

PREFACE

Of the diverse ways to study the living world, molecular biology has been most remarkable in the speed and breadth of its expansion. New data are acquired daily, and new insights into well-studied processes come on a scale measured in weeks or months rather than years. It's difficult to believe that the first complete organismal genome sequence was obtained a little over 20 years ago. The structure and function of genes and genomes and their associated cellular processes are sometimes elegantly and deceptively simple but frequently amazingly complex, and no single book can do justice to the realities and diversities of natural genetic systems.

This book is aimed at advanced students in molecular genetics and molecular biology. In order to provide the most current understanding of the rapidly changing subjects in molecular biology, we have enlisted leading scientists to provide revisions and content updates in their individual fields of expertise. Their expert knowledge has been incorporated throughout the text. Much of the revision and reorganization of this edition follows that of the third edition of *Lewin's Essential GENES*, but there are many updates and features that are new to this book. This edition follows a logical flow of topics; in particular, discussion of chromatin organization and nucleosome structure precedes the discussion of eukaryotic transcription, because chromosome organization is critical to all DNA transactions in the cell, and current research in the field of transcriptional regulation is heavily biased toward the study of the role of chromatin in this process. Many new figures are included in this book, some reflecting new developments in the field, particularly in the topics of chromatin structure and function, epigenetics, and regulation by noncoding RNA and microRNAs in eukaryotes.

This book is organized into four parts. **Part I (Genes and Chromosomes)** comprises Chapters 1 through 8. Chapter 1 serves as an introduction to the structure and function of DNA and contains basic coverage of DNA replication and gene expression. Chapter 2 provides information on molecular laboratory techniques. Chapter 3 introduces the

interrupted structures of eukaryotic genes, and Chapters 4 through 6 discuss genome structure and evolution. Chapters 7 and 8 discuss the structure of eukaryotic chromosomes.

Part II (DNA Replication, Repair, and Recombination) comprises Chapters 9 through 16. Chapters 9 through 12 provide detailed discussions of DNA replication in plasmids, viruses, and prokaryotic and eukaryotic cells. Chapters 13 through 16 cover recombination and its roles in DNA repair and the human immune system, with Chapter 14 discussing DNA repair pathways in detail and Chapter 15 focusing on different types of transposable elements.

Part III (Transcription and Posttranscriptional Mechanisms) includes Chapters 17 through 23. Chapters 17 and 18 provide more in-depth coverage of bacterial and eukaryotic transcription. Chapters 19 through 21 are concerned with RNA, discussing messenger RNA, RNA stability and localization, RNA processing, and the catalytic roles of RNA. Chapters 22 and 23 discuss translation and the genetic code.

Part IV (Gene Regulation) comprises Chapters 24 through 30. In Chapter 24, the regulation of bacterial gene expression via operons is discussed. Chapter 25 covers the regulation of expression of genes during phage development as they infect bacterial cells. Chapters 26 through 28 cover eukaryotic gene regulation, including epigenetic modifications. Finally, Chapters 29 and 30 cover RNA-based control of gene expression in prokaryotes and eukaryotes.

For instructors who prefer to order topics with the essentials of DNA replication and gene expression followed by more advanced topics, the following chapter sequence is suggested:

- Introduction: Chapter 1
 - Gene and Genome Structure: Chapters 4–6
 - DNA Replication: Chapters 9–12
 - Transcription: Chapters 17–20
 - Translation: Chapters 22–23
 - Regulation of Gene Expression: Chapters 7–8 and 24–30
- Other chapters can be covered at the instructor's discretion.