

PREFACE

Integrated Principles of Zoology continues to be the leading text for the introductory zoology course. With the seventeenth edition, the authors bring a wealth of real experience as they describe the diversity of animal life and the fascinating adaptations that enable animals to inhabit so many ecological niches.

The overall organization of this text has proven to work well to help students understand the content. Distinctive features, especially the emphasis on principles of evolution and zoological science, have been strengthened. To aid in student learning, several pedagogical features have been retained: opening chapter prologues drawn from the chapter's theme; chapter summaries and review questions to aid in comprehension and study; concise and visually appealing illustrations; chapter notes and essays that offer interesting sidelights to the narrative; literature citations; and an extensive glossary providing pronunciations, derivations, and definitions of terms used in the text.

NEW TO THE SEVENTEENTH EDITION

Revisions for the seventeenth edition are primarily for improved pedagogy, and guided by an electronic tabulation of student responses to questions. All parts of the sixteenth edition were linked to electronic questions designed to measure students' comprehension of their reading. Authors received a heat map of the sixteenth edition, showing for each paragraph the percentage of correct student responses for that material. We focused our revisions on improving explanations wherever the heat map showed less than 50% of the students responding correctly. With this detailed and insightful guidance, we have made our text more accessible to its readers.

In addition to focused revision of the writing, we have replaced many photographs and diagrams throughout the book to improve clarity and vibrancy.

We summarize our major revisions in order by the book's five major parts.

Part One, Introduction to Living Animals

In Chapter 1, a new section, *Historical Continuity of Life*, replaces the section formerly titled *Does Life Have Defining Properties?* A new figure illustrating protein structure strengthens the visual correspondence between the bonding of amino acids and the three-dimensional macromolecular structure of a protein. Regarding general properties of living systems, we expand the explanation of speciation as part of the biological hierarchy, and extend the principle of movement to the macromolecular level, emphasizing reversible conformational changes in proteins. In Chapter 2, expanded captions for Figures 2.12–2.15 make the diagrams more independent of the text in conveying the fundamental structures of biological macromolecules. The important role of ATP in cellular

metabolism and as a precursor to RNA gets expanded treatment, as does the role of membrane-bound vesicles in the evolution of biological polymers. Chapter 3 features a new explanation of electron microscopy, more information on the Golgi apparatus and on how cells adapt to temperature, and a more detailed description of how spindle fibers organize chromosomes for cellular division.

Part Two, Continuity and Evolution of Animal Life

Chapter 5 features greater detail on Mendel's investigations, plus a more detailed and precise explanation of how geneticists use the term "chromosome." Also given expanded explanations are the topics of chromosomal sex determination, how a new allele arises by mutation, occurrence of multiple alleles in a population, autosomal linkage and crossing over, DNA structure, and gene expression. Chapter 6 contains a more complete explanation of geological dating, a reorganized section, *Forces of Evolutionary Change*, and a new section describing studies of Caribbean ectopros as the best-documented case of punctuated equilibrium. New information on the CRISPR tool used to splice and to manipulate genes appears in Chapter 8. Chapter 8 includes updates on mesoderm and coelom formation, plus new and improved diagrams of development.

Part Three, Diversity of Animal Life

Chapters 9 and 11 update taxonomy of unicellular eukaryotes. Chapter 10 features more precise explanation of cladistic terminology, phylogenetic reconstruction, the conflicts among the major schools of taxonomy, and the major divisions of life. Chapter 11 emphasizes symbiogenesis as a major theme emerging from studies of eukaryotic origins. Chapter 11 also includes clarifications on saprozoic feeding and sexual reproduction in unicellular eukaryotes, and updates on recent U.S. outbreaks of *Cryptosporidium parvum*. Chapter 12 updates sponge taxonomy to use Calcispongiae instead of Calcarea, provides greater detail on Homoscleromorpha, and updates the debate on whether sponges have true tissue epithelia, including classification of pinacoderm as an incipient tissue. Chapter 13 is retitled *Cnidarians and Ctenophores*. "Jellyfishes" are now consistently called "jellies." The section on sea anemones is revised with greater detail, and the section on coral reefs now includes an example of coral bleaching in the Maldives. The section on phylogeny and adaptive diversification is substantially revised to include detail on the evolutionary biology of muscle cells in cnidarians and ctenophores. In Chapter 14, the section on Cestoda is updated with greater detail on the life cycle of pork tapeworms. New phylogenetic evidence groups acoelomorphs and xenoturbellids as a clade. The introduction to Chapter 15 now mentions controversy concerning homology of the lophophore across the three lophophorate phyla. The section on Phylum Ectoprocta now includes detail on *Tricellaria inopinate* as an invasive species.

