Preface



Animal Diversity is tailored for the restrictive requirements of a one-semester or one-quarter course in zoology, and is appropriate for both non-science and science majors of varying backgrounds. This fourth edition of *Animal Diversity* presents a survey of the animal kingdom with emphasis on diversity, evolutionary relationships, functional adaptations, environmental interactions, and certainly not least, readability.

We are fortunate to recruit as coauthors Susan L. Keen, who supervised this revision, and David J. Eisenhour. They bring fresh perspectives and the most current coverage from their research areas.

Organization and Coverage

The sixteen survey chapters of animal diversity are prefaced by four chapters presenting the principles of evolution, ecology, classification, and animal architecture. Throughout this revision we updated references and worked to simplify and streamline the writing.

Chapter 1 begins with a brief explanation of the scientific method—what science is (and what it is not)—and then moves to a discussion of evolutionary principles. Following an historical account of Charles Darwin's life and discoveries, the five major components of Darwin's evolutionary theory are presented, together with important challenges and revisions to his theory and an assessment of its current scientific status. This approach reflects our understanding that Darwinism is not a single, simple statement easily confirmed or refuted. It also prepares the student to dismiss the arguments of creationists who misconstrue scientific challenges to Darwinism as contradictions to the validity of organic evolution. The chapter ends with discussion of micro- and macroevolution.

Chapter 2 explains the principles of ecology, with emphasis on populations, community ecology, and variations in life history strategies of natural populations. The treatment includes discussions of niche, population growth and its regulation, limits to growth, competition, energy flow, nutrient cycles, and extinction.

Chapter 3 on animal architecture is a short but important chapter that describes the organization and development of body plans distinguishing major groups of animals. This chapter includes a picture essay of tissue types and a section explaining important developmental features associated with the evolutionary diversification of the bilateral metazoa.

Chapter 4 treats classification and phylogeny of animals. We present a brief history of how animal diversity has been organized for systematic study, emphasizing current use of Darwin's theory of common descent as the major principle underlying animal taxonomy. Continuing controversies over concepts of species and higher taxa are presented, including a discussion of how alternative taxonomic philosophies affect our study of evolution. Special attention is given to phylogenetic systematics (cladistics) and the interpretation of cladograms. Chapter 4 also emphasizes that current issues in ecology, evolution, and conservation biology all depend upon our taxonomic system.

The sixteen survey chapters are a comprehensive, modern, and thoroughly researched coverage of the animal phyla. We emphasize the unifying phylogenetic, architectural, and functional themes of each group. Structure and function of representative forms for major taxonomic groups are described, together with their ecological, behavioral, and evolutionary relationships. Each chapter includes succinct statements of "Position in the Animal Kingdom" and "Biological Contributions." Students find these highlights, a distinctive feature of this text, helpful in organizing their knowledge of animal diversity.

The Linnean classifications in each chapter are positioned following other coverage of a particular group, in most cases immediately preceding the summary at the end of the chapter. Discussions of phylogenetic relationships are written from a cladistic viewpoint, and cladograms are presented to show the structure of each group's history and the origin of the principal shared derived characters. Phylogenetic trees have been drawn to agree with cladistic analyses as closely as possible.

Changes in the Fourth Edition

Major revisions for the fourth edition include:

Scientific method—expanded explanation in Chapter 1.

Evolutionary mechanisms and theory—greater explanation of the rejection of teleology by Darwinian theory, sorting versus natural selection, population bottlenecks, roles of homeobox genes and mutations of large effect in evolution, and modes of species formation (Chapter 1).

Political controversies—updated coverage of controversies surrounding animal rights and "intelligent design" creationism (Chapter 1), and environmental issues (Chapter 2).

Metapopulation dynamics—added coverage of metapopulation dynamics in ecology (Chapter 2).

Life-history ecology—expanded coverage of life-history ecology, including general concepts (iteroparity versus semelparity, Chapter 2), evolution of cnidarian life cycles (Chapter 7), basic life histories of eels and hagfishes (Chapter 16), evidence for parental care in dinosaurs (Chapter 18), and social behavior of reproduction in birds (Chapter 19).

Community ecology—topics with expanded coverage include mutualism, Batesian and Müllerian mimicry, newly discovered hydrothermal-vent communities, and nutrient pools (Chapter 2).

Physiological ecology—expanded coverage of physiological ecology of many groups, particularly hemichordates (Chapter 14), echinoderms (locomotion and feeding, Chapter 14), tunicates (Chapter 15), fishes (swim bladder, fins, and osmotic regulation, Chapter 16), snakes (prey-capture strategies, Chapter 18), and mammals (feeding, Chapter 20).

Biodiversity and extinction—added discussion of animal diversity and extinction in the context of geological time (Chapter 2).

