PREFACE

What a time it is to be an evolutionary biologist! In the first edition of this book, we wrote that we envy the student taking a class in evolutionary biology today. Recent events only strengthen this sentiment. For example, since the first edition of the book was released, our understanding of human evolutionary history has been upended by findings including definitive evidence of substantial interbreeding between humans and other *Homo* species such as Neanderthals and Denisovans. Or to provide another example, as the final drafts of this edition were being completed, extensive evidence of a new hominin species, *Homo naledi*, was uncovered in a South African cave. We scrambled to tell its remarkable story before the book went to press. These findings, along with other major advances in our understanding of human evolutionary history, stimulated us to expand our coverage of human evolution from a short section in our first edition to an entirely new chapter in this second edition.

Evolutionary biologists continue to collaborate in new and dynamic ways with researchers in many disciplines and bring to such collaboration a diverse set of perspectives—from areas such as phylogenetics, population genetics, the study of adaptation, molecular genetics, and developmental biology, to name just a few. The result is a much deeper understanding of the history and diversity of life on Earth over the past 4 billion years or so. Our job as the authors of this book is to capture the exciting work that has gone into this effort and to present it in a rigorous and engaging fashion.

To achieve this goal, we draw on our dual roles as researchers in and teachers of evolutionary biology. We each run active labs abuzz with the excitement that surrounds the science of evolution. We both lecture about evolution to students at our own universities and to audiences around the world. And we are each enthusiasts about the history of science in general and the history of evolutionary biology in particular. The successful strategies we've developed for communicating with these diverse audiences have informed the tone, emphases, and features in this textbook in a way that we hope will excite the scientific imaginations of students and instructors alike.

We relish the fact that *all science* is about testing hypotheses. Hypothesis-driven science has proved to be the most powerful approach ever devised for understanding the nature of the physical world we live in. No other approach even comes close. We convey this through the abundant use of examples in which evolutionary biologists generate and test hypotheses. In this second edition, we continue the path we took in the first edition and include the newest work from around the globe. Through these examples, students will gain an intimate understanding that evolutionary biology is a continually developing field in which theoretical ideas translate into testable predictions and in which the process of hypothesis testing leads to refinements of theory. Through the lens of current research, students can see how the scientific understanding of evolutionary biology is ever changing and that built into science is a system that allows each assumption to be challenged and refined or even rejected based on a preponderance of evidence.

We understand that it is *stories*, not catalogs of facts, that resonate with students (or anyone else). And so, in each chapter, we make use of the natural human inclination to acquire and process information in narrative form. Within the field of evolutionary biology are fascinating stories on many levels: stories of individual scientists and how they came to their discoveries, stories of how human thought has changed over the centuries, stories of how major evolutionary innovations arose in the history of life, stories of how individual species have changed over millennia through biological evolution or, as in the case of many microbes, how a population can change dramatically in a matter of weeks.

Science is much more than narrative, of course. As in all mature sciences, models play a fundamental role in evolutionary biology today. In this book, we devote considerable attention to simple conceptual models of evolutionary processes. Often, such models can be profitably expressed through the language of mathematics, and one of our principal aims in the text is to help students become comfortable with this approach. One of the most important things that students learn in college-level physics or economics classes is how to formulate questions about the real world in the language of mathematical models and how to answer these questions appropriately using mathematical analysis. We believe strongly that this should be a critical component of a college education in the biological sciences as well. At the same time, we recognize that students enter this course with varying degrees of mathematical preparedness, and so we have placed the more advanced concepts in boxes in an effort to offer instructors maximum flexibility in integrating mathematical models into their course.

So that students will gain a firm understanding of the essential foundations of evolutionary reasoning, we introduce several fundamental components of evolutionary thought in Chapter 1 and emphasize them throughout this textbook. These include:

- **Phylogenetics**. All living things on the planet today—and indeed all life that has ever existed—are linked by a shared evolutionary history that evolutionary biologists represent using phylogenetic trees. Thus, to understand evolutionary relationships, whether between two HIV strains or among the different domains of life, students must learn to think in terms of phylogenetic relationships. We consider it crucial that any textbook on evolution seamlessly integrates phylogenetic thinking throughout, and we have done so here. If students walk away remembering just one thing about this book—though of course we hope they walk away remembering much more—it will be the importance of phylogenetic thinking.
- **Population thinking**. Evolutionary change occurs in populations, but most contemporary biology curricula train students to think at the level of the individual, as one would in a physiology course, for example. In this book, we demonstrate how to think at the population level as well, paying careful attention to the properties of populations: population composition, variation among individuals within and between populations, change in the properties of a population over time, and so forth. This population-level perspective, particularly as it relates to the process of natural selection, permeates this book. Because we know that some students initially struggle to master this type of population-level thinking, we devote considerable space to teaching this skill.
- **Natural selection**. Evolution is often defined as "descent with modification." As a population geneticist (CTB) and a behavioral evolutionary biologist (LAD), we both study the processes responsible for such "modification." We convey the importance of this topic to students by teaching them how the process of natural selection has shaped the diversity of life on this planet and how other processes—most notably genetic drift—have also contributed to the myriad forms of life around us.