CONTENTS

Preface xiii

Chapter 1 Introduction 1 Chapter Summary 6

Chapter 2 Concepts of Evolution 7 A Brief History of Evolutionary Ideas 7 Ideas About Time 7 The Great Chain of Being 9 Scientific Approaches to Evolution 9 Lamarck's Theory of Evolution 10 Darwin's Theory of Evolution 11 Types of Evidence for Evolution 13 Creationists vs. Evolutionists 13 Adaptation 15 Paleontology 19 Biogeography 19 Comparative Anatomy 20 Comparative Embryology 23 Artificial Selection 23 Other Evidence for Evolution 23 Chapter Summary 24

Chapter 3 Genetics and Microevolution 26

The Chemical Basis of Life 26 Proteins 26 Nucleic Acids 27 Duplication of DNA 30 Direction of Protein Synthesis 31 Genetics 32 Sexual Reproduction 33 Mendelian Genetics 34 Microevolution 40 Introduction to Population Genetics 40 Forces of Evolution 43 The Synthetic Theory of Evolution 46 Chapter Summary 47

Molecular Genetics, Genomics, Chapter 4 and Human Genetics 48 A Closer Look at Chromosomes 48 Characteristics of Chromosomes 48 Chromosome Mapping 51 **Epigenetics** 53 Extrachromosomal Genetics 55 RNA Processing 55 Mitochondrial DNA 57 Chloroplast DNA 58 Tracing Genetic Variability and Function 58 Genetic Variability 58 Understanding Gene Function 59 A Brief Look at Quantitative Genetics 61 Human Genetics and the Human Genome 62 Family Studies in Human Genetics 62 The Human Genome 63 The Human Genome Project 63 The Next Step? 64 Chapter Summary 65

Chapter 5 Macroevolution and Taxonomy 66

Taxonomy 66

Species and Speciation 66 Taxonomic Units above the Species Level 71 Macroevolution 74 Some Highlights in the History of Life: An Anthropocentric View 74 The Human Journey 81 Macroevolutionary Processes 86 Chapter Summary 87

Chapter 6 "Race" and Human Variation in Physical Traits 89

Race 89
Race, Population, and Ethnic Group 90
Clines Versus Clumps 90
A Short History of Western Race Concepts: Ancient 91
A Short History of European Race Concepts: Modern 93
Phenotypic Characteristics of Human Variability 96
Nature Versus Nurture 96
Human Pigmentation: Skin Color 97

Human Pigmentation: Hair and Eye Color 102 Hair Form 104 Epicanthic Evefolds 105 Body Size and Shape 105 Head Form 108 Dermatoglyphics 109 Skeletal and Dental Variation 110 Age Differences in the Skeleton and Teeth 110 Sex Differences in the Skeleton 110 Individual Variation in Skeletal and Dental Features 111 Race and Intelligence 112 What Is Intelligence? 112 IQ and Heredity 113 Population Differences in IQ 113 Patterns of Human Variability 114 Chapter Summary 115

Chapter 7 Genotypic Traits and the Tracing of Population Affiliations 116

Genotypic Traits Traditionally Used in Human Biology 116 Blood Groups: The ABO System 117 The MNSs Blood Group Systems 120 The Rhesus (Rh) Blood-Group System 120 Hemoglobin Variants 122 Glucose-6-Phosphate Dehydrogenase Deficiency 127 Genetic Traits from Contemporary Molecular Biology Used in Human Biology 127 Major Types of Molecular Genetic Studies Used in Human Biology 128 Uses for Human Molecular Genetics Studies 128 The Genetic History of Homo Sapiens 129 Genetics and Human Migrations 132 Genetic and Disease Risk 140 Genetics and the Notion of Race 140 Chapter Summary 141

Chapter 8 Demography: Populations, Reproduction, and Mortality 142 Population Ecology 142 Population Growth 142 Population Ecology: Concluding Remarks 146 Demography of Human Populations 147 Fertility and Fecundity 147 Mortality 150 Migration 153 Human Population Growth 155 Population Increase 155 Human Population Structure 156 Implications of Growth 157 Chapter Summary 160