Chapter 16 features a new description of evolution of terrestrial slugs, new information on how ocean acidification threatens marine molluscs, and the economic importance of molluscs. Chapter 17 presents a completely revised introductory section on annelids with updated information on the fluid-filled coelomic cavity, and more background on annelid evolutionary history. The section describing earthworms' peristaltic movement is augmented and improved. Chapter 18 reports that all plant parts have specialized nematode parasites. The section on form and function of nematodes is augmented and improved with updated information on the life cycle of *Ascaris* worms. Information from the CDC on filarial worms is updated. The evolutionary placement of the fossil *Hallucigenia* sheds light on the evolution of teeth in ecdysozoans and their loss in velvet worms. Additional detail appears on mating in nematomorphs. Chapter 19 features greater detail on spider respiration. Updates include the role of the *Varroa* mite in the dramatic loss of U.S. honeybees. Chapter 20 reports the first venomous crustacean and includes updates on the symbiotic feeding habits of yeti crabs. Chapter 21 features new phylogenetic data suggesting that insects arose far earlier than the fossil record indicates. The section on insect metamorphosis and growth includes new information on molting and ecdysis. The defense section includes a new box on luna moths. The section on insects and human welfare continues from Chapter 19 the discussion of colony collapse disorder in honeybees, plus updates on defoliation and the Zika virus. Chapter 22 adds information on species diversity of Chaetognatha, echinoderm larvae and nervous systems, and echinoderms of Class Ophiuroidea.

In Chapters 23–24, we adopt unranked nested clade names for vertebrate taxonomy. There is no longer a consensus system for placing the higher groups of vertebrates into a Linnaean system. We update hagfish and lamprey relationships; these are now considered sister groups, forming the clade Cyclostomata. Also presented is new information about hagfish development and reproduction, which includes the first documentation that at least some hagfishes do have vertebrae. Extensive clarification of wording throughout these chapters follows the guidance of the heat map. The fish cladogram was heavily modified, incorporating new ideas about relationships of placoderms and acanthodians. There is new lungfish art depicting aestivation behavior. An updated boxed essay describes the impact of dams, and their removals, on salmon populations. Chapter 25 presents more precise dating information on the Devonian origin of tetrapods in the text and accompanying figures. Chapter 26 features updated information on turtle evolution, highlighting evolutionary developmental biology of the shell. The opening section on enclosing the pond has been substantially revised for context and clarity, now specifying the four living reptile groups and noting that dinosaurs form a clade with birds. A new boxed essay describes the Burmese python as an invasive species in southern Florida. Chapter 27 features more precise terminology and description of the categories of bird flight. The boxed essay on flightless birds includes an update on the height of the largest bird, and the essay on Himalayan migration by bar-headed geese is updated. Chapter 28 presents an expanded section on mammalian omnivory. Updates to human evolution include new information from recent South African and European fossils and from DNA studies of Neanderthal and modern humans. The boxed essay on trade in rhinoceros horns is updated.