Epidemiology—new coverage of environmental epidemiological topics, including the fish-killing dinoflagellate, *Pfiesteria piscicida* (Chapter 5), the mosquito-borne West Nile virus (Chapter 12), incidence of snakebite in humans (Chapter 18), and declining amphibian populations (Chapter 17).

Body plans—expanded comparisons of major body plans, including formation of body plans and body cavities (Chapter 3) and implications of a possible sister-taxon relationship between annelids and molluscs for evolution of segmentation (Chapter 11).

Systematic concepts and theory—expanded explanation of systematic concepts, including species concepts, polytypic species, and the new taxonomic system PhyloCode as an alternative to Linnean taxonomy (Chapter 4).

Phylogenetic methodology—expanded explanation of molecular phylogenetic procedures (Chapter 4) and why evolutionary relationship of some taxa, such as chaetognaths, are difficult to discern (Chapter 13).

Phylogeny and classification of animals—updated phylogenies and taxonomies based largely on new comparative molecular studies (Chapters 4–20). Major cases include (1) new hypotheses for major prokaryotic and eukaryotic lineages and the concept of taxonomic domains above the kingdom level (Chapters 4–5); (2) phylogenetic position of acoelomorph flatworms outside all other bilaterians (Chapter 8); (3) pogonophorans subsumed into annelid class Polychaeta as clade Siboglinidae (Chapters 11 and 13); (4) paraphyly of annelid classes Polychaeta and Oligochaeta (Chapter 11); (5) arthropod taxon Uniramia abandoned in favor of four extant subphyla: Chelicerata, Myriapoda, Crustacea, and Hexapoda (Chapter 12); (6) arthropod subphylum Hexapoda revised to contain classes Entognatha and Insecta (Chapter 12); (7) revised phylogenetic relationships among many pseudocoelomate and lesser protostome phyla and their grouping into taxa Lophotrochozoa versus Ecdysozoa (Chapters 8 and 13); (8) sea daisies (formerly Concentricycloidea) subsumed into Asteroidea; (9) greatly revised cladograms and/or classifications for Mollusca (Chapter 10), Hemichordata (Chapter 14), Aves (Chapter 19), Mammalia (Chapter 20), and anthropoid apes (Chapters 4 and 20); and (10) priority of the name Urodela now given to salamanders (Chapter 14).

New taxa—addition of some newly described taxa, including a group of carnivorous sponges that lack choanocytes (Chapter 6) and the pseudocoelomate group Micrognathozoa (Chapter 9).

Vertebrate origins—expanded coverage of vertebrate origins, including ecological physiology, role of *Hox* genes and developmental changes (Chapter 15).

Paleontology—updated fossil discoveries, especially those pertaining to vertebrate origins (Chapter 15), sharing of derived characters between dinosaurs and birds (Chapter 19), and cynodont mammals and human ancestry (Chapter 20).

Group characteristics—extensive revision of group characteristics (Chapters 5–20).

Readability—reorganization of many topics to improve ease of reading; major cases include presentation of systematic principles (Chapter 4) and of phyla Cnidaria (Chapter 7), Platyhelminthes (Chapter 8), and Mollusca (Chapter 10).

These revisions include redrawing of many figures and enlargement of photos to improve clarity of presentation.

An extensively revised glossary includes all bolded key terms with the exception of those found in the "classification" boxes of their respective chapters. Additional unbolded terms that are useful in understanding terms in other definitions are also included.

Teaching and Learning Aids

Vocabulary Development

Key words are boldfaced and derivations of generic names of animals are given where they first appear in the text. In addition, derivations of many technical and zoological terms are provided in the text; in this way students gradually become familiar with the more common roots that recur in many technical terms. Updated for the fourth edition, the extensive glossary provides pronunciation, derivation, and definition of each term.

Chapter Prologues

A distinctive feature of this text is an opening essay placed in a panel at the beginning of each chapter. Each essay presents a theme or topic relating to the subject of the chapter to stimulate interest. Some present biological, particularly evolutionary, principles; others illuminate distinguishing characteristics of the group treated in the chapter.

Chapter Notes

Chapter notes, which appear throughout the book, augment the text material and offer interesting sidelights without interrupting the narrative.

For Review

Each chapter ends with a concise summary, a list of review questions, and annotated selected references. The review questions enable students to test themselves for retention and understanding of the more important chapter material.

Art Program

The appearance and usefulness of this text are much enhanced by numerous full color paintings by William C. Ober and Claire W. Garrison. Bill's artistic skills, knowledge of biology, and experience gained from an earlier career as a practicing physician, have enriched the authors' zoology texts through several editions. Claire practiced pediatric and obstetric nursing before turning to scientific illustration as a full-time career. Texts illustrated by Bill and Claire have received national recognition and won awards from the Association of Medical Illustrators, American Institute of Graphic Arts, Chicago Book Clinic, Printing Industries of America, and Bookbuilders West. Bill and Claire also are recipients of the Art Directors Award.

