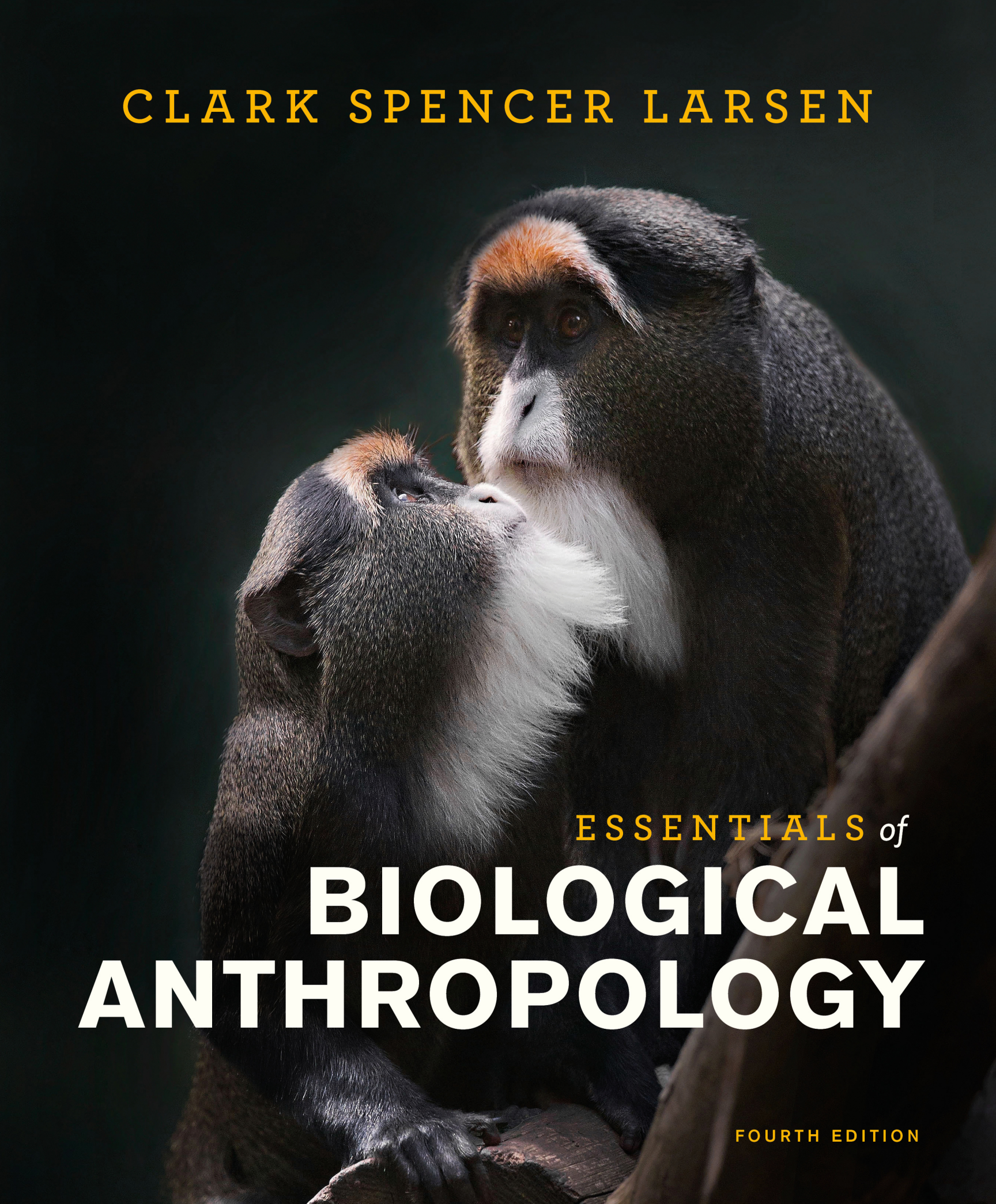


CLARK SPENCER LARSEN



ESSENTIALS *of*
**BIOLOGICAL
ANTHROPOLOGY**

FOURTH EDITION

ESSENTIALS OF BIOLOGICAL ANTHROPOLOGY
FOURTH EDITION



FOURTH EDITION

ESSENTIALS OF
**BIOLOGICAL
ANTHROPOLOGY**

CLARK SPENCER LARSEN

THE OHIO STATE UNIVERSITY



W. W. NORTON & COMPANY
NEW YORK • LONDON

W. W. Norton & Company has been independent since its founding in 1923, when William Warder Norton and Mary D. Herter Norton first published lectures delivered at the People's Institute, the adult education division of New York City's Cooper Union. The firm soon expanded its program beyond the Institute, publishing books by celebrated academics from America and abroad. By midcentury, the two major pillars of Norton's publishing program—trade books and college texts—were firmly established. In the 1950s, the Norton family transferred control of the company to its employees, and today—with a staff of four hundred and a comparable number of trade, college, and professional titles published each year—W. W. Norton & Company stands as the largest and oldest publishing house owned wholly by its employees.

Copyright © 2019, 2017, 2014, 2011, 2008 by W. W. Norton & Company, Inc.

Printed in the United States of America.

Editor: Jake Schindel
Associate Editor: Rachel Goodman
Development Editor: Sunny Hwang
Project Editor: Caitlin Moran
Associate Director of Production: Benjamin Reynolds
Marketing Manager, Anthropology: Katie Sweeney
Media Editor: Miryam Chandler
Associate Editor, Emedia: Mary Williams and Ariel Eaton
Editorial Assistant, Emedia: Joshua Bianchi
Photo Editor: Stephanie Romeo
Photo Researcher: Lynn Gadson
Director of College Permissions: Megan Schindel
Permissions Clearing: Bethany Salminen
Text Designer: Jillian Burr
Art Director: Rubina Yeh
Composition: Sixredmarbles / Jouve—Brattleboro, VT
Illustrations: Imagineering—Toronto, ON
Manufacturing: LSC Communications—Kendallville, IN

Fourth Edition

Library of Congress Cataloging-in-Publication Data

Names: Larsen, Clark Spencer, author.
Title: Essentials of biological anthropology : discovering our origins /
Clark Spencer Larsen, The Ohio State University.
Other titles: Essentials of physical anthropology
Description: Fourth Edition. | New York : W.W. Norton & Company, Inc., [2018]
| Includes bibliographical references and index.
Identifiers: LCCN 2018033475 | ISBN 9780393667431 (paperback)
Subjects: LCSH: Physical anthropology.
Classification: LCC GN50.4 .L367 2018 | DDC 599.9—dc23 LC record available at
<https://lccn.loc.gov/2018033475>

W. W. Norton & Company, Inc., 500 Fifth Avenue, New York, N.Y. 10110-0017
www.wwnorton.com
W. W. Norton & Company Ltd., 15 Carlisle Street, London W1D 3BS

1 2 3 4 5 6 7 8 9 0

To Chris and Spencer,
with my deepest thanks for their help,
encouragement, and (unwavering) patience

In memory of Jack Repcheck
(January 13, 1957–October 14, 2015)
Editor, writing mentor, and friend

ABOUT THE AUTHOR



Clark Spencer Larsen is a native of Nebraska. He received his B.A. from Kansas State University and M.A. and Ph.D. from the University of Michigan. Clark's research is in bioarchaeology, skeletal biology, and paleoanthropology. He has worked in North America, Europe, and Asia. His current fieldwork is in Turkey, Italy, and the United States. He has taught at the University of Massachusetts, Northern Illinois University, Purdue University, and the University of North Carolina. Since 2001, he has been a member of the faculty at The Ohio State University, where he is Distinguished University Professor. He served as Chair of the Department of Anthropology from 2001 to 2017. He teaches introductory biological anthropology, osteology, bioarchaeology, and paleoanthropology. Clark has served as president of the American Association of Physical Anthropologists and as editor-in-chief of the *American Journal of Physical Anthropology*. He is a member of the National Academy of Sciences and a Fellow of the American Association for the Advancement of Science. In addition to *Essentials of Biological Anthropology*, he has authored or edited 35 books and monographs, including *Bioarchaeology: Interpreting Behavior from the Human Skeleton*, *Skeletons in Our Closet*, *Advances in Dental Anthropology*, and *A Companion to Biological Anthropology*.

BASIC TABLE OF CONTENTS

To the Instructor xix

To the Student xxviii

1. What Is Biological Anthropology? 3

PART I THE PRESENT: FOUNDATION FOR THE PAST 19

2. Evolution: Constructing a Fundamental Scientific Theory 21
3. Genetics: Reproducing Life and Producing Variation 45
4. Genes and Their Evolution: Population Genetics 73
5. Biology in the Present: Living People 103
6. Biology in the Present: The Other Living Primates 135
7. Primate Sociality, Social Behavior, and Culture 171

PART II THE PAST: EVIDENCE FOR THE PRESENT 191

8. Fossils and Their Place in Time and Nature 193
9. Primate Origins and Evolution: The First 50 Million Years 227
10. Early Hominin Origins and Evolution: The Roots of Humanity 259
11. The Origins and Evolution of Early *Homo* 297
12. The Origins, Evolution, and Dispersal of Modern People 327
13. Our Past 10,000 Years: Agriculture, Population, Biology 375

TABLE OF CONTENTS

Dedication	v
About the Author	vi
Basic Table of Contents	vii
Table of Contents	ix
To the Instructor	xix
How This Book Can Help Your Students Discover Biological Anthropology	xix
Aids to the Learning Process	xxii
Tools for Teaching and Learning	xxii
Who Helped	xxiv
To the Student	xxviii

CHAPTER 1 WHAT IS BIOLOGICAL ANTHROPOLOGY? 3

Big Questions 3

What Is Anthropology?	5
What Is Biological Anthropology?	7
What Do Biological Anthropologists Do?	7
What Makes Humans So Different from Other Animals? The Six Steps to Humanness	10
How We Know What We Know: The Scientific Method	14

Chapter Review 17

Answering the Big Questions	17
-----------------------------	----



Study Quiz 17
 Key Terms 17
 Evolution Review: Biological Anthropology as Science 18
 Additional Readings 18

PART I THE PRESENT: FOUNDATION FOR THE PAST 19

CHAPTER 2 EVOLUTION: CONSTRUCTING A FUNDAMENTAL SCIENTIFIC THEORY 21

Big Questions 21

The Theory of Evolution: The Context for Darwin 23
 Geology: Reconstructing Earth's Dynamic History 24
 Paleontology: Reconstructing the History of Life on Earth 25
 Taxonomy and Systematics: Classifying Living Organisms and Identifying Their Biological Relationships 26
 Demography: Influences on Population Size and Competition for Limited Resources 27
 Evolutionary Biology: Explaining the Transformation of Earlier Life-Forms into Later Life-Forms 29

Concept Check Darwin Borrows from Malthus 31

The Theory of Evolution: Darwin's Contribution 31

Concept Check Pre-Darwinian Theory and Ideas: Groundwork for Evolution 32

Since Darwin: Mechanisms of Inheritance, the Evolutionary Synthesis, and the Discovery of DNA 33
 Mechanisms of Inheritance 33
 The Evolutionary Synthesis, the Study of Populations, and the Causes of Evolution 38
 DNA: Discovery of the Molecular Basis of Evolution 39

