



教育部高等教育司推荐
国外优秀生命科学教学用书

Zoology

动物生物学

影印版

Fifth Edition



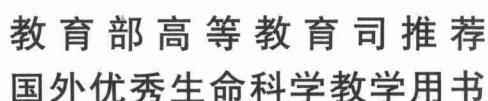
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• Stephen A. Miller

• John P. Harley



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Stephen A. Miller, John P. Harley

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出版前言

随着克隆羊的问世和人类基因组计划的完成,生命科学成为 21 世纪名副其实的领头学科,生物高新技术产业逐步成为高科技产业的核心。生物技术和生物产业的发展对世界科技、经济、政治和社会发展等方面产生着深刻的影响,这也是我国赶超世界发达国家生产力水平最有前途和希望的领域。生命科学与技术全方位的发展呼唤高等教育培养更多高水平的复合型科技人才。

为此,教育部在《关于加强高等学校本科教学工作 提高教学质量的若干意见》[教高(2001)4 号文件]中提出,高等学校要大力提倡编写、引进和使用先进教材,其中信息科学、生命科学等发展迅速、国际通用性强、可比性强的学科和专业可以直接引进先进的、能反映学科发展前沿的原版教材。教育部高等教育司还于 2001 年 11 月向全国主要大学和出版社下发了“关于开展‘国外生命科学类优秀教学用书’推荐工作的通知”,有力推动了生命科学类教材的引进工作。

高等教育出版社对国外生命科学教材进行了充分的调研,并委托教育部高等学校生物科学与工程教学指导委员会的专家教授开展了“引进国外优秀生命科学教材及其教学辅助材料专项研究”,并就国内外同类教材进行了比较,提出了具体的引进教材书目。经过版权谈判,目前我社已经购买了 Pearson Education, McGraw - Hill, John Wiley & Sons, Blackwell Science, Thomson Learning, Cambridge University Press, Lippincott Williams & Wilkins 等出版的 15 种教材的影印权,学科领域涉及植物学、动物学、生物化学、细胞生物学、遗传学、微生物学、生态学、免疫学、神经科学、发育生物学、解剖学与生理学、分子生物学、普通生物学等。这些教材具有以下特点:(1)所选教材基本是近 2 年出版的,及时反映了学科发展的最新进展,在国际上使用广泛,具有权威性和时代感;(2)内容简明,篇幅适中,结构合理,兼具一定的深度和广度,适用范围广;(3)插图精美、丰富,既有很强的艺术性,又不失严谨的科学性,图文并茂,与正文相辅相成;(4)语言简练、流畅,十分适合非英语国家的学生阅读。其中 11 种已入选教育部高等教育司推荐“国外优秀生命科学教学用书”。

考虑到中国国情,为了让学生买得起,同时又能让学生看到原版书彩色精美的插图,我们在引进学生用原版教材时,一方面采用黑白影印,最大限度地降低定价,另一方面随书附赠含有原书彩色插图的光盘,以充分体现原教材的风格、特色,为读者提供方便。

引进国外优秀生命科学教学用书是我社一项长期的重点工作,因此,我们衷心希望广大专家教授和同学提出宝贵的意见和建议,如有更好的教材值得引进,请与高等教育出版社生命科学分社联系,联系电话:010-58581438, E-mail 地址: lifescience@hep.com.cn。

高等教育出版社

2002 年 11 月

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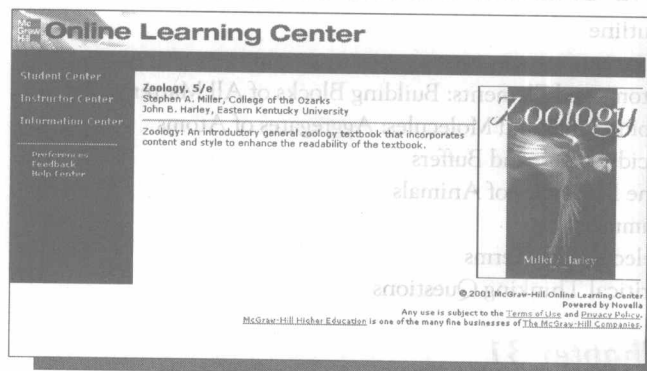
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Students: You'll appreciate extensive self-quizzing opportunities; interactive activities; and related web links in addition to the new Zoology Essential Study Partner—a web-based review of major zoology topics—hosted on this site.

