

Human Chromosomes

Fourth Edition

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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 multi-color 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 firsthand 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.

Detroit, Michigan
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Contents

Preface v

1 Origins and Directions of Human Cytogenetics 1

Origins: Cytology, Genetics, and DNA Chemistry 2

The Midwives of Human Cytogenetics 3

The Birth of Clinical Cytogenetics 4

The Lyon Hypothesis 6

Adolescence: The Chromosome Banding Era 6

Somatic Cell Genetics and Chromosome Mapping 7

Maturity: The Molecular Era 8

References 10

2 The Mitotic Cell Cycle 13

The Cell Cycle: Interphase, Mitosis, and Cytokinesis 14

Cell Cycle Progression: Cyclins and Cyclin-Dependent Kinases 16

Contents

	Cell Cycle Checkpoints	19
	Prophase	20
	Prometaphase, Centrosomes, and the Mitotic Spindle	22
	Metaphase, Anaphase, and Telophase	22
	Nondisjunction, Loss of Chromosomes, and Mosaicism	24
	References	25
3	DNA Replication and Chromosome Reproduction	29
	Replication Is Semiconservative	29
	The Chemistry of Replication	31
	Initiation at Many Sites: Origins of Replication	33
	Replication Is Precisely Ordered: Replication Banding	35
	The Control of DNA Replication	38
	Replication of Chromosome Ends: Telomerase and Cell Aging	40
	Postreplication Steps: DNA Methylation and Chromatin Assembly	41
	References	42
4	General Features of Mitotic Chromosomes	45
	Metaphase Chromosomes	45
	The Chromosome Complement and Karyotype	47
	DNA Content and DNA-Based Flow Cytometric Karyotypes	48
	Centromeres and Kinetochores	49
	Telomeres	54
	Nucleolus Organizers and Ribosomal RNA Genes	55
	Constitutive and Facultative Heterochromatin	56
	References	56
5	The Chemistry and Packaging of Chromosomes	61
	DNA Content and the Estimated Number of Base Pairs in the Genome	62
	Histone Proteins and the Nucleosome	62
	The Chromosome Scaffold and Chromatin Loops	63
	Chromosome Domains in the Interphase Nucleus	67
	The Nuclear Matrix: Replication and Transcription Complexes	68
	Locus Control Regions and Functional Domains	70
	Euchromatin and Heterochromatin: Regulation of Gene Function	71
	Histone Modifications, DNA Methylation, and Chromosome Condensation	72
	References	74

6 Chromosome Bands 79

Q-banding 80

C-banding 81

G-banding, R-banding, and T-banding 83

High-Resolution and Replication Banding 84

Banding with Other Fluorochromes and Nonfluorochromes 85

Antibody Banding 87

Nuclease Banding 88

In Situ Hybridization Banding 89

Nomenclature of Banded Chromosomes and Abnormal Karyotypes 89

References 92

7 Molecular Correlates of Chromosome Bands 95

GC- and AT-Rich Isochores 95

Unmethylated CpG Clusters and Housekeeping and

Tissue-Specific Genes 98

Interspersed Repetitive DNA Sequences and Transposable Elements 99

Tandemly Repetitive Elements: Telomeres, Centromeres, and
Satellite DNAs 100

Chromosomal Proteins and Chromatin Conformation 101

Functional Significance of Chromosome Bands 103

References 103

8 In Situ Hybridization 107

In Situ Hybridization of Repetitive and Unique DNA Sequences 108

Fluorescence In Situ Hybridization 109

Replication Timing by FISH 114

Cloned, PCR-Generated, and In Situ-Generated Probes 114

Chromosome-, Region-, and Band-Specific Painting Probes 116

Multicolor FISH, Spectral Karyotyping, and Bar Codes 117

High-Resolution (Interphase and Fiber) FISH 118

Comparative Genomic Hybridization 121

References 121

9 Main Features of Meiosis 125

Prophase I: Leptotene, Zygotene, Pachytene, Diplotene,
and Diakinesis 127

Contents

Chiasmata and Genetic Recombination	132
Metaphase I, Anaphase I, Telophase I, Interkinesis, and Meiosis II	133
Female Meiosis: Dictyotene Arrest, Metaphase II Arrest, and Apoptosis	134
Male Meiosis	135
Segregation Distortion and Meiotic Drive	136
Meiotic Behavior of Three Homologous Chromosomes	137
References	138
10 Details of Meiosis	141
The Switch from Mitosis to Meiosis	141
Pairing of Homologous Chromosomes	142
The Synaptonemal Complex and Recombination Nodules	142
Nonrandom Distribution of Meiotic Recombination Sites	145
Molecular Mechanisms of Meiotic Recombination	146
Meiotic DNA Damage Checkpoint	149
Absence of a Spindle Assembly Checkpoint in Female Meiosis: Role in Nondisjunction?	151
References	151
11 Meiotic Abnormalities: Abnormal Numbers of Chromosomes	157
Incidence of Nondisjunction in Meiosis and Gametes	159
Incidence of Nondisjunction in Spontaneous Abortions, Stillborns, and Liveborns	161
Causes of Meiotic Nondisjunction	164
Maternal Age, Recombination, and Mechanisms of Nondisjunction	164
Parental Origin of Aneuploid Gametes	168
The Origin of Diploid Gametes and Polyploidy	169
Aneuploidy of Somatic (Mitotic) Origin: Mosaicism	170
References	171
12 Abnormal Phenotypes Due to Autosomal Aneuploidy or Polyploidy	175
Trisomy 21 and Down Syndrome	176
Trisomy 18 and Edwards Syndrome	178
Trisomy 13 and Patau Syndrome	178