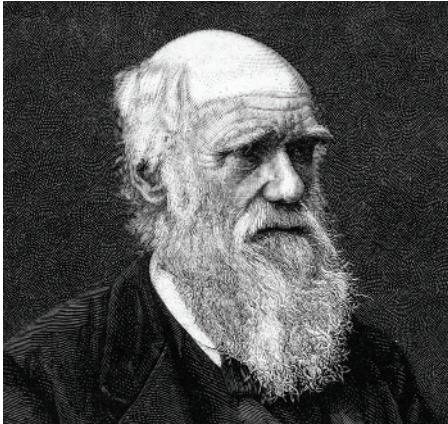
Chapter Review 42

Answering the Big Questions 42
 Key Terms 42
 Study Quiz 42
 Evolution Review: Past, Present, and Future of a Fundamental Scientific Theory 43
 Additional Readings 43

CHAPTER 3 GENETICS: REPRODUCING LIFE AND PRODUCING VARIATION 45

Big Questions 45

The Cell: Its Role in Reproducing Life and Producing Variation 46
 The DNA Molecule: The Genetic Code 50
 DNA: The Blueprint of Life 51



The DNA Molecule: Replicating the Code 51
 Chromosome Types 52
 Mitosis: Production of Identical Somatic Cells 53
Concept Check The Two Steps of DNA Replication 55
 Meiosis: Production of Gametes (Sex Cells) 55
 Producing Proteins: The Other Function of DNA 57
Concept Check The Two Steps of Protein Synthesis 62
 Genes: Structural and Regulatory 63
 Polymorphisms: Variations in Specific Genes 64
 Genotypes and Phenotypes: Genes and Their Expression 67
 The Complexity of Genetics 67
Chapter Review 70
 Answering the Big Questions 70
 Key Terms 70
 Study Quiz 70
 Evolution Review: Insights from Genetics 71
 Additional Readings 71

CHAPTER 4 GENES AND THEIR EVOLUTION: POPULATION GENETICS 73

Big Questions 73

Demes, Reproductive Isolation, and Species 74
 Hardy–Weinberg Law: Testing the Conditions of Genetic Equilibrium 78
 Mutation: The Only Source of New Alleles 79
 Natural Selection: Advantageous Characteristics, Survival, and
 Reproduction 82
 Patterns of Natural Selection 83
 Natural Selection in Animals: The Case of the Peppered Moth and
 Industrial Melanism 83
 Natural Selection in Humans: Abnormal Hemoglobins and
 Resistance to Malaria 86
The Geography of Sickle-Cell Anemia and the Association with Malaria 87
The Biology of Sickle-Cell Anemia and Malarial Infection 89
The History of Sickle-Cell Anemia and Malaria 89
Other Hemoglobin and Enzyme Abnormalities 89
 Genetic Drift: Genetic Change Due to Chance 92
 Founder Effect: A Special Kind of Genetic Drift 94
 Gene Flow: Spread of Genes across Population Boundaries 96
 Agriculture and Origins of Modern Europeans 97
Concept Check What Causes Evolution? 99
Chapter Review 100
 Answering the Big Questions 100
 Key Terms 100
 Study Quiz 100
 Evolution Review: The Four Forces of Evolution 101
 Additional Readings 101





CHAPTER 5 BIOLOGY IN THE PRESENT: LIVING PEOPLE 103

Big Questions 103

- Is Race a Valid, Biologically Meaningful Concept? 104
 - Brief History of the Race Concept 104
 - Debunking the Race Concept 105
 - So-Called Racial Traits are not Concordant 105
 - Human Variation: Geographic Clines, not Racial Categories 106
- Life History: Growth and Development 107
 - The Growth Cycle: Conception through Adulthood 107
 - Prenatal Stage: Sensitive to Environmental Stress, Predictive of Adult Health 108
 - Postnatal Stage: The Maturing Brain, Preparing for Adulthood 108
 - Adult Stage: Aging and Senescence 112
 - Evolution of Human Life History: Food, Sex, and Strategies for Survival and Reproduction 113
 - Prolonged Childhood: Fat-Bodied Moms and Their Big-Brained Babies* 113
- Concept Check** Life History Stages in Humans: Prenatal, Postnatal, and Adult 114
 - Grandmothering: Part of Human Adaptive Success* 114

Adaptation: Meeting the Challenges of Living 115

- Climate Adaptation: Living on the Margins 116
 - Heat Stress and Thermoregulation* 116
 - Body Shape and Adaptation to Heat Stress* 117
 - Cold Stress and Thermoregulation* 118
 - Solar Radiation and Skin Color* 119
 - Solar Radiation and Vitamin D Synthesis* 119
 - Solar Radiation and Folate Protection* 120
 - High Altitude and Access to Oxygen* 120
- Nutritional Adaptation: Energy, Nutrients, and Function 121
 - Macronutrients and Micronutrients* 121
 - Human Nutrition Today* 122
- Concept Check** Adaptation: Heat, Cold, Solar Radiation, High Altitude 123
 - Overnutrition and the Consequences of Dietary Excess* 126
- Workload Adaptation: Skeletal Homeostasis and Function 128
 - Excessive Activity and Reproductive Ecology 130

Chapter Review 132

- Answering the Big Questions 132
- Key Terms 132
- Study Quiz 132
- Evolution Review: Human Variation Today 133
- Additional Readings 133

CHAPTER 6 BIOLOGY IN THE PRESENT: THE OTHER LIVING PRIMATES 135

Big Questions 135

- What Is a Primate? 137



- Arboreal Adaptation—Primates Live in Trees and Are Good at It 140
 - Primates Have a Versatile Skeletal Structure* 140
 - Primates Have an Enhanced Sense of Touch* 142
 - Primates Have an Enhanced Sense of Vision* 142
 - Primates Have a Reduced Reliance on Senses of Smell and Hearing* 143

Concept Check What Makes Primates Good at Living in Trees? 143

- Dietary Plasticity—Primates Eat a Highly Varied Diet, and their Teeth Reflect this Adaptive Versatility 144
 - Primates Have Retained Primitive Characteristics in Their Teeth* 144
 - Primates Have a Reduced Number of Teeth* 144
 - Primates Have Evolved Different Dental Specializations and Functional Emphases* 145

Concept Check What Gives Primates Their Dietary Flexibility? 147

- Parental Investment—Primate Parents Provide Prolonged Care for Fewer but Smarter, More Socially Complex, and Longer-Lived Offspring 147

Concept Check Primate Parenting 150

What Are the Kinds of Primates? 150

- The Strepsirhines 155

Concept Check Monkey or Ape? Differences Matter 159

- The Haplorhines 159

Concept Check Strepsirhines and Haplorhines Differ in Their Anatomy and Senses 164

Chapter Review 168

Answering the Big Questions 168

Key Terms 168

Study Quiz 168

Evolution Review: Our Closest Living Relatives 169

Additional Readings 169

CHAPTER 7 PRIMATE SOCIALITY, SOCIAL BEHAVIOR, AND CULTURE 171

Big Questions 171

- Primate Societies: Diverse, Complex, Long-Lasting 173
 - Diversity of Primate Societies 173
 - Primate Social Behavior: Enhancing Survival and Reproduction 173
 - Primate Residence Patterns 174
 - Primate Reproductive Strategies: Males' Differ from Females' 175

Concept Check Male and Female Reproductive Strategies 176

- The Other Side of Competition: Cooperation in Primates 177

Getting Food 178

Acquiring Resources and Transmitting Knowledge: Got Culture? 182

Vocal and Nonvocal Communication Is Fundamental Behavior in Primate Societies 184

- Translating Primate Communication: It's about the Context 184

- Predator Alarms: In Defense of the Primate Society 185



Chimpanzee Vocalization: Labeling the World Around Them 186

Gesturing is Not Limited to Humans 187

Nonvocal Communication: Learning Signing 188

Chapter Review 189

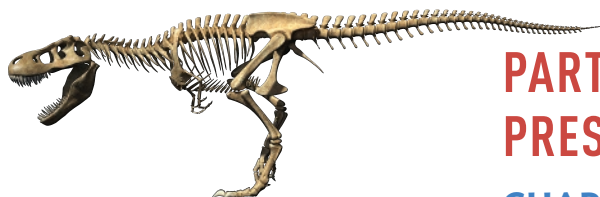
Answering the Big Questions 189

Key Terms 189

Study Quiz 189

Evolution Review: Primate Social Organization and Behavior 190

Additional Readings 190



PART II THE PAST: EVIDENCE FOR THE PRESENT 191

CHAPTER 8 FOSSILS AND THEIR PLACE IN TIME AND NATURE 193

Big Questions 193

Fossils: Memories of the Biological Past 195

What Are Fossils? 195

Taphonomy and Fossilization 195

Types of Fossils 198

Limitations of the Fossil Record: Representation is Important 199

Just How Old Is the Past? 200

Time in Perspective 200

Geologic Time: Earth History 201

Relative and Numerical Age 205

Relative Methods of Dating: Which Is Older, Younger, the Same Age? 206

Stratigraphic Correlation 206

Chemical Dating 206

Biostratigraphic (Faunal) Dating 208

Cultural Dating 208

Absolute Methods of Dating: What Is the Numerical Age? 211

The Radiometric Revolution and the Dating Clock 211

The Revolution Continues: Radiopotassium Dating 214

Non-Radiometric Absolute Dating Methods 215

Genetic Dating: The Molecular Clock 217

Concept Check How Old Is It? 218

Reconstruction of Ancient Environments and Landscapes 219

The Driving Force in Shaping Environment: Temperature 220

Chemistry of Animal Remains and Ancient Soils: Windows onto Diets and Habitats 222

Chapter Review 224

Answering the Big Questions 224

Key Terms 224

Study Quiz 224

Evolution Review: The Fossil Record 225

Additional Readings 225

CHAPTER 9 PRIMATE ORIGINS AND EVOLUTION: THE FIRST 50 MILLION YEARS 227

Big Questions 227

Why Did Primates Emerge? 229

The First True Primate: Visual, Tree-Dwelling, Agile, Smart 230

Primates in the Paleocene? 230

Eocene Euprimates: The First True Primates 231

The Anthropoid Ancestor: Euprimate Contenders 234

The First Anthropoids 236

Early Anthropoids Evolve and Thrive 237

Concept Check When Were They Primates? Anatomy through Time 240

Coming to America: Origin of New World Higher Primates 240

How Anthropoids Got to South America 241

Apes Begin in Africa and Dominate the Miocene Primate World 243

Apes Leave Africa: On to New Habitats and New Adaptations 245

Apes in Europe: The Dryopithecids 245

Apes in Asia: The Sivapithecids 248

Dead End in Ape Evolution: The Oreopithecids 250

Climate Shifts and Habitat Changes 251

Miocene Ape Survivors Give Rise to Modern Apes 251

Concept Check The First Apes: A Remarkable Radiation 252

Apes Return to Africa? 252

Monkeys on the Move 253

Chapter Review 256

Answering the Big Questions 256

Key Terms 256

Study Quiz 256

Evolution Review: Primate Social Organization and Behavior: The Deep Roots of the Order Primates 257