Part Four, Activity of Life

The section on integument in Chapter 29 includes a new footnote directing readers to the Annual Report to the Nation on the Status of Cancer 1975–2011. The section on skeletal systems presents an update on the running capability and speed of *Tyrannosaurus*. The Chapter 31 subsection on excitation and control of the heart now features greater detail on how sympathetic nerves increase stroke volume and heart rate when activated. Chapter 32 presents additional detail on the functionality of pepsin. There are updated statistics and a new footnote on the prevalence of childhood and adult obesity in the United States, plus more detail on secretions of fat cells and inflammatory responses. The section on nutritional requirements includes updated statistics on meat consumption. Coverage of hearing in Chapter 33 includes new material on luna moth defenses. In the section on prostoglandins and cytokines, Chapter 34 features more information on secretion of these hormones and inflammatory responses. In the section on hormones of metabolism, more detail appears on possible consequences of defects in thyroid hormone production or receptors, along with more detail on the evolution of bone and parathyroid glands in fishes. A boxed essay on anabolic steroids has updated statistics. The Chapter 35 section on innate defense mechanisms adds current studies on the gut microbiome, which may be altered by obesity. In Chapter 36, the subsection on genetics of behavior includes greater detail on W. C. Dilger's hybridization of lovebirds and its disruption of genetically programmed behavior. The subsection on agonistic or competitive behavior features added detail on peck order. The subsection on cooperative behavior, altruism, and kin selection describes W. D. Hamilton's modification of Ronald Fisher's concept of the fitness of an allele and self-sacrifice. The subsection on the language of honeybees features a more detailed description.

Part Five, Animals and Their Environments

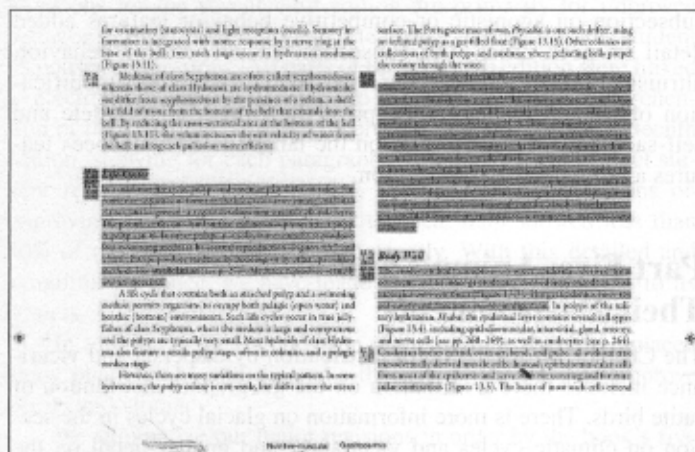
The Chapter 37 discussion of distribution by dispersal and vicariance includes more information on the geographic distribution of ratite birds. There is more information on glacial cycles in the section on climatic cycles and vicariance, and greater detail on the relationships between upwellings of phytoplankton in the Antarctic sea and krill. The Chapter 38 subsection on populations includes a new paragraph on the metapopulation model, plus greater detail and clarity on the three principal types of theoretical survivorship. Figure 38.3 has a revised and more detailed caption. This section also now includes a note on the United Nations' position that a world population of 7–11 billion people would reach the point of being unsustainable agriculturally. The section on community ecology is significantly revised and now includes coverage of ecological character displacement, microhabitat selection, and the theory of competitive exclusion. It also features new coverage of ectoparasites and endoparasites and the complexity of parasite/host relationships. The section on ecosystems is revised for clarity and to provide greater detail. The caption for Figure 38.13 is revised for better context.

OUR APPROACH TO THE REVISION

Our goal now is, as it has always been, to ensure student success. To that end, we approached this revision differently. To help guide our revision for this seventeenth edition, we were able to incorporate student usage data and input, derived from thousands of our SmartBook® users. SmartBook “heat maps” provided a quick visual snapshot of chapter usage data and the relative difficulty students experienced in mastering the content. With these data, we were able to hone not only our text content but also the SmartBook probes.

- If the data indicated that the subject was more difficult than other parts of the chapter, as evidenced by a high proportion of students responding incorrectly to the probes, we revised or reorganized the content to be as clear and illustrative as possible.
- In other cases, if one or more of the SmartBook probes for a section was not as clear as it might be or did not appropriately reflect the content, the probes were edited, rather than the text.

Below is an example of one of the heat maps from Chapter 13. The color-coding in highlighted sections indicates the various levels of difficulty students experienced in learning the material, topics highlighted in red being the most challenging for students.



TEACHING AND LEARNING AIDS

To help students in **vocabulary development**, key words are bold-faced and derivations of technical and zoological terms are provided, along with generic names of animals where they first appear in the text. In this way students gradually become familiar with the more common roots that form many technical terms. An extensive **glossary** provides pronunciation, derivation, and definition for many terms, including new ones added to the glossary or existing ones rewritten for this edition.

