

Contents

Foreword	x
Preface	xiv
Acknowledgments	xvii
Introduction	xviii
1 From Breeding to a Science of Heredity	1
The Origins of Domestic Plants and Animals	2
The Rise of Agriculture and Domestication	6
Early Ideas of Inheritance	9
<i>The Girl Who Gave Birth to Rabbits</i>	10
Heredity and the Theory of Evolution	15
Gregor Mendel Discovers the Laws of Heredity	18
2 Classical Genetics (1900–1950)	27
Cell Theory and the Discovery of Chromosomes	27
The Rediscovery of Mendel's Work	31
Chromosomes and Heredity	35
<i>The Debate over Natural Selection</i>	36
Sex and the X-Y Chromosomes	40
Fruit Flies and the Birth of the Modern Laboratory	42
Gene Maps	46
Chromosome Puzzles	49
Maize and "Jumping Genes"	52
"One Gene Makes One Enzyme"	54

3 Molecular Genetics: What Genes Are and How They Work (1950–1970)	59
Physics Stimulates New Ways of Thinking about Genes	60
Genes Are Made of DNA	62
The Double Helix	65
RNA Is the Messenger	71
The Architecture of Genes	77
On-Off Switches for Genes	79
The Flow of Information from Gene to Protein in Complex Organisms	81
 4 The Rise of Genetic Engineering (1970–1990)	 84
Recombinant DNA	85
Molecular Cloning and Using Bacteria as Drug Factories	87
“Natural” Genetic Engineering	88
DNA Sequencing	94
The Polymerase Chain Reaction (PCR)	97
Making and Marketing Genetically Modified Plants and Animals for Food	102
Knockouts, Knock Ins, and Other Methods to Study Gene Functions	107
Beatrice Mintz: A Pioneer of Mouse Genetics	108
Transgenic Animals and Models of Human Disease	110
DNA Fingerprinting	114
 5 Genetic Engineering in the Age of Genomes	 117
The Complexity of Genomes	117
Introns and Alternative Splicing	119
Noncoding RNAs	121

Quality Control: How Cells Detect	
Defective Genes	122
RNA Knockouts	127
Molecular Machines	128
Conditional Mutagenesis	131
Other Methods of Controlling the Output	
of Genes	135
Molecular Medicine and Gene Therapies	139
DNA Vaccines and T-Cell Therapies	142
Personalized Medicine in the Genome Age	143
6 Ethics and Genetic Engineering	150
Reproductive Cloning	151
Therapeutic Cloning and Experiments	
with Human Cells	156
Genetic Testing and Concerns	
about Eugenics	159
GM Foods and the Rise of	
Environmental Movements	166
Owning Genes, Genomes, and Living Beings	171
A Look Farther Ahead	174
Chronology	180
Glossary	190
Further Resources	198
Index	206