Instructors: You'll want to take advantage of our many resources designed to help enrich your zoology curriculum—all available any time you want them.

Student Resources

- Key Terms Flashcards
- Animations with Quizzing
- Boxed Readings
- Suggested Readings
- Readings on Lesser-Known Invertebrates
- Zoology Essential Study Partner
- Cladistics Laboratory
- Additional Chapters:
 - 30: The Chemical Basis of Animal Life
 - 31: Energy and Enzymes: Life's Driving and Controlling Forces
 - 32: How Animals Harvest Energy Stored in Nutrients
 - 33: Embryology
 - 34: Animal Behavior
- Links to chapter-related websites



Instructor Resources

- Instructor's Manual
- Instructor's Resource Guide
- Digital Zoology PowerPoint Slides
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- Additional chapters not available in the text (see listing under "Student Resources")
- Links to chapter-related websites

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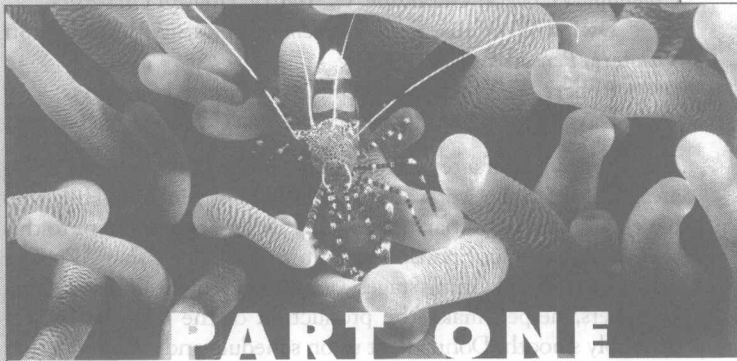
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GUIDED TOUR

The organization and features of this book have been planned with students' learning and comprehension in mind.

CHAPTER CONCEPTS

The concepts most important to the understanding of each chapter are highlighted on the first page of each chapter.



PART ONE

BIOLOGICAL PRINCIPLES

Animals are united with all other forms of life by the biological processes that they share with other organisms. Understanding these processes helps us to know how animals function and why animals are united with other forms of life from the evolutionary and ecological perspectives. Chapter 1 examines some of these unifying themes and sets the stage for the evolutionary and ecological perspectives that are developed throughout this book.

An understanding of the cell as the fundamental unit of life is key to understanding life on this planet. As you learn more about cell structure and function, you will find that many cellular components and processes are very similar in cells from a variety of organisms. One of the common functions of all cells is reproduction. Reproduction may involve individual cells within a multicellular organism, a single-celled organism, or the formation of single reproductive cells in multicellular organisms. The processes involved in cellular reproduction, and the processes involved in determining the characteristics of the new cells and organisms that are produced, are based on common biological themes. Chapters 2 and 3 present cell structure and inheritance as an important,

unifying framework within which biologists approach the diversity of organisms.

Principles of inheritance explain not only why offspring resemble their parents, but also why variation exists within populations. This variation is a key to understanding evolution. All organisms have an evolutionary history, and evolution helps us to understand the life-shaping experiences that all organisms share. Chapter 4 explores the work of pioneers of evolutionary theory, Charles Darwin and Alfred Russel Wallace, and how their work forms the nucleus for modern evolutionary theory. Chapter 5 examines the influence of modern genetics on evolutionary theory. This coverage of evolution will provide core knowledge for understanding the diversity of animal life presented in Part Two and how evolution has influenced the animal structure and function described in Part Three.

