

A close-up photograph of a chimpanzee's face, showing its eyes, nose, and mouth. The chimpanzee has dark brown fur and is looking slightly to the right. The background is blurred green foliage.

EXPLORING
BIOLOGICAL
ANTHROPOLOGY

The Essentials

FOURTH EDITION

Craig Stanford • John S. Allen • Susan C. Antón

Exploring Biological Anthropology

The Essentials



The Modern World

- ◆ Australia and possessions
- ◆ China
- ◆ Denmark and possessions
- ◆ France and possessions
- ◆ India and possessions
- ◆ Italy
- ◆ Japan and possessions
- ◆ Netherlands and possessions
- ◆ New Zealand
- ◆ Norway and possessions
- ◆ Portugal and possessions
- ◆ Russian Federation
- ◆ Spain and possessions
- ◆ Turkey
- ◆ United Kingdom and possessions
- ◆ United States and possessions
- B-H = Bosnia-Herzegovina



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Exploring Biological Anthropology

The Essentials

Fourth Edition

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To Our Parents

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Preface

We are proud to introduce you to the fourth edition of *Exploring Biological Anthropology*. We wrote this book because we felt there was a great need for a new textbook that presents the core information, concepts, and theories of biological anthropology in a modern light. Biological anthropology was once called physical anthropology, because decades ago the field was mainly about human anatomy, human fossils, and the study of racial variation. Over the past forty years, the field has evolved into biological anthropology. Modern biological anthropology comprises the study of the fossil record and the human skeleton, the genetics of both individuals and populations, our primate relatives, human adaptation, and human behavior, among other topics. This fourth edition of *Exploring Biological Anthropology* combines up-to-date coverage of the core material with a modern biological approach that includes fields that have become major areas of research by biological anthropologists over the past decade. This core-concepts version of the book is written especially for students needing to obtain a strong grounding in biological anthropology without some of the detail into which our original text delved. We three coauthors conduct our research in the main areas of biological anthropology: the human fossil record (Susan Antón), primate behavior and ecology (Craig Stanford), and human biology and the brain (John Allen). This has allowed us to provide a specialist approach to each of the broad divisions of the field covered by the text. We are biological anthropologists with extensive backgrounds in both biological and social sciences and are both teachers and researchers.

In a field changing as rapidly as human evolutionary science is today, we feel it is critical for active researchers to produce textbooks that serve the needs of students. In addition to the strong biological orientation of the book, we try to frame questions about humankind in light of our understanding of culture and the ways in which culture interacts with biology to create the template for human nature.

Undergraduate enrollment in introductory biological anthropology courses has increased sharply because biological anthropology has become one way to fulfill the basic natural science requirement at many colleges and universities. We believe the changing field and the new audience have created a need for a text such as this one, integrating traditional physical anthropology with a modern Darwinian framework and presented in a concise, clear format.

We have made an effort in the fourth edition to present a concise coverage of the core material of the field, while preserving a comprehensive coverage of certain traditionally important topics. For instance, we have included a feature on biomedical anthropology, a large feature (in Chapter 14) on the brain, and behavior and biology of modern people, from the study of foragers (hunter-gatherers) to that of the human psyche (evolutionary psychology). There is a discussion of the geological background for human paleontology (Chapter 9), and chapter sections on bioarcheology (Chapter 13) and forensic anthropology (Chapter 15). We have double-page features in many chapters to present information in a more visual way, and we have added new information to this edition in the form of new text and figures, as well as special features in some chapters.

In a field famous for intellectual disagreements over the meaning of fossils or interpretations of Darwinian theory, we've tried to present the accepted facts and concise descriptions of debates about evidence. There are places where, because of the introductory nature of the text, we have not delved deeply into the details of some debates, but we have nevertheless tried to balance multiple views of ongoing unresolved questions.

What's New in This Edition

- In this new edition we emphasize the molecular classification system in our taxonomic discussions. Chapter 7 has updated information on the latest taxonomic classification of the apes and hominins. We call humans and our exclusive ancestors hominins because this is the currently accepted approach.
- We provide additions on newly found fossils and tools, new age estimates in the fossil record, and new ancient DNA results.
- **Chapter 9** provides new art and discussion surrounding the role and relationships of Miocene hominoids.
- **Chapter 10** introduces newly named species *A. deyiremeda* and discusses new science surrounding the diet of robust australopithecines and new ages of the little foot *A. africanus* skeleton.
- **Chapter 11** introduces the new fossils that push the origin of the genus *Homo* deeper in time, provides new sections on *H. habilis* and *H. rudolfensis*, discusses new stone tools that push stone tool manufacture back past 3 million years ago, and provides up to

the minute information on the newly discovered and named *H. naledi* from the Rising Star Cave system in South Africa.