Additional Readings 257

CHAPTER 10 EARLY HOMININ ORIGINS AND EVOLUTION: THE ROOTS OF HUMANITY 259

Big Questions 259

What Is a Hominin? 260

Bipedal Locomotion: Getting Around on Two Feet 261

Nonhoning Chewing: No Slicing, Mainly Grinding 262

Concept Check What Makes a Hominin a Hominin? 266

Why Did Hominins Emerge? 266

Charles Darwin's Hunting Hypothesis 266

Peter Rodman and Henry McHenry's Patchy Forest Hypothesis 268

Owen Lovejoy's Provisioning Hypothesis 268

Sexual Dimorphism and Human Behavior 269

Bipedalism Had Its Benefits and Costs: An Evolutionary Trade-Off 269



What Were the First Hominins? 270

- The Pre-Australopithecines 271
 - Sahelanthropus tchadensis (7–6 mya) 271
 - Orrorin tugenensis (6 mya) 271
 - Ardipithecus kadabba and Ardipithecus ramidus (5.8–4.4 mya) 272
- The Australopithecines (4–1 mya) 275
 - Australopithecus anamensis (4 mya) 275

Concept Check The Pre-Australopithecines 279

- Australopithecus afarensis (3.6–3.0 mya) 280
- Australopithecus (Kenyanthropus) platyops (3.5 mya) 283
- Australopithecus deyiremeda (3.5–3.3 mya) 283

Diversification of the Homininae: Emergence of Multiple Evolutionary Lineages from *Australopithecus* (3–1 mya) 284

- Australopithecus garhi (2.5 mya) 284
- The First Toolmakers and Users: Australopithecus or Homo?* 285

Evolution and Extinction of the Australopithecines 287

Concept Check The Australopithecines 290

Chapter Review 294

- Answering the Big Questions 294
- Key Terms 294
- Study Quiz 294
- Evolution Review: The First Hominins 295
- Additional Readings 295



CHAPTER 11 THE ORIGINS AND EVOLUTION OF EARLY HOMO 297

Big Questions 297

- Homo habilis*: The First Species of the Genus *Homo* 300
 - The Path to Humanness: Bigger Brains, Tool Use, and Adaptive Flexibility 300
- Homo Habilis* and *Australopithecus*: Similar in Body Plan 301
- Homo Habilis*'s Adaptation: Intelligence And Tool Use Become Important 301

Concept Check *Homo habilis*: The First Member of Our Lineage 302

- Habitat Changes and Increasing Adaptive Flexibility 302

Homo erectus: Early *Homo* Goes Global 303

- Homo Erectus* in Africa (1.8–0.3 Mya) 303
- Homo Erectus* in Asia (1.8–0.3 Mya) 309
- Homo Erectus* in Europe (1.2 Million–400,000 Ybp) 311
- Evolution Of *Homo Erectus*: Biological Change, Adaptation, and Improved Nutrition 312

Concept Check *Homo erectus*: Beginning Globalization 319

- Patterns of Evolution in *Homo Erectus* 319
- Expect the Unexpected in Hominin Evolution: Two Surprises 320

Chapter Review 324

- Answering the Big Questions 324
- Key Terms 324

Study Quiz 324
Evolution Review: The Origins of *Homo* 325
Additional Readings 325

CHAPTER 12 THE ORIGINS, EVOLUTION, AND DISPERSAL OF MODERN PEOPLE 327

Big Questions 327

What Is So Modern about Modern Humans? 329
Modern *Homo sapiens*: Single Origin and Global Dispersal or Regional Continuity? 329
What Do *Homo sapiens* Fossils Tell Us about Modern Human Origins? 331
 Early Archaic *Homo Sapiens* 331
 Archaic *Homo sapiens* in Africa (350,000–200,000 yBP) 332
 Early Archaic *Homo sapiens* in Asia and Europe (350,000–130,000 yBP) 332
 Early Archaic *Homo sapiens*' Dietary Adaptations 333
 Late Archaic *Homo Sapiens* 335
 Late Archaic *Homo sapiens* in Asia (60,000–40,000 yBP) 335
 Late Archaic *Homo sapiens* in Europe (130,000–30,000 yBP) 337
 The Neandertal Body Plan: Aberrant or Adapted? 339
 Neandertal Hunting: Inefficient or Successful? 342
 Neandertals Buried Their Dead 344
 Neandertals Talked 345

Concept Check Archaic *Homo sapiens* 347
 Neandertals Used Symbols 348

Early Modern *Homo Sapiens* 349
 Early Modern *Homo sapiens* in Africa (200,000–6,000 yBP) 350
 Early Modern *Homo sapiens* in Asia (100,000–18,000 yBP) 354
 On the Margin of Modernity in Southeast Asia: *Homo floresiensis* 356
 Early Modern *Homo sapiens* in Europe (35,000–15,000 yBP) 356

Concept Check Early Modern *Homo Sapiens* 359

 Modern Behavioral and Cultural Transitions 360

How Has the Biological Variation in Fossil *Homo sapiens* Been Interpreted? 361

 Ancient DNA: Interbreeding between Neandertals and Early Modern People? 361

 Living People's Genetic Record: Settling the Debate on Modern Human Origins 363

Assimilation Model for Modern Human Variation: Neandertals Are Still with Us 363

Concept Check Models for Explaining Modern *Homo sapiens*' Origins 364

Modern Humans' Other Migrations: Colonization of Australia, the Pacific, and the Americas 365

 Down Under and Beyond: The Australian and Pacific Migrations 366

 Arrival in the Western Hemisphere: The First Americans 368

Chapter Review 372

Answering the Big Questions 372

Key Terms 372

Study Quiz 372



Evolution Review: The Origins of Modern People 373

Additional Readings 373



CHAPTER 13 OUR PAST 10,000 YEARS: AGRICULTURE, POPULATION, BIOLOGY 375

Big Questions 375

The Agricultural Revolution: New Foods and New Adaptations 376

Population Pressure 378

Regional Variation 379

Survival and Growth 383

Agriculture: An Adaptive Trade-Off 384

Population Growth 384

Environmental Degradation 385

Concept Check The Good and Bad of Agriculture 385

How Did Agriculture Affect Human Biology? 386

The Changing Face of Humanity 387

Two Hypotheses 387

Implications for Teeth 389

Building a New Physique: Agriculture's Changes to Workload and Activity 389

Concept Check Soft Food and Biological Change 391

Health and the Agricultural Revolution 392

Population Crowding and Infectious Disease 392

Concept Check Labor, Lifestyle, and Adaptation in the Skeleton 394

The Consequences of Declining Nutrition: Tooth Decay 394

Nutritional Consequences Due to Missing Nutrients: Reduced Growth and Abnormal Development 394

Concept Check Health Costs of Agriculture 396

Nutritional Consequences of Iron Deficiency 396

Nutritional Consequences: Heights on the Decline 396

If It Is So Bad for You, Why Farm? 397

Our Past Is Our Future 398

Our Ongoing Evolution 398

Chapter Review 400

Answering the Big Questions 400

Key Terms 400

Study Quiz 400

Evolution Review: The Future of the Human Condition 401

Additional Readings 401

Study Quiz Answers 402

Appendix: The Skeleton A1

Glossary G11

Glossary of Place Names G18

Bibliography B20

Permissions Acknowledgments C48

Index I53

TO THE INSTRUCTOR

HOW THIS BOOK CAN HELP YOUR STUDENTS DISCOVER BIOLOGICAL ANTHROPOLOGY

It Is about Engagement

Teaching is about engagement—connecting the student with knowledge, making it real to the student, and having the student come away from the course with an understanding of core concepts. *Essentials of Biological Anthropology* seeks to engage the student in the learning process. Engaging the student is perhaps more of a challenge in the study of biological anthropology than in the study of other sciences, mainly because the student has likely never heard of the subject. Most students have taken a precollege course in chemistry, physics, or biology. Biological anthropology, though, is rarely mentioned or taught in precollege settings. Commonly, the student first finds out about the subject when an academic advisor explains that biological anthropology is a popular course that fulfills the college's natural science requirement.

Once taking the course, however, that same student usually connects quickly with the subject because so many of the topics are familiar—fossils, evolution, race, genetics, DNA, monkeys, forensic investigations, and origins of speech, to name a few. The student simply had not realized that these separately engaging topics come under the umbrella of one discipline, the subject of which is the study of human evolution and human diversity.

Perhaps drawn to biological anthropology because it focuses on our past and our present as a species, the student quickly sees the fundamental importance of the discipline. In *Discover* magazine's 100 top stories of 2009, 18 were from biological anthropology. Three topics from the field were in the top 10, including the remarkable discovery of our earliest human ancestor, *Ardipithecus*. So important was this discovery that *Science*, the leading international professional science journal, called it the “Breakthrough of the Year” for 2009. The discussions in this textbook of topics, familiar and unfamiliar, give the student stepping-stones to science and to the centrality of biological anthropology

as a window into understanding our world. Whether the students find the material familiar or unfamiliar, they will see that the book relates the discipline to human life: real concerns about human bodies and human identity. They will see themselves from an entirely different point of view and gain new awareness.

In writing this book, I made no assumptions about what the reader knows, except to assume that the reader—the student attending your biological anthropology class—has very little or no background in biological anthropology. As I wrote the book, I constantly reflected on the core concepts of biological anthropology and how to make them understandable. I combined this quest for both accuracy and clarity with my philosophy of teaching; namely, engage the student to help the student learn. Simply, teaching is about engagement. While most students in an introductory biological anthropology class do not intend to become professional biological anthropologists, some of these students become interested enough to take more courses. So this book is written for students who will not continue their study of biological anthropology, those who get “hooked” by this fascinating subject (a common occurrence!), and those who now or eventually decide to become professionals in the field.

The book is unified by the subject of biological anthropology. But equally important is the central theme of science—what it is, how it is done, and how scientists (in our case, anthropologists) learn about the natural world. I wrote the book so as to create a picture of who humans are as organisms, how we got to where we are over the past millions of years of evolution, and where we are going in the future in light of current conditions. In regard to biological anthropology, the student should finish the book understanding human evolution and how it is studied, how the present helps us understand the past, the diversity of organisms living and past, the diversity of human beings, and the nature of biological change over time and across geography. Such knowledge should help the student answer questions about the world. For example, How did primates emerge as

a unique group of mammals? Why do people look different from place to place around the world? Why is it important to gain exposure to sunlight yet unsafe to prolong that exposure? Why is it unhealthy to be excessively overweight? Throughout their history, what have humans eaten, and why is it important to know?

I have presented such topics so that the student can come to understand the central concepts and build from them a fuller understanding of biological anthropology. Throughout the book, I emphasize hypothesis testing, the core of the scientific method, and focus on that process and the excitement of discovery. The narrative style is personalized. Often I draw on my own experiences and those of scientists I know or am familiar with through their teaching and writing, to show the student how problems are addressed through fieldwork or through laboratory investigations.

Scientists do not just collect facts. Rather, they collect data and make observations that help them answer questions about the complex natural world we all inhabit. Reflecting this practice, *Essentials of Biological Anthropology* is a collection not of facts for the student to learn but of answers to questions that help all of us understand who we are as living organisms and our place in the world. Science is a way of knowing, it is a learning process, and it connects our lives with our world. In these ways, it is liberating.

