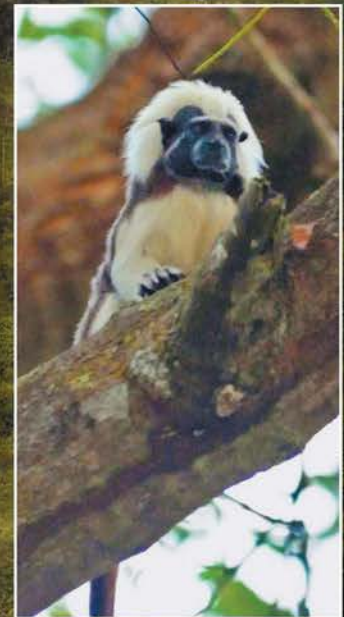


2013–2014 Edition

# INTRODUCTION TO PHYSICAL ANTHROPOLOGY



Robert Jurmain   Lynn Kilgore   Wenda Trevathan   Russell L. Ciochon

# Major Fossil Hominin Sites





1. SLOVENIA
2. CROATIA
3. BOSNIA AND HERZEGOVINA
4. ALBANIA
5. MACEDONIA
6. SERBIA AND MONTENEGRO

INTRODUCTION TO

# Physical Anthropology

## **ABOUT THE COVER IMAGE**

Our closest evolutionary cousins, the nonhuman primates are among the most endangered animals on earth. The book cover shows four of the most endangered species, all of which are close to extinction due to destructive human practices.

2013–2014 Edition

INTRODUCTION TO  
**Physical  
Anthropology**

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***Introduction to Physical Anthropology,  
2013–2014 Edition***

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Production Service, Composition, and Illustration:

Patti Zeman, Randy Miyake, Hesperheide Design;  
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Photo Researcher: Patti Zeman, Hesperheide Design

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Copy Editor: Heidi Thaens

Cover and Text Designer: Gary Hesperheide,  
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Cover Images: Deforestation in Madagascar: © Russell A. Mittermeier / Conservation International Foundation, Inc.; Tonkin snub-nosed monkey: Quyet Khac Le; Silky sifaka lemur: © Kevin Schafer / Corbis; Sahafary sportive lemur: © Edward E. Louis, Jr. / Conservation International Foundation, Inc.; Cotton-top tamarin: © Russell A. Mittermeier / Conservation International Foundation, Inc.

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Library of Congress Control Number: 2012954024

Student Edition:

ISBN-13: 978-1-285-06197-9

ISBN-10: 1-285-06197-7

Loose-Leaf Edition:

ISBN-13: 978-1-285-06203-7

ISBN-10: 1-285-06203-5

**Wadsworth**

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Printed in the United States of America

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# Brief Contents

CHAPTER 1 Introduction to Physical Anthropology 3

## Heredity and Evolution

CHAPTER 2 The Development of Evolutionary Theory 25

CHAPTER 3 The Biological Basis of Life 49

CHAPTER 4 Heredity and Evolution 77

CHAPTER 5 Macroevolution: Processes of Vertebrate and Mammalian Evolution 107

## Primates

CHAPTER 6 Survey of the Living Primates 135

CHAPTER 7 Primate Behavior 175

CHAPTER 8 Overview of the Fossil Primates 217

## Hominin Evolution

CHAPTER 9 Paleoanthropology: Reconstructing Early Hominin Behavior and Ecology 255

CHAPTER 10 Hominin Origins in Africa 277

CHAPTER 11 The First Dispersal of the Genus *Homo*: *Homo erectus* and Contemporaries 307

CHAPTER 12 Premodern Humans 331

CHAPTER 13 The Origin and Dispersal of Modern Humans 363

## Contemporary Human Evolution

CHAPTER 14 Modern Human Biology: Patterns of Variation 389

CHAPTER 15 Modern Human Biology: Patterns of Adaptation 413

CHAPTER 16 Legacies of Human Evolutionary History and the Human Life Course 441

CHAPTER 17 The Human Disconnection 469

Appendix A: Atlas of Primate Skeletal Anatomy 484

Appendix B: Sexing and Aging the Skeleton 492

Glossary 497

Bibliography 506

Index 532



# Contents

Preface xvi  
Acknowledgments xix  
Supplements xx

## CHAPTER 1

### Introduction to Physical Anthropology 3

Introduction 3  
The Human Connection 5  
Biocultural Evolution 6  
What Is Anthropology? 10

Cultural Anthropology 11  
Archaeology 11  
Linguistic Anthropology 11  
Physical Anthropology 12  
Applied Anthropology 18  
Physical Anthropology and the Scientific Method 19  
**A Closer Look** Forensic Anthropology in Practice 21  
The Anthropological Perspective 22  
Summary of Main Topics 23  
Critical Thinking Questions 23

## Heredity and Evolution



Peremou Nurdisany/Photo Researchers, Inc.

## CHAPTER 2

### The Development of Evolutionary Theory 25

A Brief History of Evolutionary Thought 26  
    The Scientific Revolution 27  
    Precursors of the Theory of Evolution 29  
The Discovery of Natural Selection 33  
    In Darwin's Shadow 37  
Natural Selection 38  
Natural Selection in Action 39  
Constraints on Nineteenth-Century Evolutionary Theory 42  
Opposition to Evolution Today 42  
    A Brief History of Opposition to Evolution in the United States 43  
**At a Glance** The Mechanism of Natural Selection 45  
How Do We Know? 46  
Summary of Main Topics 46  
Critical Thinking Questions 47  
Media Resources 47

**CHAPTER 3****The Biological Basis of Life 49**

- Cells 50
- The Structure of DNA 51
- A Closer Look** Rosalind Franklin: The Fourth (but Invisible) Member of the Double Helix Team 52
- DNA Replication 52
- Protein Synthesis 53
- What Is a Gene? 57
- Regulatory Genes 58
- A Closer Look** Noncoding DNA—Not Junk After All 59
- At a Glance** Coding and Noncoding DNA 61
- Mutation: When Genes Change 61
- Chromosomes 63
  - Karyotyping Chromosomes 66
- Cell Division 67
  - Mitosis 67
  - Meiosis 68
- New Frontiers 71
- How Do We Know? 74
- Summary of Main Topics 75
- Critical Thinking Questions 75
- Media Resources 75

**CHAPTER 4****Heredity and Evolution 77**

- The Genetic Principles Discovered by Mendel 78
  - Segregation 78
  - Dominance and Recessiveness 79
- Mendelian Inheritance in Humans 83
  - Misconceptions about Dominance and Recessiveness 83
  - Patterns of Mendelian Inheritance 85
- Non-Mendelian Inheritance 89
  - Polygenic Inheritance 89
- At a Glance** Mendelian vs. Polygenic Traits 92
  - Mitochondrial Inheritance 92
  - Pleiotropy 93
- Genetic and Environmental Factors 93
- Modern Evolutionary Theory 94
  - The Modern Synthesis 94
  - A Current Definition of Evolution 94
- Factors That Produce and Redistribute Variation 95
  - Mutation 95
  - Gene Flow 96
  - Genetic Drift and Founder Effect 97

- Natural Selection Is Directional and Acts on Variation 100
- Review of Genetics and Evolutionary Factors 102
- How Do We Know? 104
- Summary of Main Topics 105
- Critical Thinking Questions 105

**CHAPTER 5****Macroevolution: Processes of Vertebrate and Mammalian Evolution 107**

- How We Connect: Discovering the Human Place in the Organic World 108
- Principles of Classification 108
- Making Connections: Constructing Classifications and Interpreting Evolutionary Relationships 110
  - Comparing Evolutionary Systematics with Cladistics 111
- A Closer Look** Evo-Devo: The Evolution Revolution 112–113
  - An Example of Cladistic Analysis: The Evolutionary History of Cars and Trucks 114
  - Using Cladistics to Interpret Real Organisms 114
- At a Glance** Comparing Two Approaches to Interpretation of Evolutionary Relationships 117
- Definition of Species 117
- Interpreting Species and Other Groups in the Fossil Record 119
  - Recognition of Fossil Species 120
  - Recognition of Fossil Genera 121
- What Are Fossils and How Do They Form? 122
- Humans Are Vertebrates: Distant Connections 124
- A Closer Look** Deep Time 126–127
- Humans Are Also Mammals: Closer Connections 128
- The Emergence of Major Mammalian Groups 130
- Processes of Macroevolution 130
  - Adaptive Radiation 130
  - Generalized and Specialized Characteristics 131
- Working Together: Microevolution and Macroevolution 132
- How Do We Know? 133
- Summary of Main Topics 133
- Critical Thinking Questions 133