Chapter 9

Life Span: Growth and Development 161

The General Pattern of Human Growth 161 Prenatal Growth 161 Growth after Birth: General Patterns 165 Growth of Specific Body Parts 169 Development of Differential Systems 170 Development of Selected Other Systems 172 Growth after Birth: Population Differences 175 Environmental Effects on Growth 175 Genetics and Population Growth Differences 178 Growth and Development: A Final Consideration 179 Chapter Summary 179

Chapter 10 Life Span: Aging and Senescence 181

The Biology of Senescence 181 Aging at the Cellular Level 181 Superficial Changes During Senescence 186 Theories of Senescence 188 Mechanistic Theories of Senescence 188 Evolutionary Theories of Senescence 190 Selected System-Specific Senescence Theories 192 Conclusion: Theories of Senescence 192 The Human Population Biology of Senescence 193 Population Differences in Life Span 193 Sex Differences in Senescence 196 Population Differences in Diseases Associated with Senescence 196 Conclusion 200 Chapter Summary 200

Chapter 11 Human Adaptability to Physical Stressors 201

Limiting Factors, Tolerance, and Environmental Physiology 201

Law of Tolerance 201

Environmental Physiology 202

Human Adaptability 204

Adaptation to Cold and Heat 206

Thermoregulation 206

Cold Adaptation 208

Heat Adaptation 212

Hot-Dry Macroenvironments 212

Warm-Humid Environments 214

Conclusion to Thermoregulation 216

Adaptation to High Altitude 216

Behavioral and Cultural Adjustments to Hypoxia 217

Biological Adaptations to Hypoxia 218

Population Differences in Adaptability to High-Altitude Hypoxia 219

High Activity Levels 221

The Requirements of Work 221

Behavioral and Cultural Adjustments to High Workloads 221

Biological Adaptations to High Workloads 221

Adaptive Consequences of Work Capacity 224

Conclusion 224

Chapter Summary 224

Chapter 12 Human Adaptability to Biological Stressors 226

Malnutrition 226 Food versus Nutrients 226 Types of Nutrients 227 Protein-Calorie Malnutrition 227 Protein Deficiency 228 Protein-Calorie Malnutrition: Total Undernutrition 229 Micronutrient Deficiencies 233 Vitamin Deficiencies 233 Electrolyte and Mineral Deficiencies 236 Overnutrition 238 Conclusion: Malnutrition 238 Infectious Disease 238 Host-Parasite Relationships 239 Vector-Borne Diseases 240 Direct-Contact Diseases 242 Diseases Due to Intimate Contact 244 Poor-Sanitation Diseases 247 Conclusion: Infectious Diseases 249 General Conclusion: The Impact of Biological Stressors on Human Biology 249 Chapter Summary 250

Chapter 13 Human Biology in the Modern World 251

Possible Reduced Selective Forces 251 The Accumulation of Minor Genetic Problems 252 Reduced Selection Due to Medical Interventions 254 General Stress 256 The Nature of General Stress 257 Adiposity and Obesity: Are We Eating Ourselves to Death? 262 The Obesity Epidemic 262 The Causes of Increased Adiposity 263 Pollution: The Fouling of the Environment 268 Air Pollution 268 Water Pollution 269 Solid Waste Pollution 270

Solid-Waste Pollution 270

Pollution and Human Variation 271

Conclusion 272

Chapter Summary 272

Chapter 14 Human Biological Variation: A Look to the Future and Some Final Thoughts on Ethics 274

Human Biology in the Future 274
An Individual-Level View of Future Human Biology 274
The Future of Human Population Variability 275
Final Thoughts on the Ethics of Human Biology Research 277
Prevention of Harm to the Individual Participant 277
Prevention of Harm to Communities 279
What Is Normal? 280
Chapter Summary 282

Glossary 283 References 296 Credits 321 Index 323