

# *Contents in Brief*

---

## **Part 1 Fundamentals of Gene Structure, Function, and Transmission**

<b>1</b>	<i>Genetics and the Organism</i>	<b>1</b>
<b>2</b>	<i>The Structure of Genes and Genomes</i>	<b>23</b>
<b>3</b>	<i>Gene Function</i>	<b>55</b>
<b>4</b>	<i>The Transmission of DNA at Cell Division</i>	<b>91</b>
<b>5</b>	<i>The Inheritance of Single-Gene Differences</i>	<b>117</b>
<b>6</b>	<i>Genetic Recombination in Eukaryotes</i>	<b>147</b>
<b>7</b>	<i>Recombination in Bacteria and Their Viruses</i>	<b>183</b>

## **Part 2 Methods of Genetic Manipulation**

<b>8</b>	<i>Recombinant DNA and Genetic Engineering</i>	<b>213</b>
<b>9</b>	<i>Genomics</i>	<b>265</b>
<b>10</b>	<i>Gene Mutation: Origins and Repair Processes</i>	<b>313</b>
<b>11</b>	<i>Chromosome Mutations</i>	<b>349</b>
<b>12</b>	<i>Mutational Dissection</i>	<b>385</b>

## **Part 3 Systems Genetics: From Gene to Phenotype**

<b>13</b>	<i>Regulation of Gene Transcription</i>	<b>419</b>
<b>14</b>	<i>From Gene to Phenotype</i>	<b>453</b>
<b>15</b>	<i>Regulation of Cell Number: Normal and Cancer Cells</i>	<b>483</b>
<b>16</b>	<i>The Genetic Basis of Development</i>	<b>509</b>

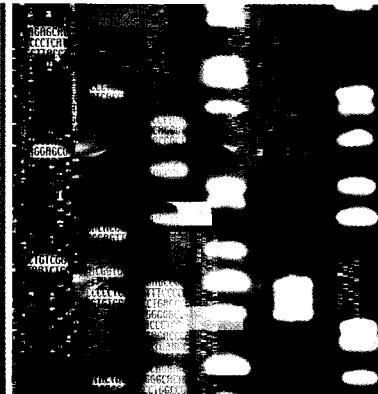
## **Part 4 Genetic Analysis of Populations**

<b>17</b>	<i>Population Genetics</i>	<b>553</b>
<b>18</b>	<i>Quantitative Genetics</i>	<b>587</b>
<b>19</b>	<i>Evolutionary Genetics</i>	<b>619</b>

# Contents

# Part 1 Fundamentals of Gene Structure, Function, and Transmission

<b>1</b>	<b>GENETICS AND THE ORGANISM</b>	<b>1</b>
	The Science of Genetics	2
	The Physical and Chemical Basis of Heredity	4
	From Gene to Protein	5
	Genetic Variation	7
	Methodologies Used in Genetics	10
	Genes in Development	11
	Genes, the Environment, and the Organism	12
	Three Levels of Development	17
	Genetics and Evolution	17
	Genetics and Human Affairs	18
<b>2</b>	<b>THE STRUCTURE OF GENES AND GENOMES</b>	<b>23</b>
	The Nature of DNA	26
	The Structure of Genes	32
	The Nature of Genomes	35
	The Nature of Eukaryotic Nuclear Chromosomes	41
	An Introduction to Comparative Genomics	49
<b>3</b>	<b>GENE FUNCTION</b>	<b>55</b>
	RNA	58
	Making and Processing Transcripts	60
	Protein	66
	Protein Function and Malfunction in Cells	74
	Defective Proteins and Dominance and Recessiveness	81
	Functional Division of Labor in the Gene Set	84