# Primates



Richard Mitterman/GonzFoto/Alamy

## CHAPTER 6

### Survey of the Living Primates 135

Primate Characteristics 136

Primate Adaptations 139

Evolutionary Factors 139

**A Closer Look** Primate Cranial Anatomy 140–141

Geographical Distribution and Habitats 141

Diet and Teeth 144

Locomotion 145

Primate Classification 146

A Survey of the Living Primates 148

Lemurs and Lorises 148

Tarsiers 150

Anthropoids: Monkeys, Apes, and Humans 151

Hominoids: Apes and Humans 158

Endangered Primates 166

**A Closer Look** Aye-Ayes: Victims of Derived

Traits and Superstition 168

The Bushmeat Trade 169

How Do We Know? 172

Summary of Main Topics 172

Critical Thinking Questions 173

## CHAPTER 7

### Primate Behavior 175

The Evolution of Behavior 176

Some Factors That Influence Social Structure 178

**A Closer Look** Types of Nonhuman Primate Social Groups 180

Why Be Social? 181

Primate Social Behavior 182

Dominance 182

**At a Glance** Primate Social Strategies 183

Communication 184

Aggressive and Affiliative Behaviors within Groups 186

Aggression 186

Affiliative Behaviors 187

Reproduction and Reproductive Behaviors 188

Reproductive Strategies 189

Sexual Selection 189

Infanticide as a Reproductive Strategy? 190

Mothers, Fathers, and Infants 192

Nonhuman Primate Models for the Evolution of Human Behavior 194

Brain and Body Size 195

Language 197

The Evolution of Language 200

Primate Cultural Behavior 202

**At a Glance** Evolution of Human Language 203

Conflict between Groups 207

Prosocial Behaviors: Affiliation, Altruism, and Cooperation 210

Altruism 210

The Primate Continuum 212

How Do We Know? 213

Summary of Main Topics 214

Critical Thinking Questions 215

**CHAPTER 8****Overview of the Fossil Primates 217**

Background to Primate Evolution: Late Mesozoic 218

Primate Origins 218

**A Closer Look** Building Family Trees from Genes 220

Made to Order: Archaic Primates 221

Eocene Euprimates 222

Lemur Connections? The Adapoids 223

**At a Glance** Key Early Primate Names 226

Closer Connections to Living Primates: The Evolution of True Lemurs and Lorises 226

Tarsier Connections? The Omomyoids 228

Evolution of True Tarsiers 229

Eocene and Oligocene Early Anthropoids 229

Oligocene Primates 231

**A Closer Look** Primate Diversity in the Fayum 232

True Anthropoids 233

Early Platyrrhines: New World Anthropoids 234

**A Closer Look** Island Hopping and Primate Evolution 236

Miocene Primates 237

Monkeying Around 237

**At a Glance** Key Early Anthropoid Names 239

Aping Monkeys 240

True Apes 244

**At a Glance** Key Fossil Ape Names 244

Evolution of Extant Hominoids 250

How Do We Know? 252

Summary of Main Topics 253

Critical Thinking Questions 253

# Hominin Evolution

**CHAPTER 9****Paleoanthropology: Reconstructing Early Hominin Behavior and Ecology 255**

Understanding Our Direct Evolutionary Connections:

What's a Hominin? 256

What's in a Name? 256

Biocultural Evolution: The Human Capacity for Culture 257

Discovering Human Evolution: The Science of Paleoanthropology 259

**A Closer Look** What Were Early Hominins Doing, and How Do We Know? 260–261

Connecting the Dots through Time: Paleoanthropological Dating Methods 264

**A Closer Look** Chronometric Dating Estimates 267

Experimental Archaeology 268

Stone Tool (Lithic) Technology 268

Analysis of Bone 270

Reconstruction of Early Hominin Environments and Behavior 270

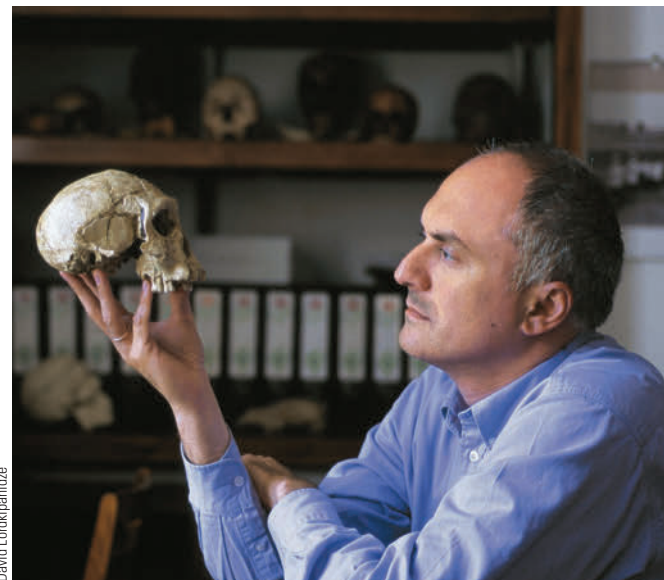
Why Did Hominins Become Bipedal? 271

How Do We Know? 275

Summary of Main Topics 275

Critical Thinking Questions 275

Media Resources 275



David Lordkipanidze

**CHAPTER 10****Hominin Origins in Africa 277**

Walking the Walk: The Bipedal Adaptation 278

The Mechanics of Walking on Two Legs 278

**A Closer Look** Major Features of Bipedal Locomotion 280–281

Digging for Connections: Early Hominins from Africa 282

Pre-Australopiths (6.0+ to 4.4 mya) 283

**At a Glance** Key Pre-Australopith Discoveries 288

Australopiths (4.2 to 1.2 mya) 288

*Australopithecus afarensis* 289**A Closer Look** Cranial Capacity 293

A Contemporaneous and Very Different Kind of Hominin 293

Later More Derived Australopiths (3.0 to 1.2 mya) 294

New Connections: A Transitional Australopith? 297

Closer Connections: Early *Homo* (2.0 to 1.4 mya) 299

Interpretations: What Does It All Mean? 301

Seeing the Big Picture: Adaptive Patterns of Early African Hominins 304

How Do We Know? 305

Summary of Main Topics 305

Critical Thinking Questions 305

Media Resources 305

**CHAPTER 11****The First Dispersal of the Genus *Homo*: *Homo erectus* and Contemporaries 307**

A New Kind of Hominin 310

The Morphology of *Homo erectus* 310

Body Size 311

Brain Size 311

Cranial Shape 311

The First *Homo erectus*: *Homo erectus* from Africa 311**At a Glance** Key *Homo erectus* Discoveries from Africa 315

Who Were the Earliest African Emigrants? 315

*Homo erectus* from Indonesia 317**A Closer Look** In Search of Ancient Human Ancestors—and a Little Shade 318–319*Homo erectus* from China 319Zhoukoudian *Homo erectus* 319

Cultural Remains from Zhoukoudian 320

Other Chinese Sites 321

**A Closer Look** Dragon Bone Hill: Cave Home or Hyena Den? 322–323Asian and African *Homo erectus*: A Comparison 323**At a Glance** Key *Homo Erectus* Discoveries from Asia 324Later *Homo erectus* from Europe 325**At a Glance** Key *Homo erectus* and Contemporaneous Discoveries from Europe 326Technological Trends During *Homo erectus* Times 327Seeing the Connections: Interpretations of *Homo erectus* 328

How Do We Know? 329

Summary of Main Topics 329

Critical Thinking Questions 329

**CHAPTER 12****Premodern Humans 331**

When, Where, and What 332

The Pleistocene 332

Dispersal of Middle Pleistocene Hominins 333

Middle Pleistocene Hominins: Terminology 333

Premodern Humans of the Middle Pleistocene 334

Africa 334

Europe 335

**At a Glance** Key Premodern Human*(H. heidelbergensis)* Fossils from Africa 335**At a Glance** Key Premodern Human*(H. heidelbergensis)* Fossils from Europe 336

Asia 337

**At a Glance** Key Premodern Human*(H. heidelbergensis)* Fossils from Asia 337

A Review of Middle Pleistocene Evolution 340

Middle Pleistocene Culture 340

Neandertals: Premodern Humans of the Late

Pleistocene 341

Western Europe 345

Central Europe 346

Western Asia 347

Central Asia 349

**At a Glance** Key Neandertal Fossil Discoveries 350

Culture of Neandertals 350

Technology 350

Subsistence 351

Speech and Symbolic Behavior 351

**A Closer Look** The Evolution of Language 352–353

Burials 354

Molecular Connections: The Genetic Evidence 354

**A Closer Look** Are They Human? 356–357

Seeing Close Human Connections: Understanding Premodern Humans 357

How Do We Know? 360

Summary of Main Topics 361

Critical Thinking Questions 361

**CHAPTER 13****The Origin and Dispersal of Modern Humans 363**

Approaches to Understanding Modern Human Origins 364

The Regional Continuity Model: Multiregional Evolution 364

Replacement Models 365

The Earliest Discoveries of Modern Humans 368

Africa 368

The Near East 371

**At a Glance** Key Early Modern *Homo sapiens* Discoveries from Africa and the Near East 373

Asia 373

Australia 375

Central Europe 375

Western Europe 377

Something New and Different: The “Little People” 378

**At a Glance** Key Early Modern *Homo sapiens* Discoveries from Europe and Asia 378

Technology and Art in the Upper Paleolithic 380

Europe 380

**A Closer Look** Maybe You *Can* Take It with You 384

Africa 384



Miford Wolpoff

Summary of Upper Paleolithic Culture 385

How Do We Know? 387

Summary of Main Topics 387

Critical Thinking Questions 387

**Contemporary Human Evolution****CHAPTER 14****Modern Human Biology: Patterns of Variation 389**

Historical Views of Human Variation 390

The Concept of Race 391

**A Closer Look** Racial Purity: A False and Dangerous Ideology 392–393

Contemporary Interpretations of Human Variation 396

Human Polymorphisms 397

Polymorphisms at the DNA Level 398

**At a Glance** Genetic Polymorphisms Used to Study Human Variation 399

**A Closer Look** What DNA Tells Us about Ancient Human Migrations 400–401

Population Genetics 402

Calculating Allele Frequencies 404

**At a Glance** Population Genetics Research 405

**A Closer Look** Calculating Allele Frequencies: PTC Tasting in a Hypothetical Population 406

Evolution in Action: Modern Human Populations 407

Nonrandom Mating 407

Human Biocultural Evolution 408

How Do We Know? 411

Summary of Main Topics 411

Critical Thinking Questions 411

Media Resources 411



**CHAPTER 15****Modern Human Biology: Patterns of Adaptation 413**

- The Adaptive Significance of Human Variation 413
  - Solar Radiation and Skin Color 415
  - The Thermal Environment 419
- A Closer Look** Skin Cancer and UV Radiation 422–423
  - High Altitude 425
- Infectious Disease 427
- The Continuing Impact of Infectious Disease 430
- At a Glance** Zoonoses and Human Infectious Disease 431
- Human Skeletal Biology: What Bones Can Tell Us about Ancient Diseases, Trauma, and Lifestyles 433
  - Evidence of Prehistoric Diseases 433
  - Reconstruction of Prehistoric Behavioral Patterns 436
- How Do We Know? 438
- Summary of Main Topics 439
- Critical Thinking Questions 439
- Media Resources 439