How the Book Is Organized

The book is divided into two parts. After an introductory overview of anthropology and biological anthropology, part I presents the key principles and concepts in biology, especially from an evolutionary perspective. This material draws largely on the study of living organisms, including humans and our closest biological relatives, and nonhuman primates. Because much of our understanding of the past is drawn from what we have learned from the present, this part lays the foundation for the presentation in part II—the past record of primate and human evolution. In putting the record of the living up front, this book departs from the style of most other introductory biological anthropology textbooks, which start out with the earliest record and end with the living. This book takes the position that most of what we learn about the past is based on theory and principles learned from the living record. Just as all of Charles Darwin's ideas were first derived from seeing living plants and animals, much of our understanding of function and adaptation comes from living organisms as models. Therefore, this book views the living as the window onto what came before—the present contextualizes and informs our understanding of the past. The origins of who we are today do not just lie in the record of the past, but are very much embodied in the living. Our origins are expressed in our physical makeup (bones, teeth, and muscles), in our behavior, and in so many other ways that the

student taking this course will learn about from this book and from you. You can teach individual chapters in any order, and that is partly because each chapter reinforces the central point: we understand our past via what we see in the living.

Part II presents evidence of the past, covering more than 50 million years of primate and human evolution. Most textbooks of this kind end the record of human evolution at about 25,000 years ago, when modern *Homo sapiens* evolved worldwide, but this textbook also provides the record since the appearance of modern humans, showing that important biological changes occurred in just the past 10,000 years, largely relating to the shift from hunting and gathering to the domestication of plants and animals. Food production was a revolutionary development in the human story, and part II presents this remarkable record, including changes in health and well-being that continue today. A new subdiscipline of biological anthropology, bioarchaeology, is contributing profound insights into the past 10,000 years, one of the most dynamic periods of human evolution. During this period, a fundamental change occurred in how humans obtained food. This change set the stage for our current environmental disruptions and modern living conditions.

Changes in the Fourth Edition

Instructors who have used previous editions of the book will note the title change from “*Essentials of Physical Anthropology: Discovering Our Origins*” for previous editions to “*Essentials of Biological Anthropology: Discovering Our Origins*” for the current edition. The change in book title reflects the development of this growing and exciting discipline, its discoveries, and the central focus of the research and teaching that I present throughout the book.

Reflecting the dynamic nature of biological anthropology, there are numerous revisions and updates throughout this new, fourth edition of *Essentials of Biological Anthropology*. These updates serve to provide content on the new and cutting-edge developments in the discipline, to give new ways of looking at older findings, and to keep the book engaging and timely for both you and your students. Although the core principles of the book remain the same, namely the focus on evolution, the revisions throughout the book present new insights, new discoveries, and new perspectives. Other changes are intended to give added focus and clarity and to increase the visual appeal that supports the pedagogy of engagement and learning:

- **New content on race and human variation.** The new edition provides answers to fundamental questions about race in America. This fourth edition explains that while race is a social reality, there is no meaningful biological basis for categorizing human

variation. Therefore, while governmental and other institutions use categories to describe “race,” the categories are not biologically informed.

- **New content on the globalization of diet.** The traditional low-fat, high-protein diet in many settings around the world is rapidly shifting to a high-fat, high-carbohydrate diet, resulting in an epidemic of obesity globally. This has important consequences for world health in the twenty-first century.
- **New content on rapidly emerging infectious diseases.** New infectious diseases—such as those caused by Ebola, bird flu, and, most recently, Zika—are emerging owing to the evolutionary changes taking place in the viruses and in the human hosts. We are learning how that evolution occurs, and how understanding this evolution offers a very practical foundation for mitigating these life-threatening events.
- **New content on epigenetics.** The new edition explores the remarkable advances in our understanding of the human genome and the role of environment in modifying the way that DNA is regulated and expressed (but without modifying the DNA itself). Some of these modifications taking place well before birth can have long-term health consequences.
- **New content on primate social behavior.** Anthropologists are learning much more about social interactions between members of primate groups, and just how critical social behavior is for the well-being and functioning of social units.
- **New content on the genomes of hominins.** Analysis of ancient DNA of Neandertals reveals the presence of alleles for modern human disease. New analysis of ancient DNA from Kennewick Man and other Paleoamericans reveals a clear genetic link between the earliest humans in the Western Hemisphere and modern Native Americans.
- **New content on fossil primate discoveries.** A newly discovered fossil New World monkey pre-dates the earliest known fossil New World monkey by as much as 10 million years.
- **New content on fossil hominin discoveries.** New discoveries of *Ardipithecus* extend the lineage back to more than 6 million years ago, taking us closer to the divergence of the great apes and hominins. In South Africa, cavers exploring the Rising Star Cave system discovered hundreds of skulls, teeth, and bones, all representing at least 15 early hominins. Named *Homo naledi*, this species is represented by the largest assemblage of early hominins in a single site in Africa. Its study is full of surprises

and is expanding the scope of our understanding of human origins and human evolution. Excavations on Flores Island, where the famous “hobbit” (*Homo floresiensis*) fossils were found, landed a new surprise: a dwarf hominin that may be the ancestor of *H. floresiensis*. Re-dating of *H. floresiensis* takes it back in time to at least 60,000 yBP.

- **Anthropology Matters Videos** New videos highlight exciting and relevant new developments in biological anthropology, including work at the “Body Farm” for developing the field of forensic anthropology; the Ebola virus and how knowledge of its evolution helps us combat the disease; new findings from genomics and the origins and evolution of modern humans and their migrations; the meaning of race and what anthropology brings to the discussion of the controversial topic; new developments in primate conservation; the exciting discovery and study of *Homo naledi*; bone chemistry and its application to the study of diets in past human evolutions, both long extinct and recent; and the earliest evidence of warfare and what human skeletons tell us about violence and conflict.
- **New content on dramatic changes in the world’s climate today.** We are living at a time of rapidly changing climate, involving global warming. New content in this edition makes the case that we may be living in a wholly new epoch, what many scientists are calling the “Anthropocene.” New content in the final chapter of *Essentials of Biological Anthropology* focuses on the effects of climate change happening in the world around us today.
- **Revision of content to enhance clarity.** There is a continued focus on understanding core concepts, with considerable attention given to cell biology, genetics, DNA, race and human variation, primate taxonomy, locomotion, and dating methods. Like previous editions, I paid careful attention to the clarity of figure captions. The figure captions do not simply repeat text but rather offer the student additional details relevant to the topic and occasional questions about concepts that the figures convey.
- **Greatly enhanced art program.** The new edition contains many new or revised figures, often using a new “photorealistic” style. The book adds several full-color two-page spreads developed by Mauricio Antón, a world-renowned artist with expertise in representing past life in wonderful visual presentations.

- **InQuizitive.** InQuizitive is an online formative and adaptive learning tool that includes a variety of question types featuring the vibrant, detailed, and photorealistic art from the text, as well as the accompanying suite of animations. Answer-specific feedback for every question helps students work through their mistakes, and InQuizitive personalizes students' quizzing experience to target the areas they need help with most.
- **New teaching and learning tools.** Consistent with the highly visual nature of biological anthropology, the instructor media package has been greatly expanded. Please see the complete listing that starts on p. xxii. The Update PowerPoint Service features a new minilecture that will be posted to the Norton Instructor's site each semester on the latest discoveries in the discipline.

AIDS TO THE LEARNING PROCESS

Each chapter opens with a *vignette* telling the story of one person's discovery that relates directly to the central theme of the chapter. This vignette is intended to draw your students into the excitement of the topic and to set the stage for the Big Questions that the chapter addresses.

Big Question learning objectives are introduced early in the chapter to help your students organize their reading and understand the topic.

Concept Checks are scattered throughout each chapter. These aids are intended to help your students briefly revisit the key points they have been reading.

Locator Maps are placed liberally throughout the book. College-level instructors tend to hope that students have a good sense of geography, but like a lot of people who do not look at places around the world on a daily basis, students often need reminders about geography. In recognition of this, locator maps in the book's margins show the names and locations of places that are likely not common knowledge.

Photorealistic Art You Can "Touch": Designed to give students an even better appreciation for the feel of the discipline, the art program has been substantially reworked. Now most illustrations of bones and skeletons have an almost photorealistic feel, and most primates were redrawn for a high degree of realism. This book helps your students visualize what they are reading about by including hundreds of images, many specially prepared for the book. These illustrations tell the story of biological anthropology, including

key processes, central players, and important concepts. As much thought went into the pedagogy behind the illustration program as into the writing of the text.

Definitions are also presented in the text's margins, giving your students ready access to what a term means in addition to its use in the associated text. For convenient reference, defined terms are signaled with boldface page numbers in the index.

At the end of each chapter, **Answering the Big Questions** presents a summary of the chapter's central points organized along the lines of the Big Questions presented at the beginning of the chapter. In addition, I have added to the Chapter Review at the end of each chapter a new Study Quiz, asking a handful of key questions that I ask my own students.

The study of evolution is the central core concept of biological anthropology. The **Evolution Review** section at the end of each chapter discusses topics on evolution featured in the chapter and asks questions that will help the student develop a focused understanding of content and ideas.

InQuizitive is our online assessment service featuring visual, conceptual, and reading assessments keyed to the Big Question learning objectives, several of which are highlighted for your convenience at the end of each chapter. InQuizitive helps you track and report on your students' progress and make sure they are better prepared for class.

Join me now in engaging your students in the excitement of discovering biological anthropology.

TOOLS FOR TEACHING AND LEARNING

The *Essentials of Biological Anthropology* teaching and learning package provides instructors and students with all the tools they need to visualize anthropological concepts, learn key vocabulary, and test knowledge.

For Instructors

InQuizitive InQuizitive online assessment is available for use with *Essentials of Biological Anthropology*, Fourth Edition, featuring engaging assignments with focused feedback. InQuizitive includes drag-and-drop and other image-based questions designed to help students better understand the core objectives of each chapter. Further questions on the reading help you check if students have worked through the chapter material. Designed to be intuitive, accessible, and easy to use, InQuizitive makes it a snap to assign, assess, and report on student performance and help keep your class on track.

Chapter 9. Primate Origins and Evolution

Page 228 9.3 What were the first higher primates?

Complete the following sentence by dragging the correct word to the blank.

Aegyptopithecus was one of the most common **propliopithecids**.

oligopithecids parapithecids

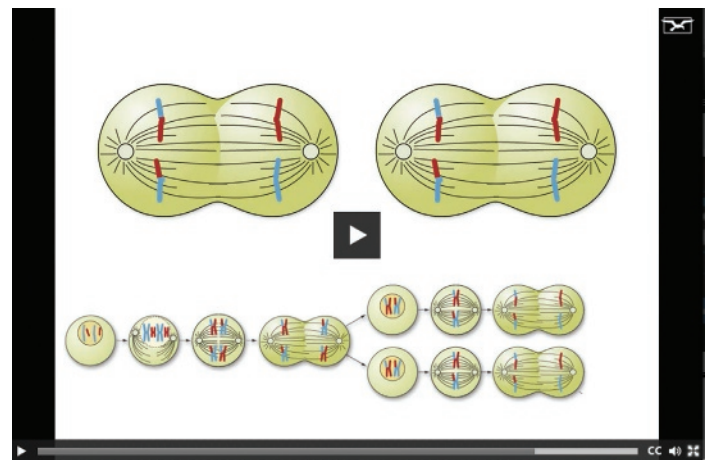


Student Access Codes for InQuizitive InQuizitive comes at no charge with all new books in any format (paperback, looseleaf, ebook, or custom). If students need to purchase a stand-alone access code for InQuizitive, they can do so at an affordable price at digital.wwnorton.com/essanthro4.