- **Chapter 12** provides new discussion of the role of archaic *H. sapiens* in the origin of Neandertals and Denisovans and discusses new ancient DNA results that show evidence of a Neandertal contribution to the fossil modern human genome.
- **Chapter 13** presents new fossil and genetic evidence related to the origin of modern humans including evidence of Neandertal contributions to early modern humans in Europe. We also discuss new finds that illuminate our understanding of the peopling of the New World.
- We have developed new Insights & Advances boxes on:
 - Population genetics and cultural history (Chapter 6)
 - Locomotion of the last common ancestor of apes and humans (Chapter 10)
 - *Homo naledi* and The Cradle of Humankind World Heritage site in South Africa (Chapter 11),
 - Early menarche and later health (Chapter 15)

In addition, we have substantially updated other boxes in Chapter 7, 9, 10, and 13 to include new perspectives and findings.

- Many chapters have new opening vignettes to give students a different perspective on the research topics presented in each chapter. New or revised vignettes are featured in Chapters 3, 4, 7, 9, and 14, chosen to highlight current trends and foundational principles.
- In this edition we have thoroughly revised the illustrative timelines provided in Chapters 9, 11, 12, and 13.

Foundation: Organization of the Fourth Edition

The book is organized in much the same way that we three authors have taught introductory courses in biological anthropology. The theory of evolution by natural selection is the unifying aspect of each chapter, and indeed for the entire discipline. Part I, Foundations (Chapters 1 and 2), reflects this. The text begins with an overview of the field of biological anthropology in the larger context of the social and life sciences, including a brief history of the field. Chapter 2 reviews the roots of evolutionary thinking and how it became central to biological anthropology. Part II, Mechanisms of Evolution (Chapters 3 through 6), reviews at length the mechanisms of evolution and describes the applications of modern genetic research techniques in unraveling some of the mysteries of human evolution. Chapters 3 and 4 review cellular, molecular, and population genetics. Chapter 5 takes the discussion of genetics into modern evolutionary theory: the formation of species and the central

topics of natural selection and adaptation. Chapter 6 surveys the field of human adaptation and the ways in which evolutionary forces mold human populations.

Part III, Primates (Chapters 7 and 8), is about the living nonhuman primates. We examine their classification, their anatomical and behavioral adaptations, and their social life. We cautiously use the behavior of living monkeys and apes to infer what extinct primates, including fossil humans, may have been like.

Part IV, The Fossil Record (Chapters 9 through 13), describes the anatomical transition from an ape to human ancestor and the fossil record for humankind. We begin with the environmental context in which fossils are found and describe both the periods of Earth's history during which primates arose and the fossil primates themselves. We include the most extensive discussion in any biological anthropology textbook of the geological background necessary for understanding human evolution (Chapter 9), which has been updated to include new dating techniques and results. In Chapter 10, we examine the anatomical transition from an ape to human ancestor and present up-to-date information on the earliest known hominins in Africa. Chapter 11 introduces the genus *Homo* and the causes and consequences of dispersal from Africa. Chapters 12 and 13 cover the more recent hominin fossils, including Neandertals, and the origins of our own species. We have tried to provide up-to-the-minute information on the discovery of new human fossils, including new interpretations of the oldest stone tools, *Australopithecus sediba*, and the newly named *A. deyiremeda* (Chapter 10); new (and older) fossil *Homo* (Chapter 11); a new box on the *Homo naledi* fossils recently describe from the Rising Star Cave system in South Africa (Chapter 11) expanded discussion of archaic *H. sapiens* and their relationship to later Neandertals (Chapter 12); and the extensive revision of age estimates of European Neandertal and modern human sites and the earliest peopling of North America (Chapter 13). We have included interpretive features and updated art to understand the significance of all these new finds.

Part V, Biology and Behavior of Modern Humans (Chapters 14 and 15), is about the biology of modern people. We include coverage of the brain and biocultural aspects of the lives of traditional foraging people (Chapter 14) and the human brain and biocultural issues of biomedical anthropology, as well as a half chapter's worth on forensic anthropology (Chapter 15), which explains how scientists use evolutionary theory and the methods of biological anthropology to identify human remains from mass disasters and victims of crime.

The appendices offer a section on the primate skeleton (Appendix A), the Hardy–Weinberg equilibrium (Appendix B), and metric-to-imperial conversion factors (Appendix C).

Student-oriented pedagogy has been maintained in each chapter. We begin each chapter with a short **vignette**

depicting the main topic of the chapter. In most cases, one of the authors has written a short description of an event in the life and work of a biological anthropologist or an important historical figure. It might, for example, be about how someone studying human fossils discovers, excavates, and analyzes her discovery. Many of these vignettes are new to this edition, chosen to highlight current trends and foundational principles. The vignettes should be used as a way to get a feel for the chapter topics and as an enjoyable and informative reflection on the text material.

Other features include a detailed margin **glossary** that defines new terms as students encounter them and a complete glossary at the back of the book. Each chapter ends with a summary and review questions. At the end of the book, the **bibliography** contains all the references used and cited in the text.

Innovation: New and Continuing Features

In earlier editions of *Exploring Biological Anthropology*, we tried to include topics not covered in many of the existing texts while preserving a comprehensive coverage of traditional topics. In the fourth edition, we have relied on instructor and student feedback as well as new events in the field to make further changes.