A fundamental unit of life also occurs at the environmental level. All animals are partners in the use of the earth's resources. Only by studying the interactions of organisms with one another and with their environment can we appreciate the need for preserving resources for all organisms. Chapter 6 presents basic ecological principles that everyone must understand if we are to preserve the animal kingdom.

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

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Chapter 8

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Chapter 12

Chapter 13

Chapter 14

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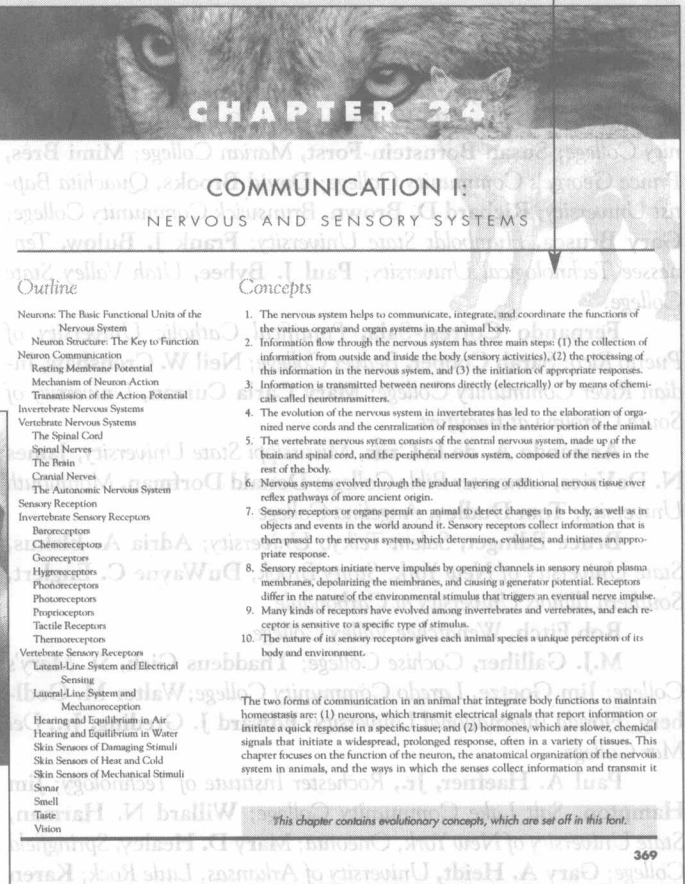
Chapter 20

Chapter 21

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Chapter 24



PART REVIEW

The three Parts of the text present an overview of the chapters within them, and also highlight important concepts and events within the chapters.

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ACKNOWLEDGMENTS

We wish to thank the reviewers who provided detailed analysis of the text during development. In the midst of their busy teaching and research schedules, they took time to read our manuscript and to offer constructive advice that greatly improved this fifth edition.

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The publication of a text requires the efforts of many people. We are grateful for the work of our colleagues at McGraw-Hill, who have shown extraordinary patience, skill, and commitment to this text. Marge Kemp, Sponsoring Editor, has helped shape *Zoology* from its earliest planning stages. Our Development Editor, Donna Nemmers, helped make the production of the fifth edition remarkably smooth. Donna kept us on schedule and the production moving in the plethora of directions that are nearly unimaginable to us. Kay Brimeyer served as our project manager. We are grateful for her skilled coordination of the many tasks involved with the publishing of this edition of *Zoology*.

Finally, but most importantly, we wish to extend appreciation to our families for their patience and encouragement. Janice A. Miller lived with this text through many months of planning and writing. She died suddenly 2 months before the first edition was released. Our wives, Carol A. Miller and Jane R. Harley, have been supportive throughout the revision process. We appreciate the sacrifices that our families have made during the writing and revision of this text. We dedicate this book to the memory of Jan, and to our families.