Chapter 2 Opening Figure Page 23

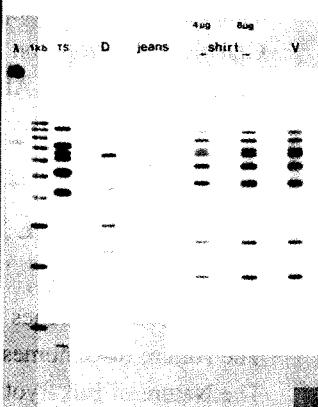


Figure 3-1b Page 56

<b>4 THE TRANSMISSION OF DNA AT CELL DIVISION</b>	<b>91</b>
DNA Replication	93
Cell Division: An Overview	100
Cell Division that Conserves the Genetic Material	100
Cell Division that Halves the Genetic Content	107
<b>5 THE INHERITANCE OF SINGLE-GENE DIFFERENCES</b>	<b>117</b>
Inheritance Patterns	119
Human Pedigree Analysis	128
Inheritance of Organelle Genes	137
<b>6 GENETIC RECOMBINATION IN EUKARYOTES</b>	<b>147</b>
Recombination Analysis	150
Independent Assortment	150
Crossing-Over	156
Linkage Maps	158
Mapping Using a Trihybrid Testcross	162
The $\chi^2$ Test	167
The Mechanism of Meiotic Crossing-Over	169
Recombination between Alleles of a Gene	172
<b>7 RECOMBINATION IN BACTERIA AND THEIR VIRUSES</b>	<b>183</b>
Detecting Recombination in Bacteria	186
Bacterial Conjugation	188
Bacterial Transformation	196
Bacteriophage Genetics	197
Physical Interaction of Phage and Bacterial Genomes	201
<b>Part 2 Methods of Genetic Manipulation</b>	
<b>8 RECOMBINANT DNA AND GENETIC ENGINEERING</b>	<b>213</b>
Generating Recombinant DNA Molecules	217
Replicating Recombinant Molecules	220
Exploiting Recombinant Molecules	226
Using Recombinant DNA Technology for Genetic Engineering	242



Chapter 8 Opening Figure 1  
Page 213



Chapter 8 Opening Figure 2  
Page 213

<b>9 GENOMICS</b>	<b>265</b>
Mapping Whole Genomes	269
Genome Projects	270
High-Resolution Genetic Maps	271
Physical Maps of the Genome	280
The Sequence of the Genome	284
Success Stories: The Weed, The Worm, The Fly, and the Human Genomes	294
Bioinformatics: Gleaning Meaning from Genomic Sequence	294
Functional Genomics	303
The Gene Content of the Human Genome	306
<b>10 GENE MUTATION: ORIGINS AND REPAIR PROCESSES</b>	<b>313</b>
Molecular Categories of Gene Mutations	315
Point Mutations	315
Mobile Elements and Gene Mutation	331
Biological Repair Mechanisms	337
Mutagenesis, Repair, and Human Disease	344
<b>11 CHROMOSOME MUTATIONS</b>	<b>349</b>
Changes in Chromosome Number	351
Changes in Chromosome Structure	363
The Overall Incidence of Human Chromosome Mutations	372
Evolution of the Genome	373
Identifying Chromosome Mutations by Genomics	375
<b>12 MUTATIONAL DISSECTION</b>	<b>385</b>
The Components of Mutational Dissection	388
Selection of Mutagen	388
The Mutational Assay System	397
Analysis of the Recovered Mutations	409
Further Aspects of Mutational Analysis	413
<b>Part 3 Systems Genetics: From Gene to Phenotype</b>	
<b>13 REGULATION OF GENE TRANSCRIPTION</b>	<b>419</b>
The Logic of Prokaryotic Gene Regulation	421
The Basics of Prokaryotic Transcriptional Regulation	421
Regulation of the Lactose System	423

