

PREFACE

This new edition of Volpe's *Understanding Evolution*, like earlier editions, is addressed to college students with no previous experience with the subject. It is meant to stand in good stead for use as a primary text for an introductory-level evolution course or as a supplement to a basic biology or anthropology course. In revising this time-honored volume, every effort has been made to provide a clear, simple, concise account of the scope, significance, and principles of evolution for the liberally educated citizen without burdening the reader with exhaustive detail. No apology is offered for drawing many of the examples used in this text from our own species. This edition has been rewritten and expanded to transmit a wealth of new ideas in evolution fostered by new discoveries in many fields of science. To accommodate the changing body of knowledge, all chapters have been extensively revised, new chapters have been added, and many new illustrations have been added. In addition, this edition includes a concise glossary to aid the reader with the challenges of scientific terminology.

The publication of Charles Darwin's *On the Origin of Species by Means of Natural Selection*, or the *Preservation of Favoured Races in the Struggle for Life*, Darwin's "big book," is one of the great landmarks in the history of science and laid the foundation for the theory of evolution via natural selection. This groundbreaking tome sold out on the first day of publication and was revised and reissued six times during Darwin's lifetime. Unlike other scientific ideas, evolution provides a framework for

much of human knowledge spanning all of the natural sciences, the social sciences, and beyond and brought about one of the most remarkable and far-reaching revolutions in human thought.

The Origin of Species shocked Victorian readers and forever changed science. It profoundly altered and forever changed our conception of ourselves and our world, of the origins and history of life on our planet, and in doing so became and remains controversial to this day. Before Darwin's *Origin of Species*, we presumed that humans occupied an exalted position in the world. In its aftermath, we were no longer at the center stage of the Earth and were instead made part of the fabric of nature. Volpe's *Understanding Evolution* is an effort to demystify evolution and provide the reader with a clear and concise grasp of this pivotal and groundbreaking idea. Although Darwin's monumental *Origin of Species* was initially greeted with a storm of criticism, his findings are now universally accepted.

Darwin's thesis has been fortified by the ever-expanding knowledge of the gene. One of the finest triumphs of modern science has been the elucidation of the chemical makeup of the gene. The fundamental chemical component of the gene is the remarkable molecule *deoxyribonucleic acid* (DNA). This molecule contains a coded blueprint for all life in its molecular structure and is the universal alphabet for the book of life. The integration of genetics and evolution occurred in the early part of the twentieth-century and is often called "the synthesis" because of the unity of

knowledge the melding of these two great bodies of knowledge brought to each other. Due to the importance of genetics to the study of evolution, Volpe's *Understanding Evolution* rehearses those facets of genetics that are fundamental to the study and understanding of evolution. Today, most of the important contributions to evolution are coming from genetics, developmental genetics, and the comparison of proteins (*proteomics*) and whole sets of chromosomes (*genomics*) among and between organisms. Modern DNA technology has so sharpened the precision of molecular analysis that it has found application in virtually all fields of scientific inquiry, from medicine to paleontology to the evolutionary history of the human species. Hence, the reader is asked to integrate the principles of genetics with basic Darwinian tenets in order to understand how important "the synthesis" was and is to our modern conceptualization of evolution.

The year 2009 marked the 200th birthday of Charles Darwin (February 12, 1809) and the 150th anniversary of the first publication of *The Origin of Species* (November 24, 1859). These dates remind us that the theory of evolution has a long and complex history filled with extraordinary discoveries and public controversies. Excellent companion books to this volume are Darwin's original books *The Origin of Species* (1859) and *The Voyage of the Beagle* (1839). Both were written for the laymen, the everyday person, living in Victorian England in Darwin's day, and both were bestsellers. *The Origin of Species* is one of the 300 most important books ever published in the history of the Western world—a collection of works spanning literature, philosophy, and science and including such giants as Homer, Dante, Hippocrates, Chaucer, Dickens, Melville, Aristotle, Shakespeare, Plato, Euripides, Copernicus, Euclid, Einstein, Galileo, Newton, Galen, Locke, Cervantes, Shaw, Orwell, and Dobzhansky.