Web Pages

At the end of each survey chapter is a selection of related internet links dealing with the chapter's topics. The URLs for the pages are found in the text's Online Learning Center at *www.mhhe.com/hickmanad4e*.

Supplements

Instructor's Manual

The Instructor's Manual provides a chapter outline, commentary and lesson plan, and a listing of resource references for each chapter. We trust that this material will be particularly helpful for first-time users of the text, although experienced teachers also may find much of value. The Instructor's Manual is available on this text's Online Learning Center at *www.mhhe.com/hickmanad4e*.

Digital Content Manager

Created to accompany *Integrated Principles of Zoology,* thirteenth edition, by Hickman et al., this helpful CD-ROM can also be used with *Animal Diversity,* fourth edition. Instructors will find all of the illustrations, photos, and tables from *Integrated Principles of Zoology,* plus 200 additional animal diversity photos and 25 full-color animations illustrating key biological processes. All illustrations, photos, and tables have been pre-inserted into PowerPoint slides and can be easily modified for use with *Animal Diversity.*

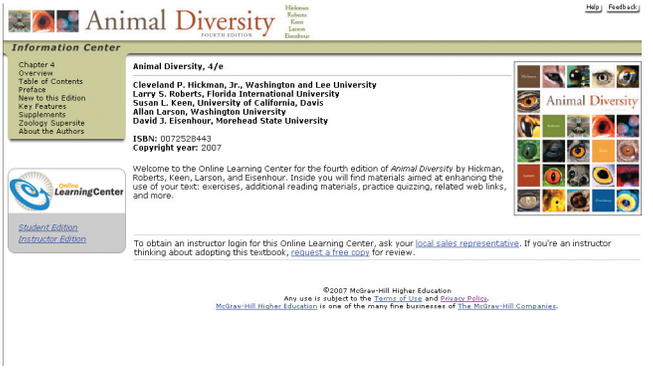
Animal Diversity Online Learning Center

www.mhhe.com/hickmanad4e

This convenient website takes studying to a whole new level. **Students** will find chapter and animations quizzing, key term flashcards, interactive web links, and more. What a great way to get a better grade!

Instructors will appreciate a password-protected Instructor's Manual and test questions, PowerPoint lecture slides with images and species/origin information, a guide to teaching animal molecular phylogenetics, and more!

The *Animal Diversity* Online Learning Center is also home to the **Zoology Essential Study Partner.** This unique learning tool allows students to test their understanding of important zoological concepts through the use of animations, learning activities, quizzing, and interactive diagrams.



Animal Diversity Laboratory Manual

The laboratory manual by Cleveland P. Hickman Jr. and Lee B. Kats, *Laboratory Studies in Animal Diversity,* is designed specifically for a survey course in zoology.

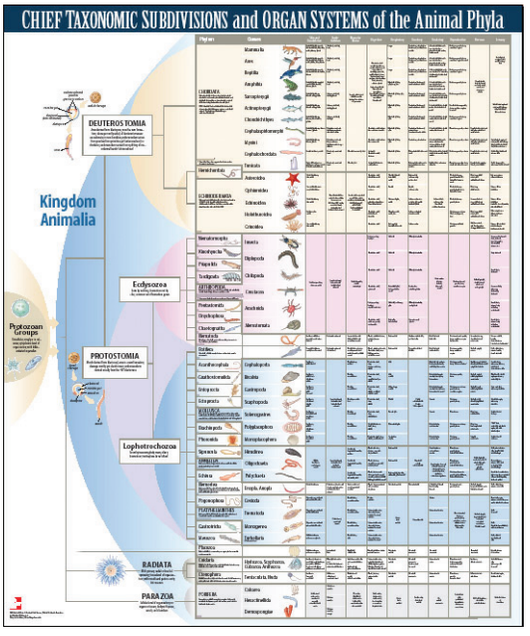
Digital Zoology

Digital Zoology **Interactive CD-ROM** by Jon Houseman is an interactive guide to the specimens and materials covered in zoology laboratory and lecture sessions. Laboratory modules contain illustrations, photographs, annotations of the major structures of organisms, interactive quizzes, and video clips. Interactive cladograms within lab modules provide links to interactive synapomorphies of the various animal groups. Key terms throughout the program link to an interactive glossary. This CD-ROM is the

perfect student study tool to promote learning both in and outside of the zoology laboratory, and also comes with an accompanying student workbook and website to provide additional study tips, exercises, and phyla characteristics.

Study Aid/Poster: Chief Taxonomic Subdivisions & Organ Systems of the Animal Phyla

This 30″ × 36″ poster is a great reference/study tool for students!



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