New Interactive Instructor's Guide Find all the resources you need to create a rich and engaging course experience in one place with the new Interactive Instructor's Guide: iig.wwnorton.com/essanthro4. Easily search by keyword, topic, or chapter to find and download videos, animations, in-class activity suggestions, PowerPoints, and more on this new site.

Coursepacks Available at no cost to professors or students, Norton Coursepacks for online or hybrid courses come in a variety of formats, including all versions of Blackboard. With just a simple download from wwnorton.com/instructors, instructors can bring high-quality Norton digital media into a new or existing online course. Content includes review and quiz questions designed for the distance or blended learning environment. Norton animations and videos are also made available to integrate in your classes, including the new Anthropology Matters videos. Additionally, if InQuizitive will be in use, contact the local Norton representative to learn about our easy integration options for a single sign-on and gradebook experience with your campus learning management system (LMS).

New Animations Animations of key concepts from the text are available to instructors and students in several ways, including via the Coursepack, the Interactive Instructor's Guide, and at wwnorton.com/instructors and digital.wwnorton.com/essanthro4. These are brief, easy to use, and great for explaining concepts either in class or as a self-study tool.



Update PowerPoint Service To help cover what is new in the discipline, each semester Norton will provide a new set of supplemental lectures, notes, and assessment material covering current and breaking research. Prepared by Jennifer Spence, this material will be available for download at wwnorton.com/instructors and in the Interactive Instructor's Guide.

- New discovery
- South Africa's "Rising Star" cave
- Genus *Homo*
 - New species *naledi*
- At least 15 individuals
- 1,550 fossils

Slide 3

- New discovery: *Homo naledi*
- Rising Star cave system in the Cradle of Humankind region of South Africa, site of many other famous hominin cave sites (e.g., Sterkfontein)
- Discovered by recreational miners; reported to University of Witwatersrand

Lecture PowerPoint Slides and Art Slides Designed for instant classroom use, these slides prepared by Melissa Torpey using art from the text are a great resource for your lectures. All art from the book is also available in PowerPoint and JPEG formats. Download these resources from wwnorton.com/instructors or from the Interactive Instructor's Guide.

Prepare for Class with the *Essentials of Biological Anthropology* Instructor's Manual Prepared by Susan Kirkpatrick Smith this resource provides lecture ideas, discussion topics, suggested reading lists for instructors and students, and suggested answers to Evolution Review questions.

Quickly and Easily Create Tests with the *Essentials of Biological Anthropology* Test Bank Prepared by

[Greg Laden] this test bank contains multiple-choice and essay questions for each chapter. It is downloadable from Norton's Instructor's site and available in Word, PDF, and *ExamView® Assessment Suite* formats. Visit www.norton.com/instructors.

Ebook: Same Great Book, a Fraction of the Price! An affordable and convenient alternative, Norton ebooks retain the content and design of the print book and allow students to highlight and take notes with ease, print chapters as needed, read online or off-line, and search the text. Instructors can even take notes in their ebooks that can be shared with their students.

WHO HELPED

I owe much to the many people who made this book possible, from the planning and writing of the first, second, third, and now this fourth edition. First and foremost, I thank my wife, Christine, and son, Spencer, who helped in innumerable ways. They were my captive audience: without protest, they listened to my ideas at the dinner table, on family trips, and in other places where we probably should have been talking about other things. Chris read many drafts of chapters and gave great advice on when and where to cut, add, or rethink. I thank my parents, the late Leon and Patricia Larsen, who introduced me to things old and sparked my interest in the human past.

Jack Repcheck first approached me about writing a textbook on introductory biological anthropology. His power of persuasion, combined with my own interest in the discipline and its presentation to college students, was instrumental in reeling me in and getting the project off the ground. Jack and others at W. W. Norton & Company made the process of writing the book a great experience in all ways, from writing to publication. On the first edition, I began work with editors John Byram and then Leo Wiegman. I am indebted to Pete Lesser, who took on the project after Leo. Pete gave direction on writing and production, provided very helpful feedback on presentation and pedagogy, and orchestrated the process of review, revision, and production—all without a hitch. Under Pete's guidance, the first edition became the most widely used textbook in biological anthropology. Jack Repcheck continued the project in preparation for the second edition. The preparation of the third edition was overseen by editor Eric Svendsen. His advice and guidance were central to seeing the book come to fruition. The current fourth edition was undertaken and completed with the guidance and support of Jake Schindel. Miryam Chandler has spearheaded the development of new media for this edition including InQuizitive. Mary Williams, Ariel Eaton, and Joshua Bianchi do an excellent

job developing the core supplement package for each edition. Kurt Wildermuth edited the entire manuscript for the first three editions. His skill as an editor and staying on top of content from beginning to end added enormously to the book's presentation and readability. Sunny Hwang has now taken Kurt's place and has especially helped with revision in the end-of-chapter material and the online supplements program. Caitlin Moran, Rachel Mayer, and Rachel Goodman were instrumental in producing these pages and directing a wide variety of editing issues. I welcome Katie Sweeney, who crafted an expert marketing and promotional campaign. Benjamin Reynolds guided the process of production from beginning to end. I am also grateful to Mauricio Antón for his wonderful illustrations of six "big events" of human evolution in chapter 1; the rendition of the Taï Forest primates as a microcosm of primate adaptation in chapter 6; the Eocene, Oligocene, and Miocene primates and their habitats in chapter 9; and his reconstructions of *Ardipithecus* in chapter 10. Greg Laden timely and efficient revision of the Test Bank is much appreciated. Susan Kirkpatrick Smith provided quality work on the Instructor's Manual and Interactive Instructor's Guide. Jennifer Spence produces our valuable Update PowerPoints each semester. Thanks to Melissa Torpey for her capable work on the Lecture PowerPoint Slides.

With the input of instructors and focus group attendees who are included in the reviewer list, we have created an extensive new media and assessment suite for the fourth edition. However, my thanks for extensive work in developing InQuizitive and our new animations go to Tracy Betsinger of SUNY Oneonta, Ashley Hurst, Kristina Killgrove of University of West Florida, Greg Laden, Joanna Lambert of the University of Colorado, and Heather Worne of University of Kentucky, with further thanks to contributors Jaime Ullinger, Quinnipiac University, and Nancy Cordell, South Puget Sound Community College. And thanks to Sandra Wheeler of University of Central Florida, Ellen Miller of Wake Forest University, Bonnie Yoshida of Grossmont College, Jacqueline Eng of Western Michigan University, Jeremy DeSilva of Dartmouth College, K. Elizabeth Soluri of College of Marin, and again Nancy Cordell of South Puget Sound Community College for their important feedback and reviews of these resources.

There are a number of new video features for this edition of *Essentials of Biological Anthropology*. I especially thank the following anthropologists who helped with providing material and advice: Lee Berger, Tracy Betsinger, Doug Crews, Rachel Caspari, Augustín Fuentes, Scott McGraw, Hannah Morris, Erin Riley, and Karen Strier. In addition, the online interviews feature Rachel Caspari, Scott McGraw, Hannah Morris, Erin Riley, Karen Strier, Sarah Tishkoff, and Tiffany

Tung. For her leading role and considerable effort in seeing these amazing presentations on key topics in biological anthropology completed, I am indebted to Tacy Quinn.

Thanks go to former and current graduate students and faculty colleagues at Ohio State University who helped in so many ways. I offer a very special thanks to Tracy Betsinger, who assisted in a number of aspects of the book as well as the Coursepack. For the first edition, she read drafts of chapters at various stages and helped in figure selection, in glossary compilation, and as a sounding board in general for ideas that went into the book. For the second edition, she offered very helpful suggestions for revisions. Tracy, Jim Gosman, Dan Temple, Haagen Klaus, and Josh Sadvari read parts or all of the manuscript and offered great advice. For all four editions, I had many helpful discussions with Scott McGraw and Dawn Kitchen about primate behavior, evolution, and taxonomy. Scott also provided advice on the production of the two-page spreads on both primate diversity and eagle predation in the Taï Forest, Ivory Coast (chapters 6 and 7). John Fleagle provided valuable support reviewing details in most of the new primate illustrations, in particular the two-page spreads, and every new piece of art was reviewed by Arthur Durband, Andrew Kramer, and Sandra Wheeler. Doug Crews gave advice on the complexities of primate (including human) biology and life history. Haagen Klaus provided materials for and help with the two-page spread on the biological consequences of the agricultural revolution and many other helpful comments and suggestions for revision. Barbara Piperata advised me on key aspects of modern human biology and nutrition science, and Dawn Kitchen provided discussion and help on the fundamentals of primate communication and how best to present it. Josh Sadvari was indispensable in the creation of the Evolution Review sections at the end of each chapter. Ellen Mosley-Thompson and John Brooke advised me on climate change and its role in our rapidly changing world. Likewise, Mary Beth Cole developed terrific student review questions for each chapter.

Over the years, I have had helpful conversations with my teachers, colleagues, and students about areas of their expertise, and these people have influenced the development of the book in so many ways. I am grateful to Patricia J. O'Brien and Milford H. Wolpoff, my respective undergraduate and graduate advisors. Both were instrumental in developing my interest in science and the wonderful profession I work in. I thank Barry Bogin, Kristen Hawkes, Jim O'Connell, David Thomas, Bob Kelly, Jerry Milanich, Bruce Smith, Kris Gremillion, Bonnie McEwan, Matt Cartmill, Dale Hutchinson, Chris Ruff, Simon Hillson, Michael Schultz, Sam Stout, Doug Ubelaker, Dan Sellen, Clark Howell, Rick Steckel, Phil Walker, John Relethford, Mark Weiss, Margaret Schoeninger, Karen Rosenberg, Lynne Schepartz,

Fred Smith, Brian Hemphill, Bruce Winterhalder, Meg Conkey, Desmond Clark, Erik Trinkaus, Katherine Russell, Vin Steponaitis, Mark Teaford, Richard Wrangham, Jerry Rose, Mark Cohen, William Bass, Loring Brace, Stanley Garn, Frank Livingstone, Phil Gingerich, T. Dale Stewart, Larry Angel, Mike Finnegan, Harriet Ottenheimer, Marty Ottenheimer, Roberto Frisancho, Randy Susman, Karen Strier, Joanna Lambert, Jim Hijiya, Cecil Brown, Bill Fash, Rich Blanton, Henry Wright, James Griffin, Bill Jungers, David Frayer, Bill Pollitzer, George Armelagos, Jane Buikstra, Elwyn Simons, Steve Churchill, Neil Tubbs, Bob Bettinger, Tim White, Dean Falk, Owen Lovejoy, Scott Simpson, David Carlson, Alan Goodman, Bill Dancey, Debbie Guatelli-Steinberg, Clark Mallam, and Chris Peebles.