Following the growing scientific consensus in biological anthropology, we have adopted the molecularly based terminology for grouping humans and our ancestors—now referring to us and our exclusive ancestors as hominins rather than hominids.

By popular demand, forensic anthropology (a topic not traditionally covered in introductory biological anthropology texts) has been expanded and included in Chapter 15, Biomedical and Forensic Anthropology. Field recovery methods, identification techniques, and applications of both bioarchaeology and forensic anthropology are described in a way that will appeal to students. Bioarchaeology, which includes a discussion of the consequences of colonization and agriculture and peopling of the Pacific, is covered in Chapter 13, The Emergence, Dispersal, and Bioarchaeology of *Homo sapiens*. This section includes a special focus on the newest evidence for a pre-Clovis occupation of North America and the breathtaking discoveries of fossil humans and ancient DNA from Mexico and the United States that illuminate our understanding of the peopling of the New World.

Chapter 1 includes a visual feature that discusses the four fields of anthropology. The text, illustrations, and design all help to make this content come alive for students.

Chapters 3 and 4 include numerous recent updates on human molecular genetics and genomics, including new and revised opening vignettes. Chapter 6 includes updates concerning the recent impact of new molecular genetic studies on aspects of human population genetics and

adaptability, including the ABO blood type system, lactase persistence, and high-altitude genetics. A new box on the genetics and cultural history of Bermuda has also been added.

As mentioned, in Part IV we keep abreast of new fossil discoveries by including figures and discussion of the latest finds. This includes additional discussion and updated illustrations of species timelines (Chapters 9, 11, 12, 13), including the relationships among Miocene hominoids, the age of early *Homo* and the identity and overlap of Neandertals and modern humans. New fossil hominins, sites, and discoveries are featured in Chapters 11 through 13, including interpretations of new *Australopithecus deyiremeda*, older ages for *A. africanus*, stone tools that only australopithecines could have made, the Rising Star expedition, the oldest fossils of genus *Homo*, the relationship between the Denisovans and archaic *Homo sapiens*, new modern human fossils from Siberia, and ancient DNA evidence of Neanderthal contributions to *H. sapiens* genomes.

There are also changes and updates in the chapters on contemporary human biology and behavior. Chapter 14 has a new opening vignette, expanded discussion of scaling factors in brain evolution, an update on hyoid bone anatomy and the evolution of spoken language, and new sections on progesterone and premenstrual syndrome and the relationship between male violence and sexual competition. Chapter 15 includes an extensive update on anorexia nervosa and a new box on the long-term health effects of early menarche.

We have added to our boxes (now called **Insights & Advances**) in each chapter. These insets expand on text material or call your attention to current events connected to our field, to emerging debates, or sometimes just to fascinating side stories. Some chapters feature entirely new boxes (Chapters 5, 6, 10, 11, 15), and others are substantially rewritten and updated as new research has become available (Chapters 7, 9, 10, 13).

A feature called **Innovations** is included in select chapters. This feature provides an intense visual presentation of new, burgeoning areas of research in our field. These research areas include the following:

- Chapter 3: DNA Barcoding
- Chapter 4: A New Genetic Era
- Chapter 8: Culture in Nonhuman Primates
- Chapter 9: Time in a Bottle
- Chapter 10: Dikika and Development
- Chapter 11: What's Size Got to Do with It?
- Chapter 12: Neanderthal Genes
- Chapter 13: Symbolism and Human Evolution
- Chapter 14: Music, the Brain, and Evolution
- Chapter 15: Ancestry Genetics

The Summary at the end of every chapter provides a review for students organized around the chapter headings and learning objectives so students can then refer back into the chapter for a more extensive review. The summary finishes with questions correlated to the learning objectives for students to test their comprehension.

Illustrations

Illustrations play a major role in any textbook, and they are crucial learning tools in introductory science texts. The publisher and authors have worked together to provide you with the best possible photos and drawings of every topic covered in the book. The fourth edition features more than fifty anatomical illustrations especially prepared for this text by medical illustrator Joanna Wallington. These drawings provide superior detail and anatomical accuracy and enhance student insight into the morphological features of importance in human evolution.

This fourth edition also includes illustrations in the genetics chapters that were inspired by the tenth edition of *Concepts of Genetics* by Klug, Cummings, Spencer, and Palladino. Illustrations throughout the book reflect this style.

Most of the photographs of living primates, fossils, and fossil sites were taken by one of the authors or were contributed by other biological anthropologists—and many of these have been updated and enhanced in this edition. Pearson has worked hard to produce some of the finest images of everything from molecular genetics to stone tools that have ever been published in a biological anthropology textbook. The maps have been specifically created for this book by Dorling Kindersley, a leading publisher of atlases for both the educational and consumer markets. These maps describe the geography of everything from the distribution of living primates in the world today to the locations of the continents in the distant past. We authors worked with Pearson to be sure everything in the fourth edition is depicted accurately and clearly, and we hope you will gain a better understanding of the science by studying the visual material as well.