**CHAPTER 16****Legacies of Human Evolutionary History and the Human Life Course 441**

- Evolved Biology and Contemporary Lifestyles—Is There a Mismatch? 442
- Biocultural Evolution and the Life Course 442
- From Embryo to Adult: Human Growth and Development Today and in the Past 443
  - Nutritional Effects on Growth, Development, and Later-Life Health 444
- A Closer Look** Diabetes 448
- At a Glance** Diet, Lifestyle, and Consequences 449
  - Other Factors Affecting Growth and Development: Genes, Environment, and Hormones 450
- Life History Theory and the Human Life Course 453
  - Pregnancy, Birth, Infancy, and Childhood 454
  - Onset of Reproductive Functioning in Humans 458
  - Mothers and Grandmothers 459
  - Aging and Longevity 461
- Effects of Technology on the Brain 464
- Are We Still Evolving? 465
- How Do We Know? 466
- Summary of Main Topics 467
- Critical Thinking Questions 467
- Media Resources 467

**CHAPTER 17****The Human Disconnection 469**

- Human Impacts on the Planet and Other Life-Forms 470
  - Humans and the Impact of Culture 470
  - Global Climate Change 472
  - Impact on Biodiversity 476
  - Acceleration of Evolutionary Processes 479
- Looking for Solutions 480
- Is There Any Good News? 481
- How Do We Know? 482
- Summary of Main Topics 483
- Critical Thinking Questions 483

**APPENDIX A****Atlas of Primate Skeletal Anatomy 484****APPENDIX B****Sexing and Aging the Skeleton 492**

- Glossary 497
- Bibliography 506
- Index 532

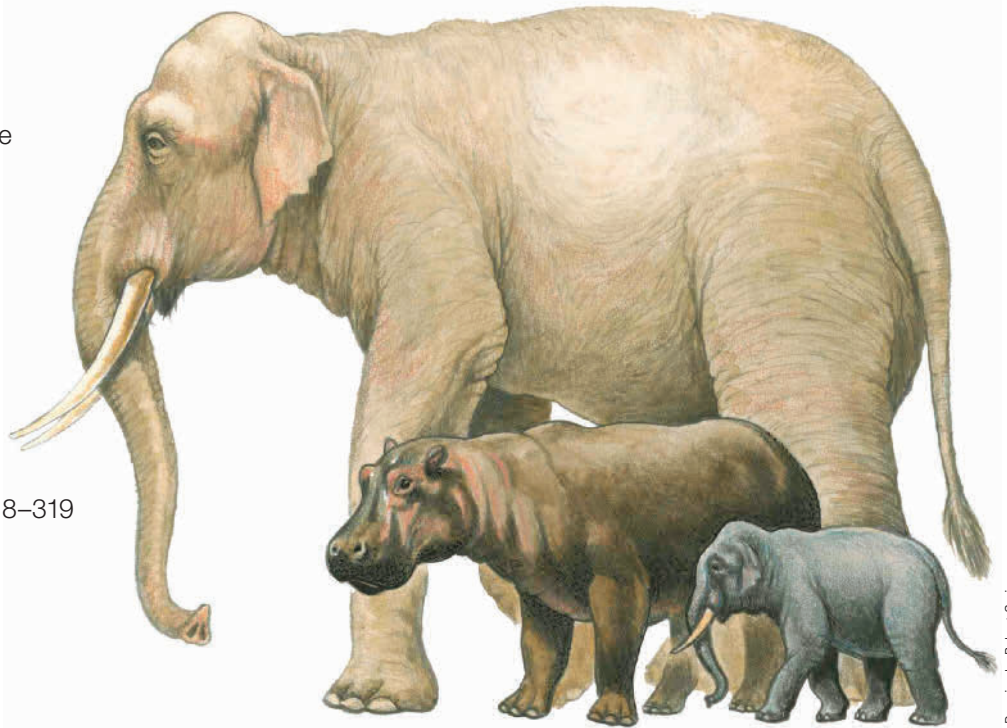


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# List of Features

## A Closer Look

- Forensic Anthropology in Practice 21
- Rosalind Franklin: The Fourth (but Invisible) Member of the Double Helix Team 52
- Noncoding DNA—Not Junk After All 59
- Evo-Devo: The Evolution Revolution 112–113
- Deep Time 126–127
- Primate Cranial Anatomy 140
- Aye-Ayes: Victims of Derived Traits and Superstition 168
- Types of Nonhuman Primate Social Groups 180
- Building Family Trees from Genes 220
- Primate Diversity in the Fayum 232
- Island Hopping and Primate Evolution 236
- What Were Early Hominins Doing, and How Do We Know? 260–261
- Chronometric Dating Estimates 267
- Major Features of Bipedal Locomotion 280–281
- Cranial Capacity 293
- In Search of Ancient Human Ancestors—and a Little Shade 318–319
- Dragon Bone Hill: Cave Home or Hyena Den? 322–323
- The Evolution of Language 352
- Are They Human? 356–357
- Maybe You *Can* Take It with You 384
- Racial Purity: A False and Dangerous Ideology 392–393
- What DNA Tells Us about Ancient Human Migrations 400–401
- Calculating Allele Frequencies: PTC Tasting in a Hypothetical Population 406
- Skin Cancer and UV Radiation 422–423
- Diabetes 448



Drawing by Robert Geisen

## At a Glance

- The Mechanism of Natural Selection 45
- Coding and Noncoding DNA 61
- Mendelian vs. Polygenic Traits 92
- Comparing Two Approaches to Interpretation of Evolutionary Relationships 117
- Primate Social Strategies 183
- Evolution of Human Language 203
- Key Early Primate Names 226
- Key Early Anthropoid Names 239
- Key Fossil Ape Names 244
- Key Pre-Australopith Discoveries 288
- Key *Homo erectus* Discoveries from Africa 315
- Key *Homo Erectus* Discoveries from Asia 324
- Key *Homo erectus* and Contemporaneous Discoveries from Europe 326
- Key Premodern Human (*H. heidelbergensis*) Fossils from Africa 335
- Key Premodern Human (*H. heidelbergensis*) Fossils from Europe 336
- Key Premodern Human (*H. heidelbergensis*) Fossils from Asia 337
- Key Neandertal Fossil Discoveries 350
- Key Early Modern *Homo Sapiens* Discoveries from Africa and the Near East 373
- Key Early Modern *Homo Sapiens* Discoveries from Europe and Asia 378
- Genetic Polymorphisms Used to Study Human Variation 399
- Population Genetics Research 405
- Zoonoses and Human Infectious Disease 431
- Diet, Lifestyle, and Consequences 449



Barbara Walton/epa/Corbis

# Preface

This textbook is about where we come from and the scientific ways we can explore our beginnings. Our species, like all species on earth, evolved from earlier life-forms. As a result of this long shared ancestry, we and all other life are *connected* in a variety of ways: genetically, anatomically, physiologically, and even behaviorally. These connections are the main focus of the book and are highlighted in every chapter.

Physical anthropology, also called “biological anthropology,” is the study of human adaptation, variability and evolution as well as of our living and fossil relatives from a biological perspective. Consequently, throughout this text, you will encounter topics that emphasize basic biological concepts. This broad biological framework allows us to connect our evolutionary history with that of other life-forms in order to better understand the evolutionary pressures that shaped our species.

In the last few years scientific knowledge in many fields has accumulated amazingly fast. What’s more, the biological sciences are certainly among the most rapidly expanding areas of knowledge as information increases dramatically every year—indeed, every month. This edition has been updated to reflect these changes and to provide the most current information available.

But, in reality, our presentation is just a beginning for students new to this field of study. It is our goal to give students a strong foundation relating to the key aspects of evolutionary biology, which includes physical anthropology. Our aim is to provide fundamental information which will allow you to better understand some of the dramatic scientific advances that almost surely will directly affect you in coming years.