Other Autosomal Aneuploidy Syndromes	180
Trisomy/Disomy Mosaicism	180
Triploidy and Tetraploidy	181
Spontaneous Abortions, Fetal Deaths, and Stillbirths	182
References	183

13 Chromosome Structural Aberrations 187

Chromosome and Chromatid Breaks and Rearrangements	189
Deletions (Partial Monosomies), Including Ring Chromosomes	191
Duplications (Partial Trisomies)	193
Misdivision of the Centromere: Centric Fusion and Centric Fission	195
Pericentric and Paracentric Inversions	196
Reciprocal Translocations	197
Robertsonian Translocations (RTs)	199
Intrachromosomal and Interchromosomal Insertions	200
Complex and Multiple Rearrangements	201
References	202

14 The Causes of Structural Aberrations 207

Exogenous Causes of Structural Aberrations	210
Endogenous Causes of Structural Aberrations	212
Transposable Elements and Other Interspersed Repeats	213
Interspersed Repeats as Hotspots for Double-Strand Breaks and Rearrangements	215
References	217

15 Syndromes Due to Autosomal Deletions and Duplications 223

Cri du Chat (Cat Cry) and Wolf–Hirschhorn Syndromes	224
Ring Chromosome Phenotypes	227
The Critical Regions for Deletion (Segmental Aneusomy) Syndromes	228
Miller–Dieker Syndrome	231
Di George/Velocardiofacial/CATCH22 Syndromes	231
Critical Region for the Charcot–Marie–Tooth Type 1A Duplication Syndrome	232
Critical Region for Down Syndrome	232
References	234

16	Clinical Importance of Translocations, Inversions, and Insertions	239
	Phenotypes of Balanced Translocation Heterozygotes (Carriers)	239
	Aberrant Meiotic Segregation in Reciprocal Translocation Carriers	240
	Aberrant Meiotic Segregation in Robertsonian Translocation Carriers	243
	Phenotypes Associated with Unbalanced Duplication/Deficiency Karyotypes	245
	Phenotypes of Inversion Heterozygotes (Carriers)	247
	Aberrant Meiotic Segregation in Inversion and Insertion Carriers	247
	Sperm Chromosomes in Meiotic Segregation Analysis	249
	References	251
17	Sex Determination and the Y Chromosome	255
	The Y Chromosome and Y Heterochromatin: The Y Body	255
	The Two Pseudoautosomal Regions	257
	Sex Determination: Rearrangements Localize the Male-Determining Gene to Yp	259
	SRY, the Only Male-Determining Gene on the Y Chromosome	260
	Autosomal Genes Involved in Male Sex Determination or Differentiation	261
	Other Genes on the Y Chromosome	262
	References	263
18	The X Chromosome, Dosage Compensation, and X Inactivation	267
	The Single Active X (Lyon) Hypothesis	269
	Skewed X Inactivation	271
	The Critical Region for X Inactivation: X Inactivation Center and the <i>XIST</i> Gene	272
	Reactivation of the X Chromosome	274
	Regions That Escape X Inactivation: Functional Map of the X Chromosome	274
	X ₁ Autosome Translocations and Spreading of Inactivation (Position Effect)	276
	References	278

19 Phenotypic Effects of Sex Chromosome Imbalance 283

- Turner Syndrome 284
- Is There a Critical Region for Turner Syndrome? 285
- Polysomy X 287
- Klinefelter Syndrome 288
- Phenotypes Associated with Multiple Y Karyotypes 288
- Deletions and Duplications of the X Chromosome: Risks Associated with Hemizygoty 289
- X_iAutosome and Y_iAutosome Translocations 291
- References 291

20 Fragile Sites, Trinucleotide Repeat Expansion, and the Fragile X Syndrome 295

- Common Fragile Sites: Methods of Induction 296
- Heritable (Rare) Fragile Sites 299
- FRAXA, the Fragile X Syndrome, and the *FMR1* Gene 300
- The Fragile X Phenotype Reflects the Number of CCG Repeats 301
- Mechanism of Expansion of Trinucleotide and Other Repeats 301
- Expansion of CCG Premutation Only in Maternal Meiosis 302
- Mechanism of Inactivation of the *FMR1* Gene 303
- Other Trinucleotide Expansion Disorders 303
- References 305