Along with the new **Innovations** features, additional special two-page figures appear in a number of chapters, especially in Part IV, and provide a snapshot of evolutionary development through time. These special figures provide a concise way for the reader to easily grasp the evolutionary changes through a vast sweep of time that are presented in greater detail in the text, and they have been updated with new photo imagery and new finds.

A Note about Language

Authors must make decisions about language and terminology, and textbook authors make those choices with the knowledge that they may be influencing the mind-set of

a generation of young scholars. Some of these choices are modest. For instance, we use the modern American spelling *Neandertal* instead of the more traditional European spelling *Neanderthal*. Other language choices are more central to the subject matter. Perhaps the most significant choice we have made in recent years relates to primate classification. Although the primate order historically has been subdivided into anthropoids (the apes and monkeys, including us) and prosimians (the “lower” primates, including lemurs, galagos, lorises, and tarsiers), this dichotomy does not reflect the currently understood molecular relationships among groups of primates. We have therefore divided the primates into the suborders haplorhines and strepsirhines, a concept familiar to current graduate students but perhaps not to instructors who have taught the former approach for many years. Haplorhines include all anthropoids and tarsiers, and strepsirhines include all prosimians except tarsiers. We use the terms *strepsirhine* and *haplorhine* rather than *prosimian* and *anthropoid*. Similarly, following the growing scientific consensus in biological anthropology, we have adopted the molecularly based terminology for grouping humans and our ancestors—now referring to us and our exclusive ancestors as *hominins* rather than *hominids*. We discuss both in some depth in Chapter 6.

Regarding Abbreviations and Time

Because of the plethora of sometimes conflicting abbreviations used to refer to time throughout the text, we have attempted to spell out time ranges (e.g., “millions of years ago” or “thousands of years ago”). Where this is not feasible, such as in tables, we use the abbreviations most common to anthropology textbooks (MYA for “millions of years ago” and kya for “thousands of years ago”). However, students should note that the standard usage in geology and paleontology is *Ma* (mega-annum) and *ka* (kilo-annum).

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Support for Instructors and Students

The ancillary materials that accompany *Exploring Biological Anthropology, Fourth Edition* are part of a complete teaching and learning package and have been carefully created to enhance the topics discussed in the text.

Instructor's Resource Manual with Tests (0134014065): For each chapter in the text, this valuable resource provides a detailed outline, list of objectives, discussion questions, and suggested readings and videos. In addition, test questions in multiple-choice, true-false, fill-in-the-blank, and short-answer formats are available for each chapter; the answers are page-referenced to the text. For easy access, this manual is available within the instructor section of MyAnthroLab for *Exploring Biological Anthropology, Fourth Edition*, or at www.pearsonhighered.com/irc.

MyTest (013401412X): This computerized software allows instructors to create their own personalized exams, to edit any or all of the existing test questions, and to add new questions. Other special features of this program include random generation of test questions, creation of alternate versions of the same test, scrambling question sequence, and test preview before printing. For easy access, this software is available for download at www.pearsonhighered.com/irc.

PowerPoint Presentation for Biological Anthropology (0134014219): These PowerPoint slides combine text and graphics for each chapter to help instructors convey anthropological principles in a clear and engaging way. For easy access, they are available for download at www.pearsonhighered.com/irc.

Method and Practice in Biological Anthropology: A Workbook and Laboratory Manual for Introductory Courses, Second Edition (0133825868): Designed to complement a wide variety of introductory level laboratory courses in biological anthropology, this new manual written by Samantha Hens of California State University, Sacramento provides optimum flexibility to suit almost all laboratory environments. The manual is divided into four sections, reflecting the typical design of introductory courses in biological anthropology: genetics and evolution, the human skeleton, the nonhuman primates, and our fossil ancestors. Each chapter has similar pedagogical elements, beginning with a list of chapter objectives, an array of topical lab exercises to choose from, and a set of pre- and post-lab questions. For more information, please contact your local Pearson sales representative.

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Textbooks require the collaboration of many people with many areas of expertise, and this book makes good use of all of those involved. The process begins with each author compiling his or her notes from years of teaching biological anthropology and thinking about how the course could be taught more effectively. Over the years, the students in our courses have helped us to assess what did and did not work in conveying the information and excitement of biological anthropology, and for this we are extremely grateful. For her vision and steady guidance over the past decade, we are most grateful to Nancy Roberts, our former publisher at Pearson. We thank our current publisher, Charlyce Jones-Owen, and our development editor, David Ploskonka, for their work on the current edition. Cheryl Keenan, production liaison at Pearson, and Nancy Kincade at Lumina Datamatics did a remarkable job coordinating the entire process, especially given the logistics of working with three different authors.

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We've made a great effort to produce a comprehensive and fully accurate text, but as is always the case, errors may remain. We would be grateful for comments or corrections from students and instructors using *Exploring Biological Anthropology, Fourth Edition*. And we hope you find this account of human evolution as fascinating and compelling as we do.

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Chapter 1

What Is Biological Anthropology?