The book benefited from the expertise of many anthropologists and other experts. I especially acknowledge the following reviewers for their insights, advice, and suggestions for revision of the text and creation of the support package:

Sabrina Agarwal, University of California, Berkeley
Paul Aiello, Ventura College
Lon Alterman, North Carolina State University
Tara Devi Ashok, University of Massachusetts Boston
Diana Ayers-Darling, Mohawk Valley Community College
Gerald Bacon, Coconino Community College
Philip de Barros, Palomar College
Thad Bartlett, University of Texas, San Antonio
Cynthia Beall, Case Western Reserve University
Owen Beattie, University of Alberta
Sara Becker, University of California, Riverside
Daniel Benyshek, University of Nevada, Las Vegas
Tracy Betsinger, College at Oneonta, State University of New York
Deborah Blom, University of Vermont
Amy Bogaard, Oxford University
Günter Bräuer, University of Hamburg
Margaret Bruchez, Blinn College
Emily Brunson, University of Washington
Victoria Buresch, Glendale Community College
Jessica Cade, Richland College
Maria Leonor Cadena, Fullerton College
Benjamin Campbell, University of Wisconsin, Milwaukee
Isabelle Champlin, University of Pittsburgh, Bradford
Joyce Chan, California State University, Dominguez Hills
Chi-hua Chiu, Kent State University
David Clark, Catholic University of America
Raffaella Commitante, California State University, Fullerton

Nancy Cordell, South Puget Sound Community College
Robert Corruccini, Southern Illinois University
Herbert Covert, University of Colorado
Libby Cowgill, University of Missouri, Columbia
Fabian Crespo, University of Louisville
Douglas Crews, Ohio State University
Alejandra Estrin Dashe, Northwestern Health Sciences
University
Eric Delson, Lehman College, City University of
New York
Jeremy DeSilva, Boston University
Katherine Dettwyler, University of Delaware
Joanne Devlin, University of Tennessee
William Duncan, East Tennessee State University
Arthur Durband, Texas Tech University
Marta Alfonso Durruty, Kansas State University
Phyllisa Eisentraut, Santa Barbara City College
Jacqueline Eng, Western Michigan University
Paul Erickson, St. Mary's University
Becky Floyd, Cypress College
Susan Ford, Southern Illinois University
David Frayer, University of Kansas
Renee Garcia, Saddleback College
Daniel Gebo, Northern Illinois University
Victoria Giambrone, Oakton Community College
Rebecca Gibson, American University
Anne Grauer, Loyola University of Chicago
Mark Griffin, San Francisco State University
Michael Grimes, Western Washington University
Nanda B. Grow, Texas A&M University
Gregg Gunnell, Duke University
Lesley Harrington, University of Alberta
Cory Harris, Orange County Community College, State
University of New York
Ryan P. Harrod, University of Alaska Anchorage
Lauren Hasten, Las Positas College
John Hawks, University of Wisconsin, Madison
Carrie Healy, University of Arkansas
Samantha Hens, California State University, Sacramento
James Hingham, New York University
Madeline Hinkes, San Diego Mesa College
Homes Hogue, Ball State University
Brigitte Holt, University of Massachusetts Amherst
Ashley Hurst, University of Texas at San Antonio
Nina Jablonski, Pennsylvania State University
Karin Enstam Jaffe, Sonoma State University
Gabriela Jakubowska, Ohio State University
Gail Kennedy, University of California, Los Angeles
Dawn Kitchen, Ohio State University
Haagen Klaus, George Mason University
Sam Kobari, San Diego State University

Andrew Kramer, University of Tennessee
Greg Laden, University of Minnesota
Joanna Lambert, University of Texas at San Antonio
Patricia Lambert, Utah State University
Cari Lange, Ventura College
Sang-Hee Lee, University of California, Riverside
Ginesse Listi, Louisiana State University
Michael Little, Binghamton University
Chris Loeffler, Irvine Valley College
Marilyn R. London, University of Maryland
Sara Lynch, Queens College, City University of New York
Lorena Madrigal, University of South Florida
Ann Magennis, Colorado State University
Stephen Marshak, University of Illinois, Urbana-Cham-
paign
Debra Martin, University of Nevada, Las Vegas
Stacey Matarazzo Rine, Holyoke Community College
Thomas McDade, Northwestern University
Richard McFarland, University of Wisconsin-Madison
William McFarlane, Johnson County Community
College
Scott McGraw, Ohio State University
Matthew McIntyre, University of Central Florida
Rachel Messinger, Moorpark College
Ellen Miller, Wake Forest University
Leonor Monreal, Fullerton College
Ellen Mosley-Thompson, Ohio State University
Michael Muehlenbein, Indiana University
Jennifer Muller, Ithaca College
Dawn Neill, California State Polytechnic University, San
Luis Obispo
Elizabeth Newell, Elizabethtown College
Wesley Niewoehner, California State University, San
Bernardino
Kevin Nolan, Ball State University
Rachel Nuger, Hunter College, City University of New
York
Dennis O'Rourke, University of Utah
Joh Otte, Ohlone College
Janet Padiak, McMaster University
Elizabeth Pain, Palomar Community College
Amanda Wolcott Paskey, Cosumnes River College
Sandra Peacock, University of British Columbia
Michael Pietrusewsky, University of Hawai'i
Michael Pilakowski, Butte College
Deborah Poole, Austin Community College
Leila Porter, Northern Illinois University
Frances E. Purifoy, University of Louisville
Ryan Raaum, Lehman College, City University of
New York
Mary Ann Raghanti, Kent State University

Lesley M. Rankin-Hill, University of Oklahoma
Jeffrey Ratcliffe, Pennsylvania State University, Abington
Marcia Regan, Hamline University
Laurie Reitsema, University of Georgia
Melissa Remis, Purdue University
Robert Renger, Ventura College
Erin Riley, San Diego State University
Paul Roach, Century College
Michael Robertson, Los Angeles Harbor College
Charles Roseman, University of Illinois
Karen Rosenberg, University of Delaware
John Rush, Sierra College
Joshua Sadvari, Ohio State University
Melissa Schaefer, University of Utah
Sarah A. Schrader, University of California, Santa Cruz
Timothy Sefczek, Ohio State University
Beth Shook, California State University, Chico
Sara Shrader, University of California, Santa Cruz
Lynette Leidy Sievert, University of Massachusetts
Scott W. Simpson, Case Western Reserve University
Pete Sinelli, University of Central Florida
Cynthia Smith, Ohio State University
Fred Smith, Illinois State University
Richard Smith, Washington University
Sara Smith, Delta College
Sarah Kirkpatrick Smith, Kennesaw State University
Lilian Spencer, Glendale Community College
James Stewart, Columbus State Community College
Marissa Stewart, Ohio State University
Sara Stinson, Queens College, City University of
New York
Christopher Stojanowski, Arizona State University
Margaret Streeter, Boise State University
Karen Strier, University of Wisconsin, Madison
Nancy Tatarek, Ohio University
Linda Taylor, University of Miami

Lonnie Thompson, Ohio State University
Victor Thompson, University of Georgia
Christopher Tillquist, University of Louisville
Melissa Torpey, University of North Carolina,
Wilmington
Sebina Trumble, Hartnell College
Lisa Valkenier, Berkeley City College
Dennis Van Gerven, University of Colorado, Boulder
Patricia Vinyard, University of Akron
Ronald Wallace, University of Central Florida
Brittany Walter, University of South Carolina
David Webb, Kutztown University
Daniel Wescott, Texas State University
Jessica Westin, Pennsylvania State University
Adam Wetsman, Rio Hondo College
Sandra Wheeler, University of Central Florida
Tim White, University of California, Berkeley
Janet Wiebold, Spokane Community College
Caleb Wild, Mira Costa College
Leslie Williams, Utah State University
Sharon Williams, Purdue University
Milford Wolpoff, University of Michigan
Thomas Wynn, University of Colorado, Colorado
Springs

Thanks, everyone, for your help! Lastly, a very special thanks goes to all of the faculty around the globe who adopted the previous three editions of *Essentials of Biological Anthropology* for their introductory biological anthropology classes. I am also grateful to the thousands of students who connected with the book—many of whom have written me with their comments. Please continue to send me your comments (Larsen.53@osu.edu).

Columbus, Ohio
August 27, 2018

TO THE STUDENT

BIOLOGICAL ANTHROPOLOGY IS ABOUT DISCOVERING WHO WE ARE

Thinking Like an Anthropologist

Who are we? Where do we come from? Why do we look and act the way we do? This book is a journey that addresses these and other big questions about us, *Homo sapiens*. This journey emphasizes humans' discovery of the fascinating record of our diversity and of our evolution, a record that serves as a collective memory of our shared biological presence on Earth. From here to the end of the book, I will share with you all kinds of ideas that add up to our current understanding of human beings as living organisms. Along the way, you will experience scientific breakthroughs such as the Human Genome Project and forensics. You will gain new understandings of phenomena such as race and human diversity, global warming and its impact on our evolution and our well-being, the origins of human violence, global disease, and the growing worldwide obesity epidemic. Like an anthropologist tackling important questions, you will discover places on nearly every continent and come to see what life was like millions of years before the present, before the emergence and evolution of humans.

Neither your instructor nor I can expect you as an introductory student to understand all the developments in biological anthropology. Both of us can, however, present you with a clear and concise framework of the field. By the time you are finished reading this book and completing this course, you will have a solid background in the basic tenets of the discipline. This knowledge will help you understand your place in nature and the world that we—more than 7 billion of us and growing—live in. The framework for developing your understanding of biological anthropology is the scientific method, a universal approach to understanding the very complex natural world. You should not assume that this book and this course are about only knowing the right answers, the “facts” of biological anthropology. Rather, they are also about seeing how biological anthropologists know

what they know—understanding the scientific method. So as you read, keep in mind the key questions that scientists try to answer, their processes and methods for finding the answers, and the answers themselves.

In writing this book, I have focused on the big questions in biological anthropology, how scientists have tackled them, and what key discoveries have been made. I have not shied away from identifying the scientists who made these discoveries—real people, young and old, from all over the world. Whether you need to learn all these individuals' names and what they contributed to the growth of biological anthropology and to our knowledge of human evolution and variation is up to your instructor. But in the introductory biological anthropology class that I teach, I encourage my students to learn about the people behind the ideas. By seeing the field through these people's eyes, you can start thinking like an anthropologist.

Seeing Like an Anthropologist

Thinking like an anthropologist includes seeing what anthropologists see. We anthropologists are constantly looking at things—fossilized human teeth, ancient DNA, excavated stone tools, primate skeletons, and much more—and using what we see to understand biology in the past and in the present. The photos and drawn art throughout this book have been chosen to help you see what anthropologists see. I strongly encourage you to pay close attention to the visuals in the book and their captions because much of our anthropological understanding is in the art program.

The Structure of the Book and Resources

The book is divided into two parts. After an overview of anthropology and biological anthropology (chapter 1), part I provides the basic context for how we understand human (and our nonhuman primate relatives') biology in the present (and how that helps us understand the past). From this section of the book you should come away with an understanding of evolution and the biology associated with it.

Evolution as an idea has a long history (chapter 2). You will need to fully grasp the meaning and power of this theory, which explains humans' biological variation today and in the past. Part I also has the important job of providing you with an understanding of genetics (chapters 3 and 4). This information is a central part of the evidence for evolution, from the level of the molecule to the level of the population.

