sufficiently fast personal computers with adequate memory. Computer modeling enhances the benefits of assembling molecular models using model kits. Use of these kits is still encouraged. However, gone are the days where students had to depend only on molecular model kits to represent molecules in three dimensions. While these models still have their uses, computer modeling programs now provide exciting visualization of molecules and calculation of physical properties and thermodynamic parameters. Where possible, it is desirable to incorporate computer modeling into organic laboratory programs. The exercises in this book can be done using relatively inexpensive commercial software from one or more providers.

Computer Simulation of Experiments

Another use of computers is for simulation of laboratory procedures and experiments. Demonstrations of laboratory techniques are available as clips on the CD accompanying this text. Simulations of experiments are useful as prelab exercises to familiarize students with the experiment and to enhance learning in the laboratory. Simulations are also useful as illustrations of experiments that are difficult to carry out in the undergraduate laboratory environment. Experiments that require special equipment, inert gaseous environments, or especially noxious and toxic reagents can be experienced by students through virtual experiments on the computer. Examples of such experiments are available on the CD accompanying this text.

Green Chemistry

Academic and industrial organic chemists have led an initiative to replace the use of organic solvents with aqueous solvents. They have encouraged the recycling of chemicals in order to reduce production requirements of chemicals. They have encouraged use of environmentally benign reagents in place of hazardous and toxic reagents where possible. In this text, there have been efforts to reduce quantities of toxic reagents and solvents wherever possible and to develop "green" experiments. For example, new Experiment 14.2 is on the use of indium reagents in aqueous solvents to accomplish coupling reactions similar to Grignard reactions. Another objective of green chemistry is to prevent waste. In this book, microscale and miniscale experiments are used in order to help minimize waste.

Microscale and Miniscale Techniques

Microscale and miniscale organic techniques were first introduced two decades ago. However, changing over to new, smaller glassware and equipment has been slow in some laboratories for a number of reasons. One reason is the initial cost, but most institutions benefit by reduced costs of chemicals and hazardous waste disposal. The decision of whether to use a microscale procedure or a miniscale procedure often depends on the methods of characterization chosen by the instructor. This governs how much product is required for analysis. If a distillation is desired, a miniscale procedure is often chosen because of difficulties associated with distilling very small quantities of liquid. If an analysis of liquid products is to be done only by gas chromatographic analysis, a microscale procedure will cut down on costs of waste disposal.

New Features in the Second Edition

Accompanying a new section on molecular modeling, significant additions to this edition include expanded coverage of Diels-Alder chemistry, inclusion of enone chemistry with a chapter on enols, a new chapter on dicarbonyl compounds, and expanded coverage of heterocycles in the chapter on amines. New experiments and new options within experiments are included in many chapters. Many are discovery experiments. Among these are

Experiment 3.3, Relationships Between Structure and Physical Properties;
Experiment 3.8, Purification and Analysis of a Liquid Mixture;
Experiment 5.1B, Miniscale Synthesis of Alkenes Via Acid-catalyzed Dehydration of 3,3-Dimethyl-2-butanol;

Experiment 9.1C, Microscale Reaction of Cyclopentadiene with Maleic Anhydride;
Experiment 9.1E, Reaction of Anthracene with Maleic Anhydride;
Experiment 14.2, Using Indium Intermediates: Reaction of Allyl Bromide with an Aldehyde;
Experiment 15.3, Photochemical Oxidation of Benzyl Alcohol;
Experiment 16.2, Nucleophilic Aliphatic Substitution Puzzle: Substitution Versus Elimination;
Experiment 17.1C, Microscale Horner-Emmons Reaction of Diethylbenzyl Phosphonate and Benzaldehyde;
Experiment 18.2A, Microscale Reduction of 2-Cyclohexenone;
Experiment 18.2B, Microscale Reduction of *trans*-4-Phenyl-3-buten-2-one;
Experiment 18.3, Catalytic Transfer Hydrogenation Miniscale Reaction of Cyclohexenone;
Experiment 21.1, Base-Catalyzed Condensations of Dicarbonyl Compounds;
Experiment 22.2, Synthesis of Pyrazole and Pyrimidine Derivatives;
Experiment 24.1, Exploring Structure-function Relationships of Phenols;
Experiment 26.1, Soap from a Spice: Isolation, Identification and Hydrolysis of a Triglyceride;
Experiment 26.2, Preparation of Esters of Cholesterol and Determination of Liquid Crystal Behavior;
Experiment 29.2, Multistep Synthesis of Sulfanilamide Derivatives as Growth Inhibitors;
Experiment 29.3, Structural Determination of Isomers Using Decoupling and Special NMR Techniques.

Instructor's Manual

An instructor's manual is available on the website accompanying this text. This manual includes directions for laboratory preparators, instructor's notes for each experiment, solutions to problems, and prelab and postlab assignments. Test questions about many experiments are available on the web CT.

Course Website

The website http://www.mhhe.com/schoffstall2 offers supportive backup for the organic laboratory course. It presents updated helpful hints for lab preparators and instructors, typical schedules, sample electronic report forms, sample quiz and exam questions, examples of lab lecture or material for self-paced prelab student preparation, and relevant links to other websites. Some additional experiments are available on the website.

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We hope you find your laboratory experience profitable and stimulating.