Because genetic mechanisms lie at the heart of understanding evolution, in the early chapters (2 through 5) we address the basic aspects of life, cells, DNA, and the ways species change. In Chapters 6 and 7, we turn to an exploration of our evolutionary cousins, the nonhuman primates, and show how they are closely connected to us genetically, physically and behaviorally. In Chapters 8 through 13, we first discuss the evolutionary history of early primates and how they relate to living nonhuman primates and our own earliest ancestors (Chapter 8). In Chapters 9–13, we turn to a more detailed exploration of

our specific human evolutionary history over the past 6 million years. This evolutionary journey begins with our small-brained, apelike ancestors in Africa and follows the development of their descendants through time and over an expanding geographical range into Asia and Europe, and much later into Australia and the Americas.

In the last section of this book (Chapters 14–17), we cover the most recent part of our evolutionary journey with a discussion of modern human biology, and we trace the ongoing evolution of our species. Major topics include the nature of human variation (including an anthropological discussion of the concept of “race”), patterns of adaptation in recent human populations, and the developmental changes experienced by humans through the course of their lives. In our new concluding chapter, “The Human Disconnection,” we discuss how contemporary humans are severely altering the planet. We compare these recent and sudden developments with our species’ long evolutionary past, when humans were not so numerous or so dependent on nonrenewable resources.

## What’s New in the 2013–2014 Edition

First, as previously mentioned, we have incorporated the unifying concept of our “connection” to all life as the framework for presenting material throughout the text. To further reinforce this central focus, each chapter now opens with a pedagogical aid that clearly shows students the biological connections as they are organized within and between chapters. Students are also now presented with the learning objectives they are expected to master after reading the chapter. In addition, at the end of each chapter we have included a new section (How Do We Know?) which briefly summarizes the basic scientific information that allows physical anthropologists and other biologists to draw accurate conclusions regarding our evolutionary history.

As genetic technology continues to grow at an unprecedented pace, it is our task to present the most rele-

vant new discoveries in as simple a manner as possible. Chapter 3 includes a new discussion of the ENCODE (Encyclopedia of DNA Elements) project that involves more than 400 geneticists from around the world. The goal of the project is to identify the functions of the “non-coding” DNA that comprises about 98 percent of the human genome. This discussion is important because some of this DNA is involved in regulatory functions and changes in regulatory genes are critical to the evolutionary process. We also increased our discussion of regulatory DNA and types of regulatory genes to emphasize their role in evolution.

A major change to this edition is the reduction of the number of nonhuman primate chapters from 3 to 2. This change was in response to reviewer comments that there be somewhat less coverage. However, all major topics have been retained, and there is added material on cooperation and empathy in nonhuman primates. We have also added more information emphasizing the endangered status of many nonhuman primates, both in the text, and in a new table (Table 6.1) that lists some of the 25 species considered most endangered by the IUCN (International Union for the Conservation of Nature). The table includes estimated numbers and the major threats to these species.

Chapter 8 (formerly Chapter 9) has been trimmed and extensively updated to include new discoveries as well as ongoing reinterpretations of fossil primates. These changes include a reassessment of molecular dating for primate origins and the evolution of all groups, as well as an updated and streamlined treatment of lower primates. This new approach relies less on nomenclature and instead emphasizes key trends in primate adaptation and relation to living groups. Three new “At a Glance” boxes call attention to significant transitional primate groups and act as handy study tools. A complete revision of ape origins is supplemented by a detailed map showing the dispersal patterns of early apes from Africa to Europe and Eurasia and then back into Africa. The chapter, as a whole, includes attractive new art emphasizing important primate traits and differences between groups in an easy-to-understand visual format.

Remarkable new discoveries of fossil hominins and evidence of their behavior are discussed in Chapters 9 through 13. In Chapter 9 we provide further information that sheds light on the controversial interpretation of what some researchers have claimed are the earliest stone tools (ostensibly used for butchering) as well the latest chemical evidence used to reconstruct early hominin diets. Chapter 10 covers the earliest hominins and presents varied interpretations, including further infor-

mation about *Ardipithecus* as well as a new find of foot remains that suggest many of these early hominins were likely bipedal, but in a very different way from us or even some other contemporary hominin species.

Our coverage of *Homo erectus* in Chapter 11 covers a new find from Java as well as new and more precise dating of several key sites. Chapter 12 contains a new framework for understanding premodern humans, especially as they occupied wider areas of the Old World with some populations becoming more isolated. In addition, we cover the amazing new DNA results obtained from a finger bone found in Siberia that have allowed researchers to determine not only that the individual was female but also her hair, skin, and eye color. Chapter 13 concludes the section on fossil hominins with a discussion of the origins of modern humans. Updates include further evidence showing more precisely the evolutionary relationships of *Homo floresiensis* as well as new archaeological discoveries pushing back the dates of cave painting in western Europe and the development of sophisticated tools in southern Africa.

In Chapters 14 through 16, our focus turns to modern human biology. Our understanding of human variation (discussed in Chapter 14) has been completely transformed by more complete DNA data, published in just the last five years. We have updated and modified our main perspective in this chapter to reflect the remarkable new findings contributed by molecular biology. New data from contemporary hunter-gatherer populations in Africa tell us about human origins; other very recent research further clarifies how migrations outside of Africa led to the peopling of Eurasia, Australia, and the New World.

In Chapter 15, there’s a new discussion of recent research demonstrating a population-wide genetic mutation in Tibetan highlanders that increases their ability to adapt to living at high altitude. We have also included a major new section on “Human Skeletal Biology: What Bones Can Tell Us about Ancient Diseases and Lifestyles.” The discussion of diseases found in bone is linked to the overall human adaptation theme of the chapter and is heavily illustrated with new photos.

In Chapter 16, now titled “Legacies of Human Evolutionary History: Effects on the Individual,” we focus on ways in which our biology, resulting from millions of years of evolution, seems to be mismatched with the lives we lead today, leading in some cases to compromised health. For example, the biology of women may not be well suited to the highly frequent menstrual cycling that results from the use of modern forms of birth control. Some health disorders that we are dealing with today may

stem from the dramatic differences between the diets of our ancestors and the foods we eat today.

Finally, in the new concluding Chapter 17 (“The Human Disconnection”), we focus on another theme that runs through the book—why it is so crucial that we know and understand human evolutionary history, its impact on the world today, and how we have distanced ourselves from other living species with which we share so many connections. We humans and the consequences of our activities are probably the most important influences on evolution today, causing the extinction or near-extinction of thousands of other life-forms and threatening the very planet on which we live. Our disconnection from other species and from our own evolutionary past pose the biggest challenges our species has ever faced. Only by understanding how we got to this point can we begin to respond to the challenges that are in our future and the futures of our children and grandchildren.

We also expanded our treatment of climate change in Chapter 17, including two new figures. The discussion provides current information from the National Snow and Ice Data Center showing that in September 2012, the Arctic sea ice minimum was 49 percent less than the average figure for the years 1979 to 2000. We point out that there has been a steady decline in Arctic sea ice since the year 2000 and we briefly deal with the likely consequences of continued melting.

## In-Chapter Learning Aids

**Connections graphic** at the beginning of each chapter shows the biological relationships emphasized in the chapter in the context of topics in other chapters.

**Student Learning Objectives** are listed on the opening page of each chapter.

**A Closer Look** boxes are high-interest features found throughout the book. They supplement chapter material and include more in-depth discussion of selected stimulating topics.

**How Do We Know?** chapter concluding sections summarize the basic scientific information used in drawing accurate conclusions about our evolutionary history.

**Video Media Resources** are now listed at the end of half of the chapters. Students are referred to the anthropology CourseMate at [www.cengagebrain.com](http://www.cengagebrain.com) for access.

**A running glossary** in the margins provides definitions of terms immediately adjacent to the text where the term is first introduced. A full glossary is provided at the back of the book.

**At a Glance** boxes found throughout the book briefly summarize complex or controversial material in a visually simple fashion.

**Figures**, including numerous photographs, line drawings, and maps, most in full color, are carefully selected to clarify text materials and directly support the discussion in the text.

**Critical Thinking Questions** at the end of each chapter reinforce key concepts and encourage students to think critically about what they have read.

**Full bibliographical citations** throughout the book provide sources from which the materials are drawn. This type of documentation guides students to published, peer-reviewed source materials and illustrates for students the proper use of references. All cited sources are listed in the comprehensive bibliography at the back of the book.

# Acknowledgments

Over the years, many friends and colleagues have assisted us with our books. For this edition we are especially grateful to the reviewers who so carefully commented on the manuscript and made such helpful suggestions: Jerusha Achterberg, Harvard University; Autumn Cahoon, Sierra College; Meredith Dorner, Saddleback College; Samantha Hens, California State University Sacramento; Melissa Remis, Purdue University West Lafayette; Kathleen Rizzo, University of Illinois at Chicago; Patricia Vinyard, University of Akron; and Brita Wynn, Sacramento City College.

We wish to thank the team at Cengage Learning: Aileen Berg, Lin Marshall Gaylord, Liz Rhoden, Michelle Williams, Mallory Ortberg, John Chell, Caryl Gorska, and Cheri Palmer. Moreover, for their unflagging expertise and patience, we are grateful to our copy editor, Heidi Thaens, our production coordinator, Gary Hespenheide, and his skilled staff at Hespenheide Design: Patti Zeman, Randy Miyake, and Bridget Neumayr.