Learning Objectives

- 1.1** Identify the subfields of anthropology and explain their applications to the study of the human species.
- 1.2** Explain the subfields of biological anthropology and discuss how they try to answer key questions about the human species.
- 1.3** Review the development of biological anthropology in the United States, including its change in focus over time.

A brilliant orange sun rises above a dusty plain in Ethiopia. The parched landscape will be unbearably hot by mid-morning, so there is no time to lose. The team of scientists, students, and assistants set off on a predetermined route that takes them over craggy hills and into steep ravines. As they walk, they stare at the ground, hoping to spot any bit of fossilized bone that the slanted morning sun may illuminate. It is tedious, sweaty work, usually without any reward to show for it. But this morning, one of the Ethiopian assistants, an older man famed for his ability to distinguish fossils from the thousands of rocks and pebbles strewn around them, spots something. He calls the team leader over, and as soon as she crouches to examine the small fragment emerging from the soil, she knows it is a primate. Gently brushing away a bit of soil, she gasps; what emerges appears to be the upper arm bone of a tiny ancient human. The team immediately maps the spot for the work of unearthing the fossilized skeleton of a fossil hominin.

Five hundred kilometers away, a different kind of scientist is also eagerly searching for primates. He is crawling nimbly through dense thickets in Gombe National Park, Tanzania, trying to find the party of chimpanzees that he was following all morning. They travel faster than he can in the thick undergrowth, and by the time he catches up to them, they've climbed a massive fig tree and are gobbling mouthfuls of the fruits. The scientist maps the location with his GPS device, then pulls out a notebook and begins recording the behavior of each of the chimpanzees. Most are eating figs, but a few infants play together. When one male tries to grab a fig from another's hand, a chaotic fight breaks out. Only when the alpha male arrives and charges through the apes in the tree canopy does order get restored, and the chimpanzees finish their morning meal.

On the other side of the world, a third scientist sits in front of a computer screen watching brain activity in bright reds and greens. In the next room, a musician—a famed cellist—sits in a functional MRI machine, listening to cello music piped in. As he listens, particular areas of the cortex of his brain light up, while other areas remain dim. His brain is hearing and processing the sound, and it's doing it in a way that reveals aspects of the inner working of the human mind. By moving the screen cursor, the scientist can study the brain's surface from every possible angle, making virtual slices through it to study its internal organization. He hopes to make a visual portrait of the musician's brain activity while listening to music, and in doing so to better understand the intense creativity that separates us from our primate relatives.

What do these three scientists—one studying ancient fossils, another observing primate behavior, and the third studying the evolution of the human brain—all have in common? They are biological anthropologists, engaged in the scientific study of humankind (from *anthropos*, meaning “human,” and *ology*, “the study of”). Despite our exalted intellect, our mind-boggling technology, and our intricately complex social behavior, we are nonetheless biological creatures. Humans are **primates** and share a recent ancestry with the living great apes. Like the apes, we are the products of millions of years of **evolution** by natural selection.

The famed geneticist Theodosius Dobzhansky once said, “Nothing in biology makes sense except in the light of evolution.” Biological anthropologists spend their careers trying to understand the details of the evolutionary process and the ways in which it has shaped who we are today. They use a central, unifying set of biological principles in their work, first set down by Charles Darwin nearly 150 years ago. The frequency of a particular trait and the genes that control it can change from one generation to the next; this is evolution. This elegantly simple idea forms the heart and soul of **biological anthropology**.

The evolutionary process usually is slow and inefficient, but over many generations it can mold animals and plants into a bewildering variety of forms. Our ancestry

primate

Member of the mammalian order Primates, including prosimians, monkeys, apes, and humans, defined by a suite of anatomical and behavioral traits.

evolution

A change in the frequency of a gene or a trait in a population over multiple generations.

biological anthropology

The study of humans as biological organisms, considered in an evolutionary framework; sometimes called physical anthropology.

includes many animals that little resemble us today. Biological anthropology is particularly concerned with the evolutionary transformations that occurred over the past 6 million years, as an ape-like primate began to walk on two legs and became something different: a **hominin**. From the perspective of evolutionary theory, humans are like all other biological species, the product of the same long process of **adaptation**.

Anthropology and Its Subfields

1.1 Identify the subfields of anthropology and explain their applications to the study of the human species.

Anthropology is the study of humankind in all its forms. But of course, this would not distinguish it from other disciplines that study the human condition, such as psychology, history, and sociology. The critical aspect of anthropology that sets it apart is its cross-cultural, holistic nature. That is, we try to understand the inner workings of a group of people who hold worldviews, values, and traditions that are different from ours. The unusual thing about the human animal is that we have **culture**. Although it often seems that anthropologists spend their careers arguing about how to define culture, we can say simply that culture is the sum of the learned traditions of a group of people. Language is culture (although the ability to use language is biological), as is religion, as are the way people dress and the food they eat. These human behaviors may vary greatly from one culture to the next. However, what about the universal taboo on incestuous relations with one's siblings, or the observation that across many human societies, women tend to marry older men? Are these common threads of human cultures the result of learned traditions, passed down across the generations, or is there a biological influence at work? As we will see, the interplay between biology and culture provides many of the most intriguing and perplexing clues about the roots of our humanity. It also creates many of the most intense debates; for decades, scholars have debated whether genes or the environment have played the more important role in molding intelligence and other human qualities.