21 Euploid Chromosome Aberrations, Uniparental Disomy, and Genomic Imprinting 309

- Uniparental Disomy 309
- Confined Placental Mosaicism and the Origin of UPD 310
- UPD Can Lead to Homozygosity of a Recessive Disease Gene 311
- UPD Can Lead to Disease Due to a Novel Mechanism:
 - Genomic Imprinting 311
- Three Imprinting Disorders: Beckwith–Wiedemann, Prader–Willi, and Angelman Syndromes 313
- Chimeras, Triploidy, and Tetraploidy 315
- Ovarian Teratomas: Both Genomes Maternal in Origin 317
- Hydatidiform Moles: Both Genomes Usually Paternal in Origin 318
- References 319

22	Chromosome Changes in Cell Differentiation	323
	Programmed DNA Loss	324
	Facultative Heterochromatin: Chromatin Structure and Gene Expression	324
	Nature and Mechanism of Genomic Imprinting	325
	Tissue-Specific Differences in X Inactivation	327
	Germline-Specific Gene Expression and Sex-Specific Imprinting	328
	Embryonic Inactivation of All but One Centromere per Chromosome	329
	Endoreduplication, Polyploidy, and Polyteny	331
	Triradials, Multiradials, and ICF Syndrome, a Hypomethylation Disorder	333
	References	335
23	Somatic Cell Hybridization in Cytogenetic Analysis	339
	Cell Fusion	340
	Complementation Analysis in Heterokaryons	340
	Premature Chromosome Condensation and Allocyclcy	341
	Somatic Cell Hybrids	343
	Preferential Human Chromosome Loss from Rodent-Human Hybrids	345
	Induced Chromosome Breakage: Radiation Hybrids	347
	Microcell Hybrids	347
	Chromosome and Gene Transfer: Transgenomes and Transgenes	348
	References	349
24	Chromosome Instability Syndromes	353
	Bloom Syndrome	354
	Mitotic Recombination or Crossing Over	356
	Fanconi Anemia	357
	Ataxia Telangiectasia: A Cell Cycle Checkpoint Disorder	359
	Related Disorders with Chromosome Instability	360
	References	363
25	DNA and Gene Amplification	369
	Double Minutes and Homogeneously Stained Regions	370
	DMs and HSRs Are Expressions of Gene Amplification	370

- Mechanisms of Gene Amplification 374
- How Does Gene Amplification Lead to Cancer? 379
- References 379

26 Genome Destabilization and Multistep Progression to Cancer 385

- Immortality of Transformed and Malignant Cells 386
- Genetic Basis of Cancer: Sequential Chromosome or Gene Mutations 387
- Clonal Origin, Selection, and Multistep Tumor Progression 389
- Spindle Aberrations and Instability of Chromosome Number 391
- The Major Mechanism of Spindle Aberrations and Heteroploidy 394
- Structural Chromosome Changes 394
- DNA Damage Checkpoint and Structural Instability of Chromosomes 395
- Other Causes of Structural Instability of Chromosomes 397
- Environmental Causes of Cancer 398
- References 399

27 Chromosomes and Cancer: Activation of Oncogenes 405

- Mechanisms of Oncogene Action 406
- Reciprocal Translocations and Oncogene Activation 407
- How Do Translocations Activate Cellular Oncogenes? 409
- Amplification and Oncogene Activation 411
- Relaxation of Imprinting and Oncogene Activation 413
- References 413

28 Chromosomes and Cancer: Inactivation of Tumor Suppressor Genes 415

- Tumor/Nontumor Cell Hybrids: First Evidence for Tumor Suppressor Genes 415
- Allele Loss and Loss of Heterozygosity 417
- Retinoblastoma and the Two-Hit Model of Carcinogenesis 417
- Mechanism of Tumor Suppression by a Functional *RB1* Gene 418
- The p53 Tumor Suppressor Gene, *TP53* 419
- Other Genes That Affect the Cell Cycle 420
- Imprinted Tumor Suppressor Genes 421
- Genes That Suppress Oncogenes or Influence Transcription 423
- Genes That Affect Cell Adhesion 425

Contents

Metastasis Suppressor Genes 426

References 426

29 Mapping Human Chromosomes 431

Genetic Linkage Maps 432

Mapping Disease Genes: Family Studies with Genetic Markers 435

Assignment of Genes to Chromosomes: Synteny Groups 435

Physical Maps 437

The Human Genome Project 440

References 443

30 Genome Plasticity and Chromosome Evolution 447

Genome Plasticity 448

Evolution of the Autosomes 451

Evolution of the X and Y Chromosomes: Dosage Compensation 452

Evolution of Telomeric and Centromeric Regions 456

References 457

31 The Future of Human Cytogenetics 463

Unsolved Problems 464

Genome Organization 465

Directions 469

New Technology 470

References 472

Index 475