STEPHEN A. MILLER

JOHN P. HARLEY

WILDLIFE ALERT BOXES

These boxes feature issues related to endangered and threatened species of animals.

CRITICAL THINKING QUESTIONS

Students can synthesize the chapter information by applying it to the Critical Thinking Questions in each chapter.

172 PART TWO Animal-like Protists and Animals

SUMMARY

1. The aschelminths are seven phyla grouped for convenience. Most have a well-defined pseudocoelom, a constant number of body cells or nuclei (nuclei), protonephridia, and a complete digestive system with a well-developed pharynx. No organs are developed for gas exchange or circulation. A cuticle that may be molted covers the body. Only longitudinal muscles are often present in the body wall. The phylogenetic affinities among the seven phyla and with other phyla are uncertain.
2. The majority of rotifers inhabit freshwater. The head of these animals bears a unique ciliated corona used for locomotion and food capture. Males are smaller than females and unknown in some species. Females may develop parthenogenetically.
3. Kinorhyncha are minute worms living in marine habitats. Their bodies are comprised of 13 somites, which have cuticular scales, plates, and spines.
4. Nematodes live in aquatic and terrestrial environments. Many are parasitic and of medical and agricultural importance. They are all elongate, slender, and circular in cross section. Two sexes are present.
5. Nematodes are the most diverse and free-living in freshwater. They lack a digestive system.
6. Acanthocephalans are also known as spiny-headed worms because of their spiny proboscis. All are endoparasites in vertebrates.
7. The phylum Loricifera was described in 1983. These microscopic animals have a spiny head and thorax, and they live in gravel in marine environments.
8. The phylum Priapulida contains only 16 known species of cucumber-shaped, wormlike animals that live buried in the bottom sand and mud in marine habitats.

SELECTED KEY TERMS

amictic egg (p. 161)
aschelminths (p. 157)
corona (p. 159)
cuticle (p. 159)

metastax (p. 160)
mictic eggs (p. 161)
trichostema (p. 166)
somites (p. 162)

CRITICAL THINKING QUESTIONS

1. Discuss how the structure of the body wall places limitations on shape changes in nematodes.
2. What characteristics set the Nematomorpha apart from the Nematoda? What characteristics do the Nematomorpha share with the Nematoda?
3. In what respects are the kinorhynchids like nematodes? How are they like rotifers?
4. How are nematodes related to the rotifers?
5. What environmental factors appear to trigger the production of mictic females in monogonont rotifers?

ONLINE LEARNING CENTER

Visit our Online Learning Center (OLC) at www.mhhe.com/zoology (click on this book's title) to find the following chapter-related materials:

- CHAPTER QUIZZING
- RELATED WEB LINKS
 - Phylum Rotifera
 - Phylum Kinorhyncha
 - Phylum Loricifera
 - Phylum Priapulida
 - Phylum Nematoda
 - Human Diseases Caused by Nematodes
 - Canorhynchids digms
 - Phylum Nematomorpha
 - Phylum Acanthocephala
- BOXED READINGS ON
 - An Application of Eutely
 - The Ecology of Soil Nematodes
- SUGGESTED READINGS
- LAB CORRELATIONS

Check out the OLC to find specific information on these related lab exercises in the *General Zoology Laboratory Manual*, 5th edition, by Stephen A. Miller.