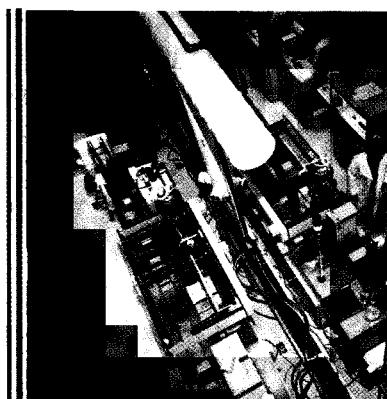


Figure 9-20 Page 286

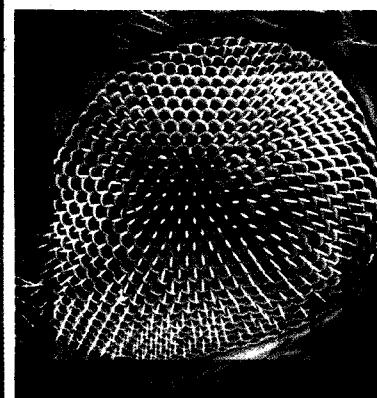


Figure 12-31 Page 407

Dual Positive and Negative Control: The Arabinose Operon	432
Metabolic Pathways	433
Transcriptional Regulation in Eukaryotes	433
Structure and Function of Transcription Factors	440
Epigenetic Inheritance	442
Transcriptional Regulation in the Era of Genomics	445
Endocrine Regulation of Transcription Factor Activity	446
<b>14 FROM GENE TO PHENOTYPE</b>	<b>453</b>
A Diagnostic Test for Alleles	456
Interactions between the Alleles of One Gene	459
Inferring Gene Interaction from Dihybrid Ratios	463
Penetrance and Expressivity	471
<b>15 REGULATION OF CELL NUMBER: NORMAL AND CANCER CELLS</b>	<b>483</b>
The Balance between Cell Proliferation and Cell Elimination	485
The Cell-Proliferation Machinery: Cell Cycle Regulation	486
The Machinery of Programmed Cell Death: The Apoptosis Pathway	488
Controlling Cell Proliferation and Death Machinery	491
Cancer: The Genetics of Aberrant Cell Control	496
<b>16 THE GENETIC BASIS OF DEVELOPMENT</b>	<b>509</b>
The Logic of Building the Body Plan	511
Binary Fate Decisions: Pathways of Sex Determination	513
<i>Drosophila</i> Sex Determination: Every Cell for Itself	515
Sex Determination in Mammals: Coordinated Control by the Endocrine System	519
Binary Fate Decisions: The Germ Line Versus the Soma	521
Forming Complex Pattern: Establishing Positional Information	526
Forming Complex Pattern: Utilizing Positional Information to Establish Cell Fates	533
Additional Aspects of Pattern Formation	538
The Many Parallels in Vertebrate and Insect Pattern Formation	542
Do the Lessons of Animal Development Apply to Plants?	545
<b>Part 4 Genetic Analysis of Populations</b>	
<b>17 POPULATION GENETICS</b>	<b>553</b>
Variation and Its Modulation	556
The Effect of Sexual Reproduction on Variation	563
Sources of Variation	566
Selection	571



Figure 14-14b Page 465



Figure 15-1b Page 484

Balanced Polymorphism	576
Artificial Selection	578
Random Events	580
<b>18 QUANTITATIVE GENETICS</b>	<b>587</b>
Genes and Quantitative Traits	590
Some Basic Statistical Notions	591
Genotypes and Phenotypic Distributions	593
Norms of Reaction	595
The Heritability of a Quantitative Character	598
Quantifying Heritability	600
Locating Genes	604
More on Analyzing Variance	606
Specialized Topics: Statistical Analysis	609
<b>19 EVOLUTIONARY GENETICS</b>	<b>619</b>
Conservation and Change in Evolution	622
The Basic Principles of Darwinian Evolution	622
A Synthesis of Forces: Variation and Divergence of Populations	624
Multiple Adaptive Peaks	627
Heritability of Variation	630
Observed Variation within and between Populations	631
Process of Speciation	632
Origin of New Genes	634
Rate of Molecular Evolution	638
Genetic Evidence of Common Ancestry in Evolution	640
Comparative Genomics and Proteomics	642
<b>APPENDIX A: Genetic Nomenclature</b>	<b>649</b>
<b>APPENDIX B: Bioinformatic Resources for Genetics and Genomics</b>	<b>651</b>
<b>GLOSSARY</b>	<b>655</b>
<b>FURTHER READINGS</b>	<b>683</b>
<b>ANSWERS TO SELECTED PROBLEMS</b>	<b>693</b>
<b>INDEX</b>	<b>715</b>

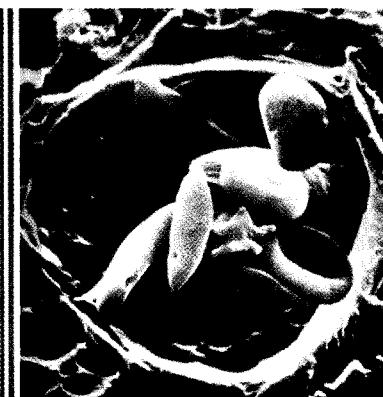


Figure 17-1a Page 554