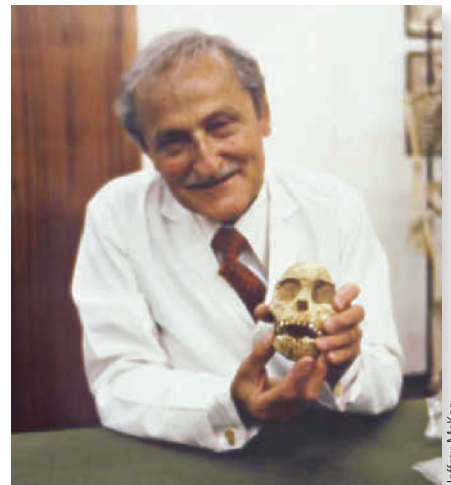
To the many friends and colleagues who have generously provided photographs, we are greatly appreciative: Zeresenay Alemsegel, Nanette Barkey, Chris Beard, Günter Bechly, David Begun, Brenda Benefit, Lee Berger, Jonathan Bloch, C. K. Brain, Günter Bräuer, Peter Brown, Ray Carson, Desmond Clark, Ron Clarke, Bill Clemens, Raymond Dart, Henri de Lumley, Louis de Bonis, Didier Descouens, Michael Donnenberg, John Fleagle, Diane France, Robert Franciscus, David Frayer, Kathleen Galvin, Philip Gingerich, Gregg Gunnell, David Haring, Terry Harrison, John Hodgkiss, Almut Hoffman, Pat Holroyd, Ellen Ingmanson, Fred Jacobs, Don Johanson, Peter Jones, Mushtaq Kahn, John Kappelman, Richard Kay, William Kimbel, Charles Knowles, Arlene Kruse, Yutaku Kanimatsu, Julie Lesnik, Linda Levitch, Thomas J. Loebel, David Lordkipanidze, Carles Lalueza-Fox, Giorgio Manzi, Tetsuro Matsuzawa, Monte McCrossin, National Museums of Kenya, Gerald Newlands, Xijun Ni, John Oates, Bonnie Pedersen, David Pilbeam, Gul Reyman, Charlotte Roberts, Duane Rumbaugh, Sastrohamijoyo Sartono, Peter Schmid, Rose Sevick, Elwyn Simons, Meredith Small, Fred Smith, Thierry Smith, Kirstin Sterner, Masanaru Takai, Heather Thew, Nelson Ting, Phillip Tobias, Erik Trinkaus, William Turnbaugh, Alan Walker, Carol Ward, Wally Wecker, Dietrich Wegner,

James Westgate, Randy White, Milford Wolpoff, Xinzhi Wu, and João Zilhão.

Over the years, many students have pledged their time and expertise to help improve Chapter 8. We would especially like to thank K. Lindsay Eaves for her invaluable help editing and researching this and earlier editions of the manuscript and for facilitating coordination of the text and art within the context of the Ciochon Lab. We also thank Kiran Patel for her unfailing attention to detail, Toby Avalos for his research on fossil apes and Mike Hussey for help with photographs. For the current and past three editions, John Fleagle has made anatomical diagrams available that were originally used in his book, *Primate Adaptation and Evolution* (Academic Press, 1999). Others who have assisted in forming the concepts that we have put into written form include David Begun, Eric Delson, John Fleagle, Terry Harrison, Pat Holroyd, Gregg Gunnell, Andrew Kitchen, Philip Rightmire, Nelson Ting, Kirstin Sterner, Iyad Zalmout, and Tim White.

Robert Jurmain  
Lynn Kilgore  
Wenda Trevathan  
Russell Ciochon  
December 2012

In memory of Phillip Tobias



Jeffrey McKee

1925–2012

# Supplements

*Introduction to Physical Anthropology 2013–2014* comes with an outstanding supplements program to help instructors create an effective learning environment so students can more easily master the latest discoveries and interpretations in the field of physical anthropology.

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This online resource includes a sample syllabus showing how to integrate the Anthropology Resource Center with the text, as well as chapter outlines, learning objectives, key terms and concepts, lecture suggestions, and enrichment topics, as well as 40–60 test questions per chapter.

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### Anthropology CourseMate

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and concepts. The site also provides an eBook version of the text with highlighting and note-taking capabilities. For instructors this text's CourseMate also includes Engagement Tracker, a first-of-its-kind tool that monitors student engagement in the course. Go to [login.cengage.com](http://login.cengage.com) to access these resources.

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This website for *Introduction to Physical Anthropology 2013–2014 Edition* brings chapter topics to life with interactive learning, study, and exam preparation tools, including quizzes, flash cards, videos, animations, and more! The site also provides an eBook version of the text with highlighting and note-taking capabilities. You can access this new learning tool and all other online resources through [www.cengagebrain.com](http://www.cengagebrain.com).



**Telecourse Course Student Guide for *Introduction to Physical Anthropology, 2013–2014 Edition***

Entitled “Physical Anthropology: The Evolving Human,” this distance-learning course provides online and print companion study guide options that include quizzing, study aids, interactive exercises, video, and more.

**Classic and Contemporary Readings in Physical Anthropology**

Edited by Mary K. Sandford and Eileen Jackson, this accessible reader presents primary articles with introductions and questions for discussion, helping students to better understand the nature of scientific inquiry. Students will read highly accessible classic and contemporary articles on key topics, including the science of physical anthropology, evolution and heredity, primates, human evolution, and modern human variation.

**Lab Manual and Workbook for Physical Anthropology, Seventh Edition**

Written by Diane L. France, this edition of the workbook and lab manual includes a new “Introduction to Science and Critical Thinking” that precedes the first. Using hands-on exercises, this richly illustrated full-color lab manual balances the study of genetics, human osteology, anthropometry, and forensic anthropology with the study of primates and human evolution. In addition to providing hands-on lab assignments that apply the field’s perspectives and techniques to real situations, this edition provides more explanatory information and sample exercises throughout the text to help make the concepts of physical anthropology easier to understand. Contact your Cengage sales representative to package with the text.

**Physical Anthropology Lab Manual by John**

**Kappelman** offers a focused sampling of laboratory exercises that range across the breadth of the discipline, from examples of heredity and evolution to primate behavior, the fossil record of apes and early humans, and questions about human biology that are linked to environmental change. Exercises are designed with a succinct focus on particular problems, and the labs follow a fixed format with the introduction of a problem followed by the collection of data that are in turn used to test and evaluate the hypothesis. Students who complete the labs will greatly expand their knowledge of physical anthropology.

**Basic Genetics in Anthropology CD-ROM: Principles and Applications, Version 2.0 by Jurmain/Kilgore/Trevathan**

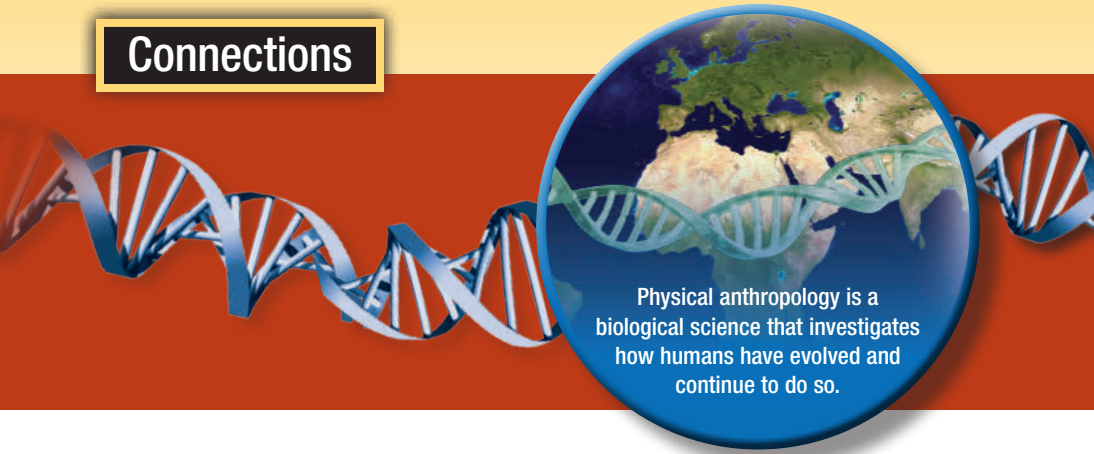
This student CD-ROM expands on basic biological concepts covered in the book, focusing on biological inheritance (such as genes and DNA sequencing) and its applications to modern human populations. Interactive animations and simulations bring these important concepts to life so that students can fully understand the essential biological principles underlying human evolution. Also available are quizzes and interactive flash cards for further study.

**Hominid Fossils CD-ROM: An Interactive Atlas by James Ahern**

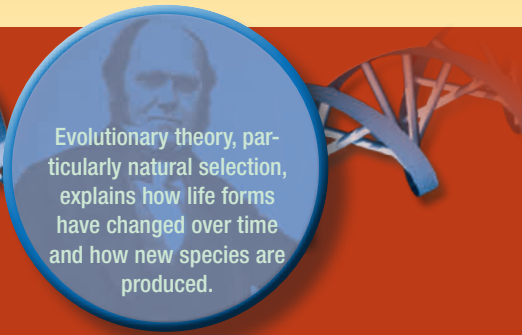
This CD-based interactive atlas includes over 75 key fossils that are important for a clear understanding of human evolution. The QuickTime® Virtual Reality (QTVR) “object” movie format for each fossil will enable students to have a near-authentic experience working with these important finds by allowing them to rotate the fossil 360°. Unlike some VR media, QTVR objects are made using actual photographs of the real objects and thus better preserve details of color and texture. The fossils used are high-quality research casts and real fossils.