Exercise 12 The Pseudocoelomate Body Plan: Aschelminths

CHAPTER 11 The Pseudocoelomate Body Plan: Aschelminths

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WILDLIFE ALERT

Indiana Bat (*Myotis sodalis*)

VITAL STATISTICS

Classification: Phylum Chordata, class Mammalia, order Chiroptera, family Vespertilionidae

Range: Midwest and eastern United States

Habitat: Limestone caves are used for winter hibernation; summer habitat data are scarce but include under bridges, in old buildings, under bark, and in hollow trees

Number remaining: 500,000

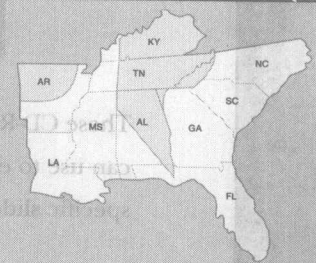
Status: Endangered throughout its range

NATURAL HISTORY AND ECOLOGICAL STATUS

The Indiana bat (also called the Indiana myotis *myotis* refers to the mouse-eared bat) is a medium-sized bat with dull gray to chestnut-colored fur (box figure 1). The bat's underparts are pinkish to cinnamon-colored. Little is known of the bat's diet beyond the fact that it consists of insects. Families and juveniles forage in the airspace near the foliage of riverbank and floodplain trees. Males usually forage in densely wooded areas at treetop height.

The Indiana bat lives in the Midwest and in the eastern United States, from the western edge of the Ozark region in Arkansas, throughout Kentucky, Tennessee, most of Alabama, and as far south as northern Florida (box figure 2). In summer, it is absent south of Tennessee; in winter, it is absent from Michigan, Ohio, and northern Indiana, where suitable habitats (caves and mines) are unknown.

The Indiana bat's breeding period is during the first 10 days of October. Mating takes place at night on the ceilings of large rooms



BOX FIGURE 2 Distribution of the Indiana Bat (*Myotis sodalis*)

near cave entrances. Hibernating colonies disperse in late March, and most of the bats migrate to more northern habitats for the summer. However, some males remain in the hibernating area during this period and wander from cave to cave. Birth occurs in June in widely scattered colonies consisting of about 25 females and their young. Each female bears a single offspring. The young require 25 to 37 days to develop to the flying stage and to feed independently.

Migration to the wintering caves usually begins in August. The bats replace depleted fat reserves from the migration during September. Feeding then declines until mid-November, when the population enters a state of hibernation. The hibernating bats form large, compact clusters. Each individual hangs by its feet from the ceiling. Every 8 to 10 days, hibernating individuals awaken to spend an hour or more flying about before returning to hibernation.

The bats prefer limestone caves with an average temperature of 37°C and a relative humidity around 87% for hibernation.

The decline of the Indiana bat is attributed to commercialization of nesting caves, wanton destruction by vandals, disturbances caused by increased numbers of spelunkers and bat banding programs, the use of bats as laboratory animals, and possibly, insecticide poisoning.

To date, primary conservation efforts have focused on installing gates across cave entrances to control access. Some gating has already been accomplished on federal and state lands. Gating of all seven of the major wintering habitats would protect about 87% of the Indiana bat population. The National Zoological Society and the American Society of Mammalogists are working together to preserve this species of bat.



FIGURE 1 Indiana Bat (*Myotis sodalis*)

ONLINE LEARNING CENTER

The Online Learning Center hosts specific study tools for each chapter, which are summarized at the end of each text chapter.

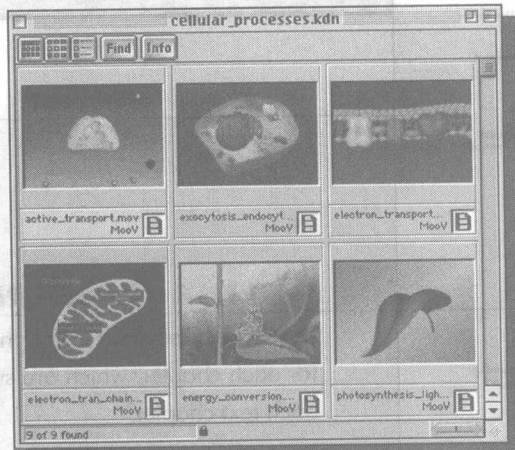
KEY TERMS

The most important terms from each chapter are linked to their page of definition in the text, for further study.

