Human Chromosomes

Fourth Edition

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With 108 Illustrations, 9 in Full Color

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Cover illustration: A metaphase spread (front cover) and a karyotype (back cover) after in situ hybridization and detection of multiplex probes. Red and green bars represent regions that hybridized to fragments in only one probe pool, and yellow bars represent regions that hybridized equally to fragments in both probe pools. Mixed colors are due to overrepresentation of fragments from one pool. Regions that fail to hybridize to fragments in either pool show background DAPI blue fluorescence. (Reproduced from Müller et al., Toward a multicolor chromosome bar code for the entire human karyotype by fluorescence in situ hybridization, Hum Genet 100, fig. 3, page 273, copyright Springer-Verlag 1997.)

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Preface

This book presents a comprehensive introduction to the principles of human cytogenetics and provides examples of their applications, especially those that are important in diagnostic and preventive medicine. The authors have each worked in human cytogenetics for more than 40 years and have witnessed first-hand the enormous strides made in the field during this time. The many advances made since the third edition of this book reflect the rapidly growing application of molecular biological techniques and concepts by human cytogeneticists. Insertion of transposable elements, genomic imprinting, and expansion of trinucleotide repeats are only a few of the important cytogenetic mechanisms that have been discovered and shown to play a role in producing disease phenotypes. Molecular cytogenetic methods have taken center stage in cancer studies with the demonstration that cancers arise by chromosomal mechanisms such as gene amplification, oncogene activation by chromosome rearrangement, ectopic recombination leading to loss of heterozygosity, and multiple mechanisms leading to genome destabilization.

Preface

We present a comprehensive and relatively brief overview of the principles of cytogenetics, including the important new disease mechanisms previously mentioned. Examples are chosen that illustrate these principles and their application, thus preparing the reader to understand the new developments that constantly appear in the laboratory, the clinic, and the current literature of this very active field. At many points in the book, important unsolved problems in cytogenetics are mentioned with suggestions of how a solution might be sought, which acts as a stimulus to the reader to come up with his or her own suggestions. The book should be particularly useful for physicians who want to keep up with new developments in this field and students interested in a career in medical genetics or genetic counseling. It could easily serve as a text for a one-semester college or graduate-level course in human cytogenetics, or, with some supplementation, a course in general cytogenetics.

In this edition, the text has been extensively reorganized and almost completely rewritten to incorporate essential insights from cell and molecular genetics, along with other advances in cytogenetics, and to present them in a systematic way. Examples have been chosen that not only emphasize the underlying principles but also illustrate the growing clinical importance of molecular cytogenetics. Most of the tables and the majority of the figures are new, and virtually all are based on studies of human chromosomes. We are grateful to the colleagues and copyright holders who have generously permitted the use of their published and unpublished figures and tables.

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