The dichotomy between biological and cultural influences on humankind is a false one, as we examine in detail later in the book. In earliest humans, biological evolution produced the capacity for culture: Intelligence had to evolve before learned traditions such as tool use could flourish, as we see in wild apes today. Our biology produced culture, but culture can also influence biology. We study these patterns under the rubric of **biocultural anthropology**.

Anthropology is divided into four subfields: biological anthropology, cultural anthropology, linguistic anthropology, and archaeology. Some anthropologists consider linguistics and archaeology to be subfields within cultural anthropology. In addition, applied anthropology—a method more than a discipline—is sometimes considered a fifth subfield. The majority of practicing anthropologists in the United States are cultural anthropologists, who typically make up more than half of the faculty of anthropology departments in universities and who also are employed in a variety of nonacademic settings, as you will see in this section.

The Scope of Biological Anthropology

1.2 Explain the subfields of biological anthropology and discuss how they try to answer key questions about the human species.

The scope of biological anthropology is broader than the study of primates, fossils, and brain evolution. Any scientist studying evolution as it relates to the human species, directly or indirectly, could be called a *biological anthropologist*. Biological anthropology includes a number of related disciplines (Figure 1.1 on page 5).

hominin

A member of the primate family Hominidae, distinguished by bipedal posture and, in more recently evolved species, a large brain.

adaptation

A trait that increases the reproductive success of an organism, produced by natural selection in the context of a particular environment.

anthropology

The study of humankind in a cross-cultural context. Anthropology includes the subfields cultural anthropology, linguistic anthropology, archaeology, and biological anthropology.

culture

The sum total of learned traditions, values, and beliefs that groups of people (and a few species of highly intelligent animals) possess.

biocultural anthropology

The study of the interaction between biology and culture, which plays a role in most human traits.

The Subfields of Anthropology

Cultural anthropology is the study of human societies in a cross-cultural perspective. The amazing variety of ways in which people lead their daily lives is at the heart of the field.

Ethnology, one of the subfields of cultural anthropology, is the study of human societies and of the behavior of people within those societies. The practice of ethnology is called **ethnography** (literally, “the describing of culture”). A written account of the initiation rituals of street gangs in Los Angeles is an example of ethnography; another is the study of how parents in Boston care for their children relative to parenting among the Sherpas of highland Nepal.



Linguistic anthropology is the study of the form, function, and social context of language. Linguistic anthropologists usually are more interested in language use and the role that language plays in shaping culture than they are in the technical aspects of language structure. An anthropological linguist might study the aspects of Black English that set it apart from mainstream and be interested in the roots of Black English on slave plantations and in West Africa.

Archaeology is the study of how people used to live, based on the materials, or **artifacts**, they left behind. These artifacts, art, implements, and other objects of **material**

culture form the basis for the analysis and interpretation of ancient cultures.

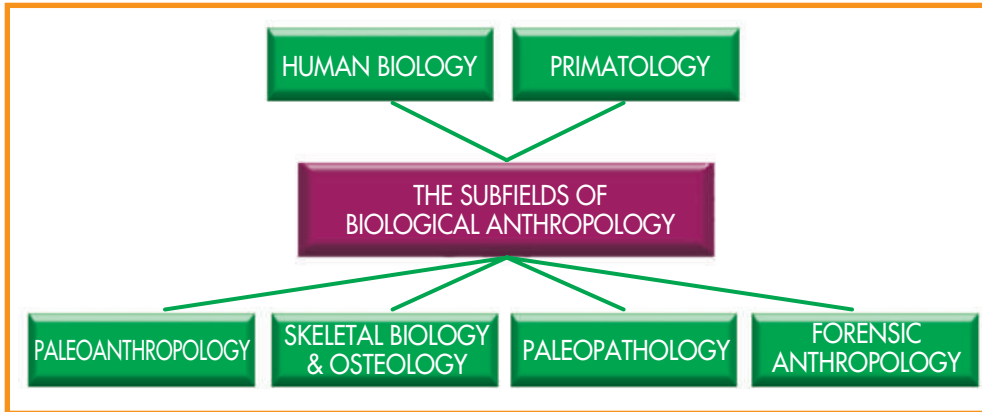


Archaeologists work at sites all over the world, studying time periods from the advent of stone tools 2.5 million years ago until the much more recent past. *Prehistoric*

archaeologists study cultures that did not leave any recorded written history—from the early hominins to the preliterate antecedents of modern cultures from Hawaii to Africa. *Historical archaeologists* study past civilizations that left a written record of their existence, whether in the hieroglyphics of Egyptian tombs, the Viking runes scratched onto rock across northern Europe, or the diaries kept by the colonial settlers of New England. Other archaeologists study Revolutionary War battlefields or sites of former slave plantations in an effort to understand how people lived and structured their societies.