The organization of the atlas is nonlinear, with three levels and multiple paths, enabling students to start with a particular fossil and work their way “up” to see how the fossil fits into the map of human evolution in terms of geography, time, and evolution. The CD-ROM offers students an inviting, authentic learning environment, one that also contains a dynamic quizzing feature that will allow students to test their knowledge of fossil and species identification as well as provide more detailed information about the fossil record.

## Connections



Physical anthropology is a biological science that investigates how humans have evolved and continue to do so.



Evolutionary theory, particularly natural selection, explains how life forms have changed over time and how new species are produced.



Cristina G. Mittermeier

# Introduction to Physical Anthropology

# 1

## Student Learning Objectives

## Introduction

One day, perhaps during the rainy season some 3.7 million years ago, two or three animals walked across a grassland **savanna** in what is now northern Tanzania, in East Africa. These individuals were early **hominins**, members of the same evolutionary lineage that includes our own **species**, *Homo sapiens*. Fortunately for us, a record of their passage on that long-forgotten day remains in the form of fossilized footprints, preserved in hardened volcanic deposits. As chance would have it, shortly after heels and toes were pressed into the damp soil, a nearby volcano erupted. The ensuing ash fall blanketed everything on the ground. In time, the ash layer hardened into a deposit that remarkably preserved the tracks of numerous animals, including those early hominins, for nearly 4 million years (**Fig. 1-1**).

These now famous prints indicate that two individuals, one smaller than the other, perhaps walking side by side, left parallel sets of tracks. But because the larger individual's prints are obscured, possibly by those of a third, it's unclear how many actually made that journey so long ago. What is clear is that the prints were made by an animal that habitually walked **bipedally** (on two feet), and that fact tells us that those ancient travelers were hominins.

In addition to the footprints, scientists working at this site (called Laetoli) and at other locations have discovered many fossilized parts of skeletons of an animal we call *Australopithecus afar-*

After mastering the material in this chapter, you should be able to:

- ▶ Describe the discipline of anthropology as it is practiced in the United States, its subfields, and the general anthropological perspective on how humans are biologically and behaviorally connected to other species.
- ▶ Provide a brief description of the major subfields of physical or biological anthropology.
- ▶ Understand the fundamentals of the scientific method and the importance of hypothesis testing.
- ▶ Explain why scientific theories are not simply guesses or hunches, as the term (theory) is often incorrectly used and interpreted.
- ▶ Appreciate how understanding the nature of scientific research can lead to the development of critical thinking skills, which, in turn, are an extremely important outcome of a college education.

*ensis*. Because the remains have been extensively studied, we know that these hominins were anatomically similar to ourselves, although their brains were only about one-third the size of ours. They may have used stones and sticks as simple tools, but there is no evidence that they actually made stone tools. In fact, they were very much at the mercy of nature's whims. They certainly could not outrun most predators, and their canine teeth were fairly small, so compared to many other animals, they were pretty much defenseless.

We've asked hundreds of questions about the Laetoli hominins, but we will never be able to answer them all. They walked down a path into what became their future, and their journey ended so long ago that we cannot really grasp how much time has passed since that

**savanna** (also spelled savannah) A large flat grassland with scattered trees and shrubs. Savannas are found in many regions of the world with dry and warm-to-hot climates.

**hominins** Colloquial term for members of the evolutionary group that includes modern humans and now-extinct bipedal relatives.

**species** A group of organisms that can interbreed to produce fertile offspring. Members of one species are reproductively isolated from members of all other species (i.e., they cannot mate with them to produce fertile offspring).

**bipedally** On two feet; walking habitually on two legs.

day. But it remains for us to learn as much as we can about them, and as we continue to do this, their greater journey continues.

On July 20, 1969, a television audience numbering in the hundreds of millions watched as two human beings stepped out of a spacecraft onto the surface of the moon. People born after that date have always lived in an age of space exploration, and many may now take that first moon landing more or less for granted. But the significance of that first moonwalk can't be overstated, because it represents humankind's presumed mastery over the natural forces that govern our presence on earth. For the first time ever, people actually walked upon the surface of a celestial body that, as far as we know, has never given birth to biological life.

As the astronauts gathered geological specimens and frolicked in near weightlessness, they left traces of their fleeting presence in the form of footprints in the lunar dust (Fig. 1-2). On the surface of the moon, where no rain falls and no wind blows, the footprints remain undisturbed to this day. They survive as silent testimony to a brief visit by a medium-sized, big-brained creature that presumed to challenge the very forces that created it.

You may wonder why anyone would care about early hominin footprints and how they can possibly be relevant to your life. You may also wonder why a physical **anthropology** textbook would begin by discussing two such seemingly unrelated events as ancient hominins walking across an African savanna and a moonwalk. But the fact is, these two events are very closely connected.

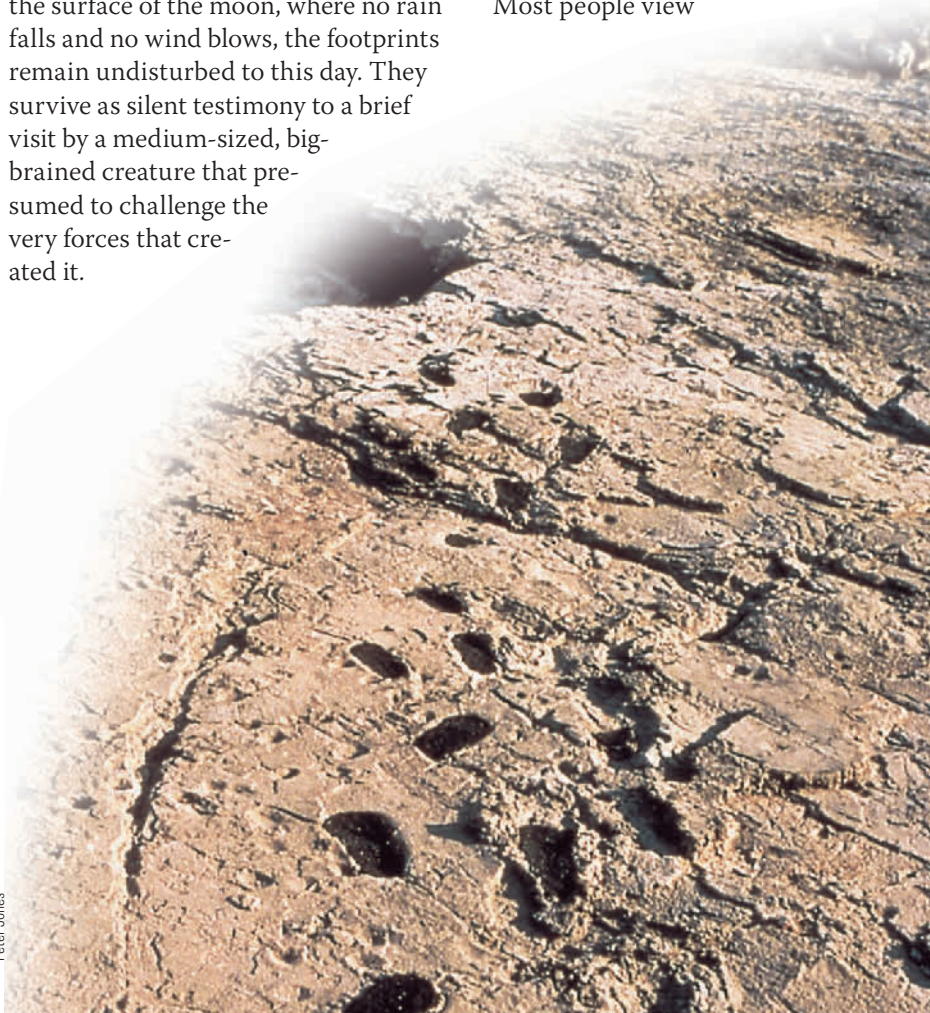
Physical, or biological, anthropology (both terms are used) is a scientific discipline concerned with the biological and behavioral characteristics of human beings; our closest relatives, the nonhuman **primates** (apes, monkeys, tarsiers, lemurs, and lorises); and our ancestors. This kind of research helps us explain what it means to be human and how we came to be the way we are. This is an ambitious goal and it probably isn't fully attainable, but it's certainly worth pursuing. We're the only species to ponder our own existence and question how we fit into the spectrum of life on earth. Most people view

► **Figure 1-1** Early hominin footprints at Laetoli, Tanzania. The tracks to the left were made by one individual, while those to the right appear to have been made by two individuals, the second stepping in the tracks of the first.

**anthropology** The field of inquiry that studies human culture and evolutionary aspects of human biology; includes cultural anthropology, archaeology, linguistics, and physical, or biological, anthropology.

**primates** Members of the mammalian order Primates (pronounced "pry-may'-tees"), which includes lemurs, lorises, tarsiers, monkeys, apes, and humans.

Peter Jones



humanity as quite separate from the rest of the animal kingdom. But at the same time, many are curious about the similarities we share with other species. Maybe, as a child, you looked at your dog and tried to figure out how her front legs might correspond to your arms. Or perhaps during a visit to the zoo, you recognized the similarities between a chimpanzee's hands or facial expressions and your own. Maybe you wondered if he also shared your thoughts and feelings. If you've ever had thoughts and questions like these, then you've indeed been curious about humankind's place in nature.