A distinctive feature of this text is a **prologue** for each chapter that highlights a theme or fact relating to the chapter. Some prologues present biological, particularly evolutionary, principles; those in Part Three on animal diversity illuminate distinguishing characteristics of the group presented in the chapter.

Chapter notes, which appear throughout the book, augment the text material and offer interesting sidelights without interrupting the narrative. We prepared many new notes for this edition and revised several existing notes.

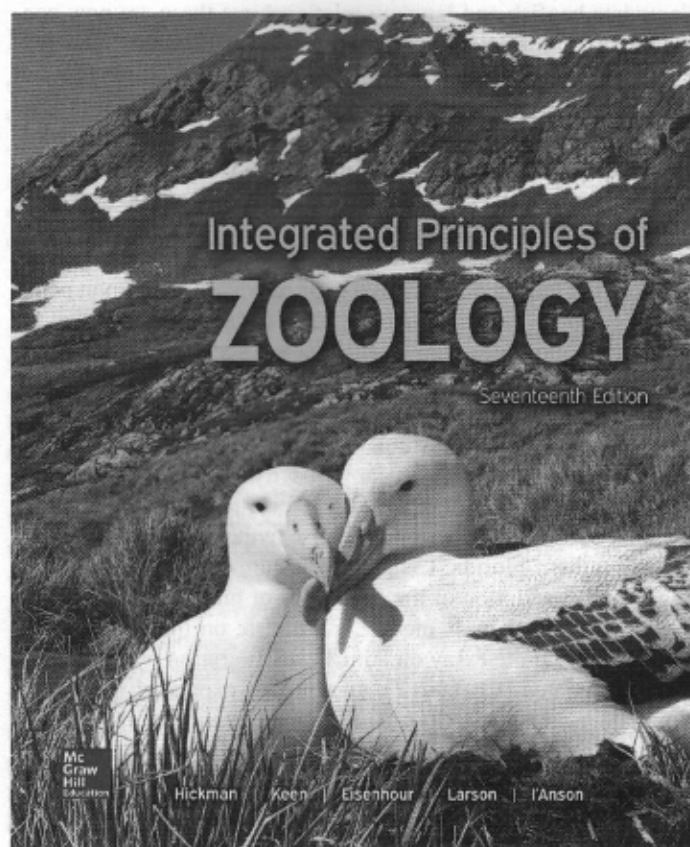
To assist students in chapter review, each chapter ends with a **concise summary**, a list of **review questions**, and **annotated selected references**. The review questions enable a student to self-test retention and understanding of the more important chapter material.

Again, William C. Ober and Claire W. Ober have strengthened the art program for this text with many new full-color paintings that replace older art, or that illustrate new material. Bill's artistic skills, knowledge of biology, and experience gained from an earlier career as a practicing physician have enriched this text through 10 of its 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. They are also recipients of the Art Directors Award.

For the Zoology Lab

Laboratory Studies in Integrated Principles of Zoology by Cleveland Hickman, Jr., Susan Keen, and Lee B. Kats

Now in its seventeenth edition, this lab manual was written to accompany *Integrated Principles of Zoology*, and can be easily adapted to fit a variety of course plans.



ACKNOWLEDGMENTS

The authors express their appreciation to the editors and support staff at McGraw-Hill Higher Education who made this project possible. Special thanks are due Justin Wyatt, Brand Manager, and Elizabeth Sievers, Lead Product Developer who were the driving forces in piloting this text throughout its development. Jessica Portz, Content Project Manager, somehow kept authors, text, art, and production programs on schedule. Lori Hancock oversaw the extensive photographic program and Tara McDermott managed the book's interior and cover design. We are indebted to them for their talents and dedication.

Although we make every effort to bring to you an error-free text, errors of many kinds inevitably find their way into a textbook of this scope and complexity. We will be grateful to readers who have comments or suggestions concerning content and send their remarks to Patrick Reidy, Executive Marketing Manager, at patrick.reidy@mheducation.com

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