Biological anthropology is vastly broader than the study of primates, fossils, and brain evolution. Any scientist studying evolution as it relates to the human species, directly or indirectly, could be called a biological anthropologist. Biological anthropology includes paleoanthropology, skeletal biology and osteology, paleopathology, forensic anthropology, primatology, and human biology.

Figure 1.1 Subfields of biological anthropology.

Paleoanthropology

When an exciting new fossil of an extinct form of human is found, paleoanthropologists usually are behind the discovery (Figure 1.2). **Paleoanthropology** is the study of the fossil record for humankind, and fossilized remains are the most direct physical evidence of human ancestry that we have for understanding where we came from. The discovery of skeletal evidence of new ancestral species, or additional specimens of existing species, revises our view of the human family tree. Discoveries of hominin fossils—some as famous as Peking Man or Lucy (Figure 1.3) but many less known—have profoundly changed the way we view our place in nature. Paleoanthropology also includes the study of the fossil record of the other primates—apes, monkeys, and prosimians—dating back at least 65 million years. These early fossils give us key clues about how, where, and why hominins evolved millions of years later. There are fossil sites producing important fossils all over the world, and with more and more students and researchers searching, our fossil history grows richer every year. In fact, although the first half of the twentieth century witnessed discoveries of new human fossils every decade or so, the pace of discovery of new species of fossil humans has accelerated rapidly in recent years. This is because global and regional political changes have allowed researchers into areas that were long off-limits because of civil war or political unrest.

Paleoanthropological research begins in the field, where researchers search the landscape for new discoveries. Much of the scholarly work then takes place around the world in museums and university laboratories, where the specimens are archived

paleoanthropology

The study of the fossil record of ancestral humans and their primate kin.

Figure 1.2 Paleoanthropologist Jane Moore maps sites at Kanapoi, Kenya.**Figure 1.3** Lucy, a partial hominin skeleton.

and preserved for detailed study. Because we can safely assume that the evolutionary process taking place in the present also took place in the past, the study of the meaning of human and nonhuman primate fossils proceeds from comparisons between extinct and living forms. For example, the presence of large canine teeth in the male specimens of a fossil monkey species implies that when it was alive, the species lived in multiple male groups in which males competed for mates; we can make this inference because in living monkeys, major differences in canine tooth size between males and females indicate mate competition.

As the fossil record has grown, we have begun to see that the evolutionary history of our species is extremely complicated; most lineages are now extinct, but many thrived for millions of years. The ladder of progress—an older, more linear view of our ancestry in which each species evolved into more complex forms—has been replaced by a family tree with many branches.

Skeletal Biology and Human Osteology

Osteology is the study of the skeleton. The first order of business when a fossil is discovered is to figure out what sort of animal the fossil—often a tiny fragment—may have been in life. Osteologists must therefore possess extraordinary skills of identification and a keen spatial sense of how a jigsaw puzzle—an array of bone chips—fits together when they are trying to understand the meaning of fossils they have found.

Among the first generation of biological anthropologists (Figure 1.4) were the *anthropometrists*, who made detailed measurements of the human body in all its forms, and their work is still important today. Understanding the relationship between genetics, human growth and stature, and geographic variation in human anatomy is vital to identifying the origins and patterns of human migration across the globe during prehistory, for example. When a 9,000-year-old skeleton was discovered some years ago on the banks of the Columbia River in the Pacific Northwest, osteologists with expertise in human variation in body form were among those who sought to identify its ethnic affinities.

Skeletal biology, like osteology, is the study of the human skeleton. However, because the bones of the body develop in concert with other tissues, such as muscles and tendons, a skeletal biologist must know the patterns and processes of human growth, physiology, and development, not just anatomy.

osteology

The study of the skeleton.

paleopathology

The study of diseases in ancestral human populations.

bioarchaeology

The study of human remains in an archaeological context.

Figure 1.4 An osteologist at work.



Paleopathology and Bioarchaeology

Hand in hand with skeletal biology are **paleopathology** and **bioarchaeology**: the study of disease in ancient human populations, and the study of human remains in an archaeological context. When the Neandertal fossils first appeared in the mid-nineteenth century, there was much scientific debate about whether they represented a true species or “race,” or whether they were simply modern individuals who had suffered from some pathological condition. It took nearly thirty years and the discovery of several additional specimens to

resolve the issue. Today, paleopathologists would help resolve such a debate much more quickly.

Bioarchaeologists work with archaeologists excavating ancient humans to study the effects of trauma, epidemics, nutritional deficiencies, and infectious diseases. If archaeologists find evidence that an ancient civilization crashed precipitously, a paleopathologist will study the remains of the bodies for signs of anything from outbreaks of sexually transmitted disease to poor nutrition.