Visual Resource Library CD-ROMs

These CD-ROMs are electronic libraries of educational presentation resources that instructors can use to enhance their lectures. View, sort, search, and print catalog images, play chapter-specific slideshows using PowerPoint, or create customized presentations when you:

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Zoology Visual Resource Library CD-ROM

This helpful CD-ROM contains 1,000 photographs and illustrations from four McGraw-Hill zoology texts. You'll be able to create interesting multimedia presentations with the use of these images, and students will have the ability to easily access the same images in their texts to later review the content covered in class.

Life Science Animations Visual Resource Library CD-ROM

This instructor's tool, containing more than 125 animations of important biological concepts and processes, is perfect to support your lecture. The animations contained in this library are not limited to subjects covered in the text, but include an expansion of general life science topics.

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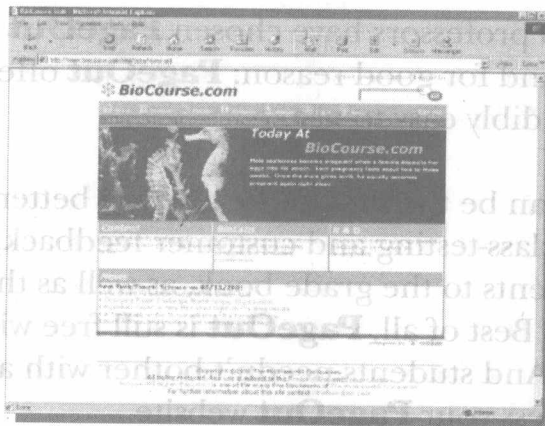


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BioCourse.com is an electronic meeting place for students and instructors. It provides a comprehensive set of resources in one place that is up-to-date and easy to navigate. You can access **BioCourse.com** from any of the Online Learning Centers.



Here is what you will find at BioCourse.com:

Faculty Club is an array of information and links to related sites for instructors.

Resources that you will find include:

- Teaching tips and basic information on pedagogy, assessment, etc.
- Suggestions for classroom and lecture activities.
- Reference searches and literature for faculty.
- Presentation tools.
- Test bank.
- Help for new instructors and teaching assistants.
- Information on available jobs, grantwriting, and available funding.
- Case studies.

Student Center contains a wide range of materials to help biology students improve their study skills and achieve success in college and beyond. Examples of materials that will be available:

- Study aids.
- Résumé writing and information on jobs and internships.
- Graduate school options.
- Information for MCAT and other tests.
- Links to content websites by topic.

Briefing Room offers instructors and students up-to-date news articles, a selection of background readings, and links to journal search tools and biology magazines. Users can e-mail articles to others, link to search engines, and read primary sources online.

BioLabs feature materials for lab students and instructors. Some tools you will find include:

For students:

- Dissection techniques.
- Equipment tutorials.
- Safety and setup procedures.

For instructors:

- Lab preparations.
- Lab support.
- Simulations.

The Quad is a powerful indexing tool and hierarchical outline of content resources for searching by students and faculty. Users can search by topic through a "content warehouse" featuring text material, activities, visuals, and animations to learn more about a selected topic.

R & D Center features our newest simulations, animations, and other teaching and learning tools. This portion of our site will allow faculty members and students to try out our materials as they are being developed.