Evolution is a central concept in science. In the 150-plus years since the publication of *The Origin of Species*, Darwin's thesis has been fortified from many branches of science. No other scientific idea has had a more unifying impact on the sciences, enabling scientists from a myriad of

disciplines to better understand and integrate their science. In 1973 the renowned Columbia University evolutionist Theodosius Dobzhansky wrote a now-famous essay entitled "Nothing in Biology Makes Sense except in the Light of Evolution." This essay could as easily have been entitled "Nothing in the *Natural Sciences* Makes Sense except in the Light of Evolution." More than any other scientific concept, evolution serves as a lattice for the natural sciences, providing both explanation and venues for prediction and hypothesis testing.

The word evolution is derived from the Latin *evolutio*, meaning "an unraveling" or "an unfolding." The term reminds us that throughout the history of the universe, change has been a constant motif, especially of the living world. In Darwin's day, evolution was conceptualized by the word *transmutation* and it was only later that the term *evolution* gained acceptance. Throughout life's history, organisms have constantly and endlessly changed. Change is the leitmotif, the recurring theme and idea, of all living things.

Coupled with the ever-increasing and rapid advances in science and technology is the need for scientific literacy of the citizenry. Scientific literacy is an essential part of a liberal arts education. With recent polls revealing that nearly half of U.S. citizens do not *accept* the tenets of evolutionary biology, the rationale for Volpe's *Understanding Evolution* have never been more important. Many otherwise well-educated people cannot describe the principles of evolution or articulate the vast body of evidence built up over the last 150 plus years since the publication of Charles Darwin's *Origin of Species*. In this book effort has been made to leave the reader a better educated member of society capable of engaging in informed discussions in all manner of venues.

NEW TO THIS EDITION

- A Prologue outlining the evidence for evolution.
- An Epilogue describing the controversy of teaching evolution in the school, scientific literacy and the legal history of teaching evolution in U.S. law.

- A Glossary to aid in learning the vocabulary associated with evolutionary biology.
- New and updated graphics throughout the chapters to clarify the concepts presented in the text.
- Supporting text website that provides instructor tools, including slides of all figures and tables as PowerPoint lectures and test questions for each chapter. Chapter outlines are available to students.

Chapter Revisions Include

- A new section on the scientific method (Chapter 1).
- A new section of Darwin's reluctance to publish the "Origin of Species" and a major revision of Darwin's explanatory model for natural selection (Chapter 2).
- Several new figures and a new section of Gregor Mendel (Chapter 3).
- New discussion of mutation supported by two new figures (Chapter 4).
- A revised description of the Hardy-Weinberg equilibrium (Chapter 5).
- A new section on sexual selection and several new figures (Chapter 6).
- A revised section on the evolution of bacterial resistance to antibiotics (Chapter 7).
- A new section on polyploidy in nature with several new figures and tables (Chapter 11).
- Major revisions and updating of material on adaptive radiation, including new sections and many new and revised figures (Chapter 13).
- Two new sections on the origin of life along with several new figures and tables (Chapter 14).
- New section of mass extinctions, revised text and many new figures (Chapter 16).
- Extensive revision and updates on human evolution including several new figures and a new discussion on Flores man and the genomic and chromosomal evolution of chimps and humans (Chapter 17).
- Integration of three previous chapters, a revised section on cultural evolution and a new section on memes (Chapter 18).

ACKNOWLEDGEMENTS

In the mid 1960s when science education was undergoing dramatic restructuring and innovation, Volpe's *Understanding Evolution* was originally conceived as *The Process of Evolution* but ultimately went to press in 1967 under the title *Understanding Evolution*. Erminio "Peter" Volpe's graceful use of language and mastery as a teacher shows through in each paragraph and page. Much of the art used in the first edition was drawn by Peter's wife, Carolyn Thorpe Volpe, some of which remains in the pages that follow. My involvement with this text began roughly a decade ago in the preparation of the sixth edition. Volpe's *Understanding Evolution* has enabled generations of students to better appreciate the basic tenets of evolutionary biology, and thus this new edition rests on broad shoulders with high expectations. This edition is the culmination of a promise I made to Peter Volpe, my professor, mentor, colleague, and friend, to keep *Understanding Evolution* in press for as long as I could. I owe an enormous debt of gratitude to the inspiration, mentorship, and trust that Peter Volpe placed in me to continue his extraordinary contribution to science education.

I am indebted to the reviewers whose comments have helped improve this and previous editions.

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Peter A. Rosenbaum
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