Forensic Anthropology

Although biological anthropology is concerned primarily with basic research into human origins, biological anthropologists also play roles in our daily lives. **Forensic anthropology**, the study of the identification of skeletal remains and of the means by which the individual died, is a contemporary application of biological anthropology. Forensic anthropologists take their knowledge of osteology and paleopathology and apply it to both historical and criminal investigations (Figure 1.5). During the war crime investigations into mass graves in Bosnia, as well as after the September 11, 2001, terrorist attacks in New York, Washington, and Pennsylvania, forensic anthropologists were called in to attempt to identify victims (Figure 1.6). When police investigate a murder, forensic scientists may analyze footprints at the crime scene to try to reconstruct the height and weight of the murderer. This is not so different from what paleoanthropologists did when they discovered a set of tiny human-like footprints embedded in fossilized ash at Laetoli in northern Tanzania. They used forensic skills to try to reconstruct the likely height and weight of the creatures that had left those prints nearly 4 million years ago.

forensic anthropology

The study of human remains applied to a legal context.

Figure 1.5 Forensic anthropologists use skeletal remains to identify victims of war in Bosnia.



Figure 1.6 Recovery team at work at the World Trade Center Ground Zero following the September 11, 2001, attack.



primatology

The study of the nonhuman primates and their anatomy, genetics, behavior, and ecology.

Primatology

Primatology is the branch of biological anthropology that is best known to the public through the highly publicized work of renowned primatologists Jane Goodall and Dian Fossey. Primatologists study the anatomy, physiology, behavior, and genetics of both living and extinct monkeys, apes, and prosimians. Behavioral studies of nonhuman primates in their natural environments gained prominence in the 1960s and 1970s, when the pioneering work of Goodall was publicized widely in the United States and elsewhere. In the early days of primate behavior study, the researchers were mainly psychologists. By the late 1960s, however, biological anthropology had become the domain of primate behavior study, especially in North America.

Primatologists study nonhuman primates for a variety of reasons, including the desire to learn more about their intrinsically fascinating patterns of behavior (Figure 1.7). Within an anthropological framework, primatologists study the nonhuman primates for the lessons they can provide on how evolution has molded the human species. For example, male baboons fight among themselves for the chance to mate with females. They are also much larger and more aggressive than females. Do larger, more macho males father more offspring than their smaller and gentler brothers? If so, these traits appear to have appeared slowly through generations of evolutionary change, and the size difference between males and females is the result of selection for large body size. Then, what about the body size difference between men and women of our own species? Is it the result of competition between men in prehistory, or perhaps a preference by women in prehistory for tall men? The clues we derive about human nature from the behavior and anatomy of living primates must be interpreted cautiously but can be vitally important in our understanding of who we are and where we came from.

Biological anthropologists trained as primatologists find careers not only in universities but also in museums, zoos, and conservation agencies. Many valuable wildlife conservation projects seeking to protect endangered primate species are being carried out around the world by biological anthropologists.

Figure 1.7 Jane Goodall is a pioneering primatologist whose studies of wild chimpanzees changed our view of human nature.



Human Biology

In addition to paleoanthropology and primatology, biological anthropologists span a wide range of interests that are often labeled **human biology**. Some work in the area of *human adaptation*, learning how people adjust physiologically to the extremes of Earth's physical environments. For instance, how are children affected by growing up high in the Andes mountain range of South America at elevations over 14,000 feet (4,270 meters)? Other human biologists work as *nutritional anthropologists*, studying the interrelationship of diet, culture, and evolution. Biological anthropologists interested in demography examine the biological and cultural forces that shape the composition of human populations. Other biological anthropologists are particularly interested in how various hormones in the human body influence human behavior and how, in turn, the environment affects the expression of these hormones. The study of *human variation* deals with the many ways in which people differ in their anatomy throughout the world.

At an earlier time in history, the scholarly study of physical traits such as height, skull shape, and especially skin color was tainted with the possibility that the researcher had some racially biased preconceptions. Today, biological anthropologists are interested in human variation, both anatomical and genetic, simply because it offers clues about the peopling of the world by the migrations of early people. Understanding when, where, and how people left Africa and colonized Europe, Asia, and eventually the New World can tell us a great deal about the roots of modern languages, diseases, population genetics, and other topics of great relevance in the world today.

Many contemporary biological anthropologists are interested in research problems that require an understanding of both biological and cultural factors. Biological anthropologists with these interests sometimes are called *biocultural anthropologists*. One area in which a biocultural perspective is vitally important is *biomedical anthropology* (Figure 1.8). Biomedical anthropologists might study how human cultural practices influence the spread of infectious disease and how the effects of pollution or toxins in the environment affect human growth. Biomedical anthropologists are particularly interested in looking at the effects that adopting an urbanized (and Western) lifestyle has on people who have lived until recently under more traditional, non-Western conditions. The expression of many human diseases is influenced by genetic factors, and biomedical anthropologists often look at the long-term evolutionary consequences of disease on human populations.

Finally, an increasing number of biological anthropologists work in the field of genetics. *Molecular*

human biology

Subfield of biological anthropology dealing with human growth and development, adaptation to environmental extremes, and human genetics.

Figure 1.8 Biomedical anthropologists study, among other things, the human brain.