Part I also looks at the biology of living people, that of the other living primates, and the variation among primate species. I am keen on debunking the common notion that there are discrete categories—races—of human beings (chapter 5). In fact, nothing about the biology of people, present or past, indicates that we can be divided into distinct groups. After looking at how environment and culture help shape the way humans look and behave, I will look similarly at nonhuman primates (chapters 6 and 7). Because nonhuman primates' appearances are much more categorical than humans' are, nonhuman primate appearance lends itself to classification or taxonomy. In these chapters, we will look at what nonhuman primates do in the wild, what they are adapted to, and especially the environment's role in shaping their behavior and biology. By looking at living people and living nonhuman primates, we will be better equipped to understand the biological evidence drawn from the past.

Part II examines the processes and evidence biological anthropologists and other scientists use to understand the past (chapter 8), the evolution of prehuman primate ancestors that lived more than 50 million years ago (chapter 9), and both the emergence of our humanlike ancestors and their evolution into modern humans (chapters 10, 11, and 12). Contrary to popular (and some scientific) opinion, human evolution did not stop when anatomically modern people first made their appearance in various corners of the globe. Rather, even into the past 10,000 years a considerable amount of biological change has occurred. Anthropologists have learned that agriculture, which began some 10,000 years ago, has been a fundamental force behind population increase. The downside of this shift to new kinds of food



Gorilla meets hominin and author of *Essentials of Biological Anthropology*, Clark Larsen.

and the resulting population increase was a general decline in health. The later section of part II (chapter 13) explores the nature and cause of biological change, including the changes associated with health and well-being that led to the biological and environmental conditions we face today.

With this book in hand and our goals—thinking and seeing like anthropologists—in mind, let us set off on this exciting journey. Consider it a voyage of discovery, on which our shipmates include your instructor and your fellow students. If we work hard and work together, we will find perhaps the most interesting thing on Earth: ourselves.

ESSENTIALS OF BIOLOGICAL ANTHROPOLOGY
FOURTH EDITION



1

WHAT IS BIOLOGICAL ANTHROPOLOGY?

In the heat of the midday summer sun, our boat slowly made its way across the 5 miles of water that separate mainland Georgia from St. Catherines Island, one of a series of barrier islands dotting the Atlantic seaboard. Today, the island is covered by dense vegetation typical of the subtropical American South—palmettos and other palm trees, pines, hickories, and live oaks—and is infested with a wide array of stinging, burrowing, and biting insects. It is hard to imagine that this setting was once a focal point of the Spanish colonial “New World,” representing the northernmost extension of Spain’s claim on eastern North America (**Figure 1.1**). This was the location of the Roman Catholic church and Mission Santa Catalina de Guale, where several hundred Native Americans and a dozen Spaniards lived and worked during the late 1500s and most of the 1600s.

What could possibly have motivated my field team and me to work for months under a blazing sun, fighting insects?

BIG QUESTIONS

1. What is anthropology?
2. What is biological anthropology?
3. What makes humans so different from other animals?
4. How do biological anthropologists know what they know?

◀ The Georgia coast was a focal point for Spanish colonization in the sixteenth and seventeenth centuries. European colonization set in motion changes in human living conditions that eventually affected human biology on a global scale.



FIGURE 1.1 Spanish Mission Sites Spanish colonization relied on the establishment of missions north and west of St. Augustine, Florida, along the coast of Georgia and the panhandle of northern Florida. These sites, such as Mission Santa Catalina de Guale (on St. Catherines Island), provide insight into what the missions might have looked like (inset). Researchers have reconstructed the lifestyles of the Native Americans and the Spanish colonizers who inhabited the sites; by studying their skeletons, the researchers assessed how the inhabitants changed biologically after colonization.

Like any scientific investigation, our fieldwork was motivated by specific questions that we keenly wanted to answer. Buried in the sands of St. Catherines were the mortal remains—skeletons—of the native people who had lived at this long-abandoned place. These remains held answers to questions about the biology of modern people. Native Americans had lived in this area of the world for most of the past 10,000 years. We wanted to know about their biological evolution and variation: How had these people changed biologically over this time span? What caused these changes? What circumstances led to the changes that we hoped to identify and interpret?

When we first set foot on St. Catherines Island in the summer of 1982 to begin our work at Mission Santa Catalina, we were excited about our project, but little did we realize just what a spectacular scientific journey we were undertaking. The skeletons we sought turned out to provide wonderfully rich biological details about a little-understood region of the world, especially relating to the health and behavioral consequences of European contact on native peoples. In setting up the research project, I had envisioned that our findings would prove to be a microcosm of what had unfolded globally—in the Americas, Asia, Africa, and Australia—during the previous 500 years of human history. During this period, significant biological changes had taken place in humans. Some of these changes were evolutionary—they resulted in genetic change. Other biological changes, nonevolutionary ones, reflected significant alterations in health and lifestyle, alterations that had left impressions on the skeletons we studied. Such study—of genetic and nongenetic changes—here and elsewhere in the world has proved fundamental to understanding human biology in the early twenty-first century.

Like any scientific investigation, the research project at Mission Santa Catalina did not develop in a vacuum. Prior to our work there, my team and I had devoted nearly a decade to studying hundreds of skeletons we had excavated from the region that predated the arrival of the Spaniards. We had learned from archaeological evidence that before AD 1000 or so, the people there ate exclusively wild animals, fish, and wild plants—they were hunters and gatherers. Never settling into one place for any period of time, they moved from place to place over the year, hunting animals, fishing on the coastline, and collecting plants. Then, their descendants—the later prehistoric ancestors of the mission Native Americans—acquired corn agriculture, becoming the first farmers in the region. These people did lots of fishing, but farming produced the mainstay of their diet. This major shift in lifestyle led to the establishment of semipermanent villages. In comparison with the hunter-gatherers living before AD 1000, the later agricultural people were shorter, their skulls and limb bones were smaller, and they had more dental disease and more infections. All of this information—scientific discoveries about the prehistoric people, their biological changes, and their adaptations—set the stage for our return to the island to study the people who lived at Santa Catalina, the descendants of the prehistoric hunter-gatherers and later farmers. From our study of their remains, we learned that after the Spaniards' arrival, the native people worked harder, became more focused on producing and eating corn, and their health declined. The combination of declining quality of life and new diseases introduced by the Spaniards led to the native people's extinction in this area of North America.

The research just described is one small part of the broader discipline known as *biological* (or *physical*) *anthropology*. My work concerns life on the Atlantic coast of the southeastern United States, but biological anthropologists explore and study *everywhere* humans and their ancestors lived. This enterprise covers a lot of ground and a lot of time, basically the entire world and the past 50 million years or so!

The territorial coverage of biological anthropology is so widespread and so diverse because the field addresses broad issues, seeking to understand human evolution—*what* we were in the past, *who* we are today, and *where* we will go in the future. Biological anthropologists seek answers to questions about *why* we are what we are as biological organisms. How we answer these questions is oftentimes difficult. The questions, though, motivate biological anthropologists to spend months in the subtropics of coastal Georgia, learning about an extinct native people; in the deserts of central Ethiopia, finding and studying the remains of people who lived hundreds, thousands, or even millions of years ago; or at the high altitudes of the Andes, studying living people and their responses and long-term adaptation to low oxygen and extreme cold, to name just a few of the settings you will learn about in this book. In this chapter, we will explore in more detail the nature of biological anthropology and its subject matter.

1.1 What Is Anthropology?

When European explorers first undertook transcontinental travel (for example, Marco Polo into Asia in the late 1200s) or transoceanic voyages to faraway lands (for example, Christopher Columbus to the Americas in the late 1400s and early 1500s), they encountered people that looked, talked, dressed, and behaved very differently from themselves. When these travelers returned to their home countries, they described the peoples and cultures they saw. Building on these accounts, early scholars speculated on the relationships between humans living in Europe and those encountered in distant places. Eventually, later scholars developed new ideas about other cultures, resulting in the development of the discipline of anthropology.

Anthropology is the study of humankind, viewed from the perspective of all people and all times. As it is practiced in the United States, it includes four branches or subdisciplines: **cultural anthropology**, **archaeology**, **linguistic anthropology**, and **biological anthropology**, also called **physical anthropology** (**Figure 1.2**).

Cultural anthropologists typically study present-day societies in non-Western settings, such as in Africa, South America, or Australia. Culture—defined as learned behavior that is transmitted from person to person—is the unifying theme of study in cultural anthropology.

Archaeologists study past human societies, focusing mostly on their material remains—such as animal and plant remains and places where people lived in the past. Archaeologists are best known for their study of material objects—**artifacts**—from past cultures, such as weaponry and ceramics. Archaeologists study the processes behind past human behaviors; for example, why people lived where they did, why some societies were simple and others complex, and why people shifted from hunting and gathering to agriculture beginning more than 10,000 years ago. Archaeologists are the cultural anthropologists of the past—they seek to reassemble cultures of the past as though those cultures were alive today.

Linguistic anthropologists study the construction and use of language by human societies. **Language**—defined as a set of written or spoken symbols that refer to things (people, places, concepts, etc.) other than themselves—makes possible the transfer of knowledge from one person to the next and from one generation to the next. Popular among linguistic anthropologists is a subfield called **sociolinguistics**, the investigation of language's social contexts.

Biological (or physical) anthropologists study all aspects of present and past human biology. As we will explore in the next section, biological anthropology

artifacts Material objects from past cultures.

sociolinguistics The science of investigating language's social contexts.