How did *Homo sapiens*, a result of the same evolutionary forces that produced all other forms of life on this planet, gain the power to control the flow of rivers and even alter the climate on a global scale? As tropical animals, how were we able to leave the tropics and eventually occupy most of the earth's land surfaces? How did we adjust to different environmental conditions as we dispersed? How could our species, which numbered fewer than 1 billion until the mid-nineteenth century, come to number more than 7 billion worldwide today and, as we now do, add another billion people approximately every 11 years?

These are some of the many questions that physical anthropologists try to answer through the study of human **evolution**, variation, and **adaptation**. These issues, and many others, are covered in this textbook, because physical anthropology is, in large part, human biology seen from an evolutionary perspective. On hearing the term *evolution*, most people think of the appearance of new species. Certainly new species are one important consequence of evolution, but not the only one. Evolution is an ongoing biological process with more than one outcome. Simply stated, evolution is a change in the **genetic** makeup of a population from one generation to the next, and it can be defined and studied at two levels. Over time, some genetic changes in populations do result in the appear-

ance of a new species (or *speciation*), especially when those populations are isolated from one another. Change at this level is called *macroevolution*.

At the other level, there are genetic alterations *within* populations; and though this type of change may not lead to speciation, it does cause populations of a species to differ from one another in the frequency of certain traits. Evolution at this level is referred to as *microevolution*. Evolution at both these levels will be discussed in this book.

## The Human Connection

The unifying theme of this textbook is how human beings are linked to all other life on earth. We can see how we are connected to other organisms in countless ways, as you will learn throughout this book. For example, our DNA is structurally identical to that of every living thing. Indeed, we share genes that are involved in the most fundamental life processes with even the simplest of animals, such as sponges. These genes have changed very little over the course of several hundred million years of evolution. With few exceptions, our cells have the same structure and work the same way as in all life forms. Anatomically, we have the same muscles and bones as other animals. What's more, many aspects of our **behavior** have direct connections to nonhuman species, especially other primates.

The countless connections we share with other organisms show that



▲ **Figure 1-2** Human footprints left on the lunar surface during the *Apollo* mission.

**evolution** A change in the genetic structure of a population. The term is also frequently used to refer to the appearance of a new species.

**adaptation** An anatomical, physiological, or behavioral response of organisms or populations to the environment. Adaptations result from evolutionary change (specifically as a result of natural selection).

**genetic** Having to do with the study of gene structure and action and the patterns of inheritance of traits from parent to offspring. Genetic mechanisms are the foundation of evolutionary change.

**behavior** Anything organisms do that involves action in response to internal or external stimuli; the response of an individual, group, or species to its environment. Such responses may or may not be deliberate, and they aren't necessarily the result of conscious decision making (which is absent in single-celled organisms, insects, and many other species).

humans are a product of the same evolutionary forces that produced all living things. But, clearly we aren't identical to any other species. In fact, all species are unique in some ways. We humans are one contemporary component of a vast biological **continuum** at a particular point in time; and in this regard, we aren't really all that special. Stating that humans are part of a continuum doesn't imply that we're at the peak of development on that continuum. Depending on the criteria used, humans can be seen to exist at one end of the spectrum or the other, or somewhere in between, but we don't occupy a position of inherent superiority over other species (**Fig. 1-3**).

However, human beings are unquestionably unique regarding one highly significant characteristic, and that is intellect. After all, humans are the only species, born of earth, to stir the lunar dust. We're the only species to develop language and complex culture as a means of buffering nature's challenges, and by doing so we have gained the power to shape the planet's very destiny.

## Biocultural Evolution

**B**iological anthropologists don't just study physiological and biological systems. When these topics are considered within the broader context of human evolution, another factor must be considered, and that is **culture**. Culture is an extremely important concept, not only as it relates to modern humans but also because of its critical role in human evolution. Quite simply, and in a very broad sense, culture can be defined as the strategy by which humans adapt to the natural environment. In fact, culture has so altered and dominated our world that it's become the environment in which we live. Culture includes technologies ranging from stone tools to computers; subsistence patterns, from hunting and gathering to global agribusiness; housing types, from thatched huts to skyscrap-

ers; and clothing, from animal skins to high-tech synthetic fibers (**Fig. 1-4**). Technology, religion, values, social organization, language, kinship, marriage rules, gender roles, dietary practices, inheritance of property, and so on are all aspects of culture. Each culture shapes people's perceptions of the external environment, or **worldview**, in particular ways that distinguish a particular society from all others.

One important point to remember is that culture isn't genetically passed from one generation to the next. We aren't born with innate knowledge that leads us to behave in ways appropriate to our own culture. Culture is *learned*, and the process of learning one's culture begins, quite literally, at birth. All people are products of the culture they're raised in, and since most human behavior is learned, it follows that most human behaviors, perceptions, values, and reactions are shaped by culture.

It's important to emphasize that even though culture isn't genetically determined, the human predisposition to assimilate culture and function within it is very much influenced by biological factors. Most nonhuman animals rely to varying degrees on learned behavior. This is especially true of the great apes (gorillas, chimpanzees, bonobos, and orangutans), which exhibit several aspects of culture.

The predisposition for culture is perhaps the most critical component of human evolutionary history, and it was inherited from our early hominin or even prehominin ancestors. In fact, the common ancestor we share with chimpanzees may have had this predisposition. But during the course of human evolution, the role of culture became increasingly important. Over time, as you will see, culture influenced many aspects of our biological makeup; in turn, aspects of biology influenced cultural practices. For this reason, humans are the result of long-term interactions between biology and culture. We call these interactions **biocultural evolution**; and in this respect, humans are unique.

**continuum** A set of relationships in which all components fall along a single integrated spectrum (for example, color). All life reflects a single biological continuum.

**culture** Behavioral aspects of human adaptation, including technology, traditions, language, religion, marriage patterns, and social roles. Culture is a set of learned behaviors transmitted from one generation to the next by nonbiological (i.e., nongenetic) means.

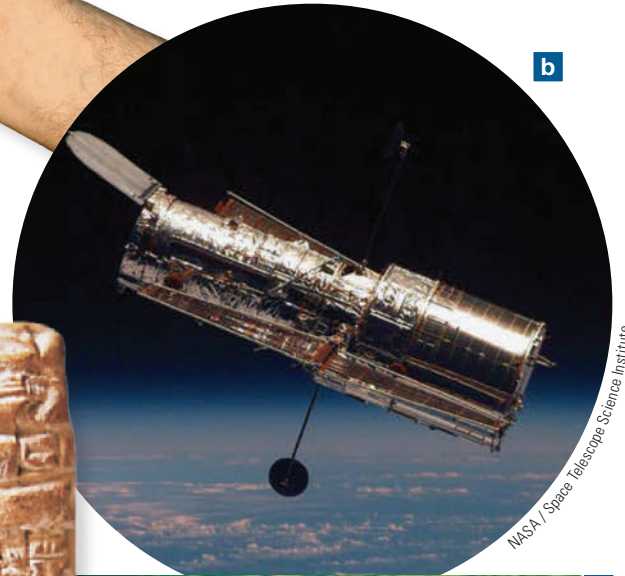
**worldview** General cultural orientation or perspective shared by the members of a society.

**biocultural evolution** The mutual interactive evolution of human biology and culture; the concept that biology (anatomy, neurological attributes, etc.) makes culture possible and that developing culture further influences the direction of biological evolution; this is a basic concept in understanding the unique components of human evolution.

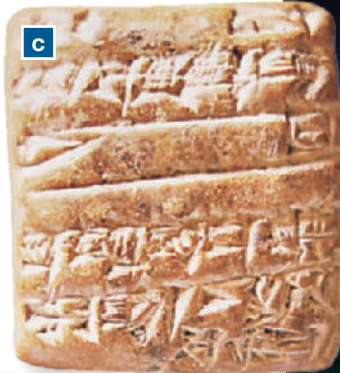
► **Figure 1-3** Traditional and recent technologies. **(a)** An early stone tool from East Africa. This artifact represents one of the oldest types of stone tools found anywhere. **(b)** The Hubble Space telescope, a late twentieth-century tool, orbits the earth every 96 minutes at an altitude of 360 miles. Because it is above the earth's atmosphere, it provides distortion-free images of objects in deep space. **(c)** A cuneiform tablet. Cuneiform, the earliest form of writing, involved pressing symbols into clay tablets. It originated in southern Iraq some 5,000 years ago. **(d)** Text messaging, a fairly recent innovation in satellite communication, has generated a new language of sorts. Today, more than 500 million text messages are sent every day worldwide. **(e)** A Samburu woman in East Africa building a traditional but complicated dwelling of stems, small branches, and mud. **(f)** These Hong Kong skyscrapers are typical of cities in industrialized countries today.