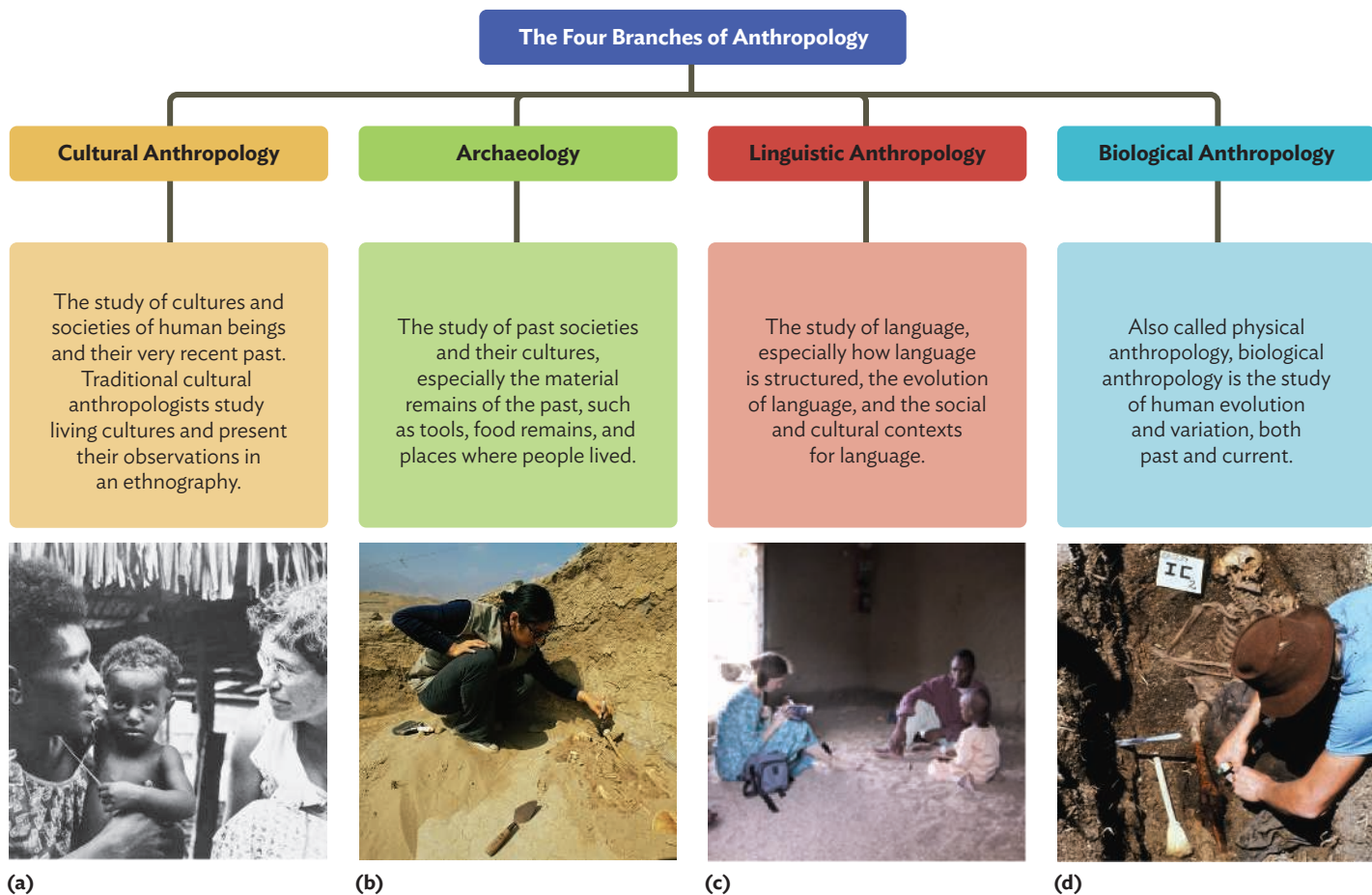


FIGURE 1.2 The Four Branches of Anthropology (a) *Cultural anthropologists*, who study living populations, often spend time living with cultural groups to gain more intimate perspectives on those cultures. The American anthropologist Margaret Mead (1901–1978), one of the most recognizable names in cultural anthropology, studied the peoples of the Admiralty Islands, near Papua New Guinea. (b) *Archaeologists* study past human behaviors by investigating material remains that humans leave behind, such as buildings and other structures. This archaeologist examines remnants from a pyramid in the ancient sacred city of Caral, Peru. (c) *Linguistic anthropologists* study all aspects of language and language use. Here, Leslie Moore, a linguistic anthropologist working in a Fulbe community in northern Cameroon, records as a teacher guides a boy in memorizing Koranic verses. (d) *Biological anthropologists* study human evolution and variation. Some biological anthropologists study skeletons from the past to investigate evolution and variation throughout human history. Those working in **forensic anthropology**, a specialty within biological anthropology, examine skeletons to identify who they were in life. Such an identification may be of a single person or of thousands. For example, the forensic anthropologist pictured here was called on to help identify the estimated 30,000 victims of Argentina’s “Dirty War,” which followed the country’s 1976 coup.

deals with the evolution of and variation among human beings and their living and past relatives.

No anthropologist is expected to be an expert in all four branches. Anthropologists in all four areas and with very different interests, however, acknowledge the diversity of humankind in all contexts. No other discipline embraces the breadth of the human condition in this manner. In fact, this remarkably diverse discipline differs from other disciplines in its commitment to the notion that, unlike other animals, humans are biocultural—both biological and cultural beings. Anthropologists are interested in the interrelationship between biology and culture and call this focus the **biocultural approach**. Anthropology also differs from other disciplines in emphasizing a broad comparative approach to the study of biology and culture, looking at all people (and their ancestors) and all cultures in all times and all places. Anthropologists are interested in people and their ancestors,

biocultural approach The scientific study of the interrelationship between what humans have inherited genetically and culture.

wherever or whenever they lived. Simply, you are studying a field that is holistic, unlike any you have studied before.

1.2 What Is Biological Anthropology?

The short answer to this question is, *biological anthropology is the study of human biological evolution and human biocultural variation*. Two key concepts underlie this definition.

Number one, every person is a product of evolutionary history, or all the biological changes that have brought humanity to its current form. The remains of humanlike beings, or **hominins**, indicate that the earliest human ancestors, who appeared in Africa, date to sometime around 6–8 million years ago (mya). Since that time, the physical appearance of hominins and their descendants, including modern humans, has changed dramatically. Our physical appearance, our intelligence, and everything else that makes us distinctive biological organisms evolved in our predecessors, whose genes led to the species we are today. (Genes and species are among the subjects of chapters 3 and 4.)

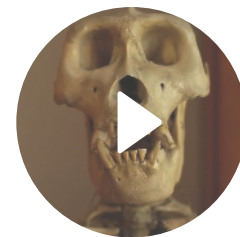
Number two, each of us is the product of his or her own individual life history. From the moment you were conceived, your biological makeup has been determined mostly by your genes. (The human **genome**—that is, all the genetic material in a person—includes some 20,000–25,000 genes.) Your biological makeup is also strongly influenced by your environment. *Environment* here refers not just to the obvious factors such as climate but to everything that has affected you—the physical activities you have engaged in (which have placed stress on your muscles and bones), the food you have eaten, and many other factors that affect overall health and well-being. Environment also includes social and cultural factors. A disadvantaged social environment, such as one in which infants and children receive poor-quality nutrition, can result in negative consequences such as poor health, reduced height, and shortened life expectancy. The Native American child who lived after the shift from foraging to farming on the Georgia coast ate more corn than did the Native American child who lived in the same place before AD 1000. Because of the corn-rich diet, the later child’s teeth had more cavities. Each child’s condition reflects millions of years of evolution as well as more immediate circumstances, such as diet, exposure to disease, and the stresses of day-to-day living.

WHAT DO BIOLOGICAL ANTHROPOLOGISTS DO?

Biological anthropologists routinely travel to places throughout the United States and around the world to investigate populations. Some biological anthropologists study living people, while others study extinct and living species of our nearest biological relatives, **primates** such as lemurs, monkeys, and apes. I am among the biological anthropologists who travel to museum collections and archaeological localities to study past societies. When I tell people outside the field what I do for a living, they often think biological anthropology is quite odd, bizarre even. Frequently they ask, *Why would anyone want to study dead people and old bones and teeth?* A good answer to this question is provided by American bioarchaeologist Tiffany Tung, who says, “skeletons tell us a considerable amount about a person

hominins Humans and humanlike ancestors.

genome The complete set of genetic information—chromosomal and mitochondrial DNA—for an organism or species that represents all of the inheritable traits.



WATCH THE VIDEO

Anthropology of Decay
digital.wwnorton.com/essanthro4

primates A group of mammals in the order Primates that have complex behavior, varied forms of locomotion, and a unique suite of traits, including large brains, forward-facing eyes, fingernails, and reduced snouts.

when they were alive. Biological anthropologists study bones and teeth because they are a time capsule, telling the story of the person's life experiences, including the age of a person when they died, their sex, their diet, their stresses, injuries, and where they were from. Biological anthropologists place that person in their larger society and living circumstances." Everyone has heard of physics, chemistry, and biology; but the average person has never heard of biological anthropology. Compared to other areas of science, biological anthropology is small. But smallness does not make it unimportant. It is practical and significant, providing answers to fundamental questions that have been asked by scholars and scientists for centuries, such as *Who are we as a species? What does it mean to be human? Where did we come from?* Moreover, biological anthropology plays a vital role in addressing questions that are central to our society, sometimes involving circumstances that all of us wish had never come about. For example, the tragedy that Americans identify as 9/11 called immediately for the assistance of specialists from forensic anthropology.

The discipline as practiced in the United States began in the first half of the twentieth century, especially under the guidance of three key figures: Franz Boas for American anthropology generally; Czech-born Aleš Hrdlička, who started the professional scientific journal and professional society devoted to the field; and Earnest Hooton, who trained most of the first generation of biological anthropologists. While the theory and methods of biological anthropologists today have changed greatly since the early 1900s, the same basic topics first envisioned by these founders form what we do today.

Biological anthropologists study all aspects of human biology, specifically looking at the evolution and variation of human beings and their living and past relatives. This focus on biology means that biological anthropologists practice a *biological science*. But they also practice a *social science*, in that they study biology within the context of culture and behavior. Depending on their areas of interest, biological anthropologists might also examine molecular structure, bones and teeth, blood types, breathing capacity and lung volume, genetics and genetic history, infectious and other types of disease, origins of language and speech, nutrition, reproduction, growth and development, aging, primate origins, primate social behavior, brain biology, and many other topics dealing with variation in both the living and the dead—sometimes the bones and teeth of the very long dead (**Figure 1.3**).

In dealing with such topics, biological anthropologists apply methods and theories developed in other disciplines as well as in their own as they answer questions that help us understand who we are, a point that I will raise over and over again throughout this book. The very nature of their discipline and their constant borrowing from other disciplines mean that biological anthropologists practice an *interdisciplinary science*. For example, they might draw on the work of geologists who study the landforms and layering of deposits of soil and rock that tell us when earlier humans lived. Or they might obtain information from paleontologists, who study the evolution of life-forms in the distant past and thus provide the essential context for understanding the world in which earlier humans lived. Some biological anthropologists are trained in chemistry, so they can analyze the chemical properties of bones and teeth to determine what kinds of foods were eaten by those earlier humans. Or to learn how living humans adapt to reduced-oxygen settings, such as in the high altitudes of the Peruvian Andes, biological anthropologists might work with physiologists who study the ability of the lungs to absorb oxygen. The firm yet flexible identity of their science allows biological anthropologists to gather data from other disciplines in order to address key questions. Questions drive what they do.



(a)



(b)



(c)



(d)



(e)



(f)

FIGURE 1.3 A Sample of What Biological Anthropologists Do (a) Human remains excavated at Badia Pozzeveri, a medieval church cemetery in Tuscany, Italy, provide a window through which to view health and living conditions in Europe. (b) Geneticists analyze samples of human DNA for various anthropological purposes. DNA studies are used to determine how closely related humans are to other primate species, to examine human origins, and to determine individual identities. (c) A human biologist records the physical activities of a lactating woman (right, weaving basket) living in a rural community in the eastern Amazon, Brazil. These data will be used to calculate the woman's energy expenditure and to understand how she copes with reproduction's great energy demands. (d) In a lab, a forensic anthropologist measures and assesses human bones. If the bones came from a contemporary grave, this forensic information might help to identify the victim. If the bones belonged to a past population, biological anthropologists might use these data to gain insight into the population's health and lifestyle. (e) Laboratory investigations of human ancestors' bones help paleoanthropologists to determine where these ancestors fit in the human family tree. (f) Primatologists, such as the British researcher Jane Goodall (b. 1934), study our closest living relatives, nonhuman primates. The behavior and lifestyle of chimpanzees, for example, help biological anthropologists to understand our evolutionary past.