Lynn Kilgore

**a****b**

NASA / Space Telescope Science Institute



Museum of Primitive Art and Culture, Peace Dale, RI

**c****d**

iStockphoto.com/Ravi Tahirramani

**e**

Lynn Kilgore

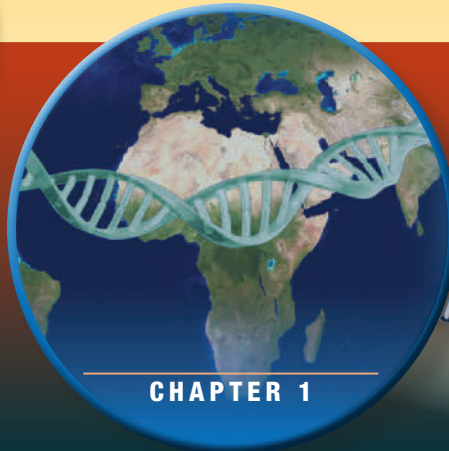
**f**

iStockphoto.com/Justin Horrocks

# Connections

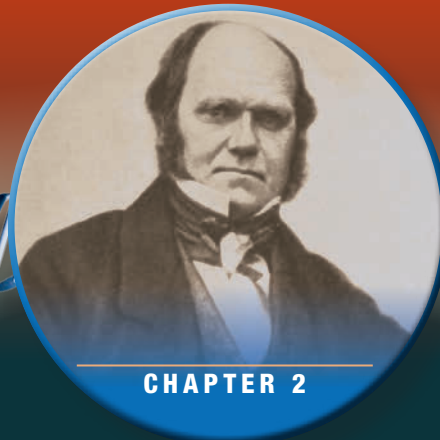
**Figure 1-4**

Humans are biologically connected to all forms of life. This central theme will be addressed in every chapter of this textbook as shown in this figure.



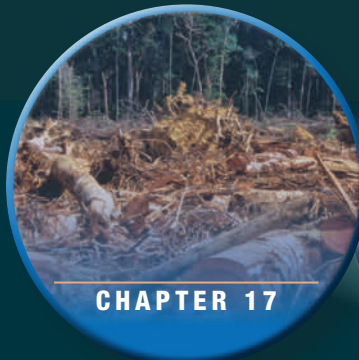
## CHAPTER 1

Physical anthropology is a biological science that investigates how humans have evolved and continue to do so.



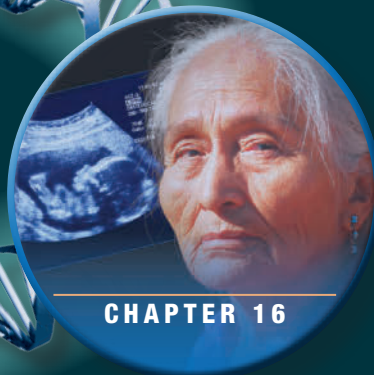
## CHAPTER 2

Evolutionary theory, particularly natural selection, explains how life forms have changed over time and how new species are produced.



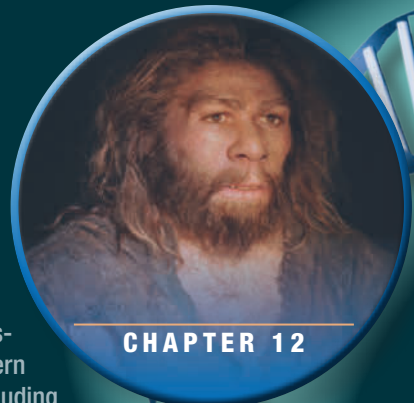
## CHAPTER 17

Humans have recently become disconnected from other life and are rapidly altering the planet.



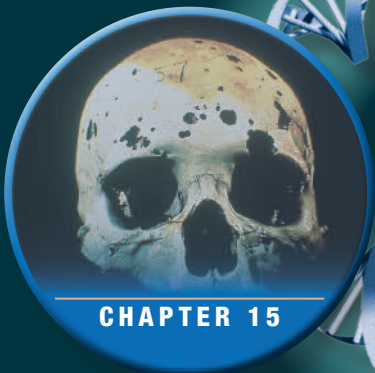
## CHAPTER 16

Human development and adaptation is best understood from an evolutionary perspective.



## CHAPTER 12

The immediate predecessors of modern humans, including the Neandertals, were much like us, but had some anatomical and behavioral differences.



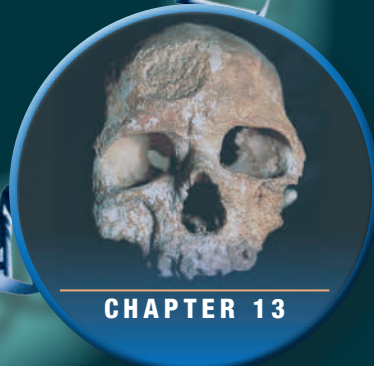
## CHAPTER 15

Through natural selection, humans have and continue to adapt to environmental factors including solar radiation, cold, altitude, and, most importantly, infectious disease.



## CHAPTER 14

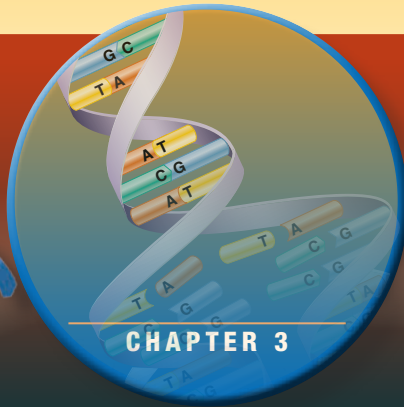
Modern human variation is best understood by examining similarities and differences in DNA among populations.



## CHAPTER 13

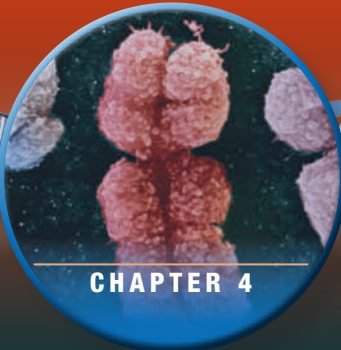
Modern humans first evolved in Africa and later spread to other areas of the world, where they occasionally interbred with Neandertals and other pre-modern humans.





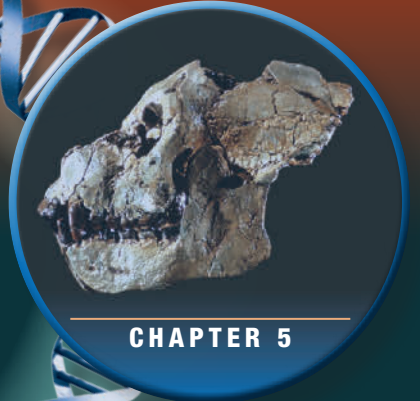
### CHAPTER 3

The DNA molecule is the basis of all life.



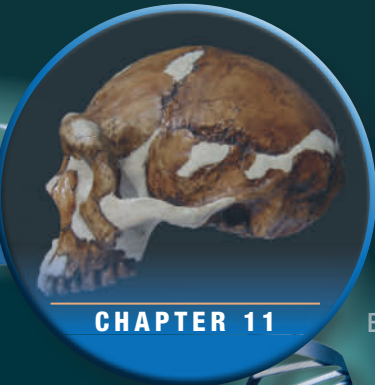
### CHAPTER 4

Evolution occurs when DNA changes and genetic variation is further influenced by natural selection and other factors.



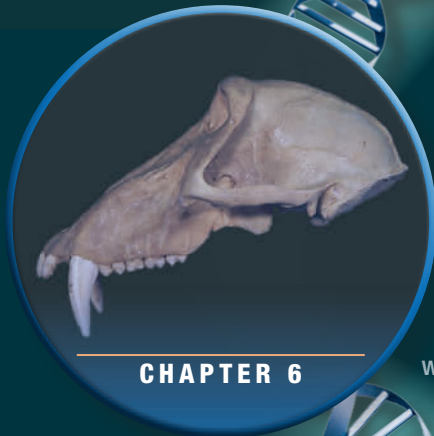
### CHAPTER 5

Humans are both vertebrates and mammals, and their evolutionary history over many millions of years explains our early roots.



### CHAPTER 11

Hominins began to disperse out of Africa around 2 million years ago, and during the next 1 million years inhabited much of Eurasia.



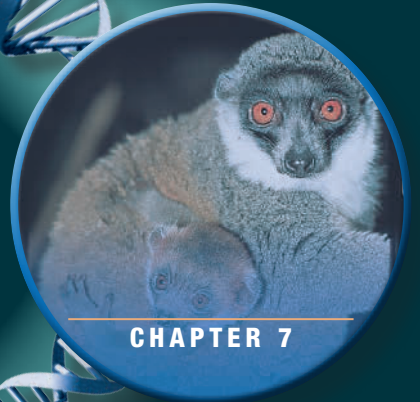
### CHAPTER 6

Humans are primates and share many biological characteristics with other primates.



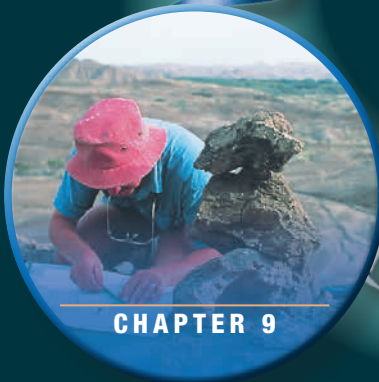
### CHAPTER 10

The first more human-like animals (hominins) appeared in Africa around 6 mya ago and evolved into a variety of different species.



### CHAPTER 7

Partly because of common evolutionary history, many human behaviors are also seen in other primates.



### CHAPTER 9

Paleoanthropology, which includes physical anthropology, archaeology, and geology, provides the scientific basis to understand hominin evolution.



### CHAPTER 8

Fossil evidence indicates our primate origins date to at least 65 million years ago.