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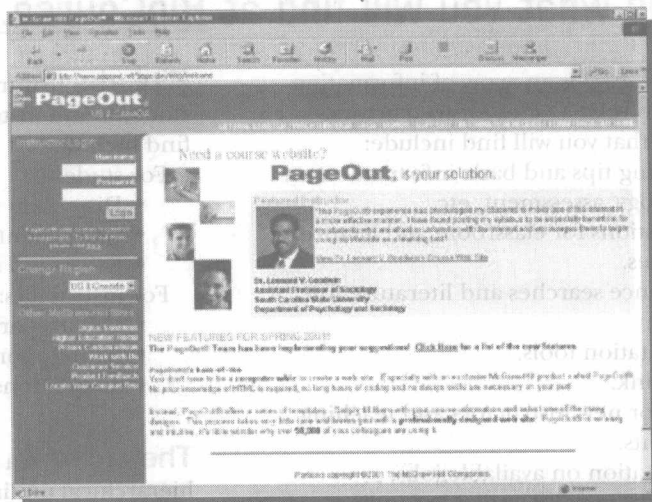
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now greatly enhanced with the availability of both online and printed resources. As a part of the fifth edition revision, chapters on cell chemistry, energy and enzymes, embryology, and animal behavior—along with numerous boxed readings and pedagogical elements—have been moved to the Online Learning Center. This content-rich website is located at www.mhhe.com/zoology—just click on this book's title.

ONLINE LEARNING CENTER

Both instructors and students can take advantage of numerous teaching and learning aids within this book's Online Learning Center.

Instructor Resources

- Instructor's Manual
- Laboratory Resource Guide
- Zoology Visual Resource Library (VRL), containing 1,000 images for classroom presentation
- PowerPoint Lecture Slides

Student and Instructor Resources

- Interactive Cladistics Laboratory
- Chapters on:
 - Chapter 30: The Chemical Basis of Animal Life
 - Chapter 31: Energy and Enzymes: Life's Driving and Controlling Forces
 - Chapter 32: How Animals Harvest Energy Stored in Nutrients
 - Chapter 33: Embryology
 - Chapter 34: Animal Behavior
- Boxed Readings
- Suggested Readings
- Readings on Lesser-Known Invertebrates
- Quizzing
- Key Terms Flashcards
- Zoology Essential Study Partner (ESP)
- Animations
- Free Zoology Screen Saver

All of these tools, and even more, are available to you with this text. To access these resources, go to www.mhhe.com/zoology and click on the title of this book. (Also, see pages xvi–xx for more details.)

OTHER RESOURCES

The following items may accompany *Zoology*. Please consult your McGraw-Hill representative for policies, prices, and availability as some restrictions may apply.

- **An Instructor's Manual**, prepared by Jane Aloi Horlings, is available for instructors within the Online Learning Center. It provides examples of lecture/reading schedules for courses with various emphases. In addition, each chapter contains a detailed outline, purpose, objectives, key terms, summary, resources for audiovisual materials and computer software.

- A **Zoology Test Item File** is also available for instructors. This contains approximately 50 multiple-choice questions for each chapter.
- **General Zoology Study Guide**, prepared by Jane Aloi and Gina Erickson, contains subject-by-subject summaries, questions, and learning activities.
- A set of 100 full-color acetate **transparencies** is available to supplement classroom lectures.
- **General Zoology Laboratory Manual**, fifth edition, by Stephen A. Miller, is an excellent corollary to the text and incorporates many learning aids. This edition includes new illustrations and photographs, plus activities on scientific method, cladistics, ecological and evolutionary principles, and animal structure and function. A **Laboratory Resource Guide**, available within the Online Learning Center, provides information about materials and procedures, and answers to worksheet questions that accompany the lab exercises.
- **Digital Zoology** is a new and exciting interactive product designed to help you to make the most of your zoology classes and laboratory sessions. This program contains interactive cladograms, laboratory modules, video, interactive quizzes, hundreds of photographs, a full glossary, and much detailed information about the diversity and evolution of the animals that we find on the planet. To find out the latest news on this ever-expanding product, log on to www.mhhe.com/digitalzoology and find out how to get your copy.
- The **Zoology Visual Resource Library** is a dual-platform CD-ROM that allows instructors to search with key words or terms and access 1,000 images to illustrate classroom lectures, with just the click of a mouse. It contains images from four McGraw-Hill textbooks in the zoology field.
- Available through the **Zoology Online Learning Center**, the **Zoology Essential Study Partner** is a complete, interactive study tool offering animations and learning activities to help students understand complex zoology concepts. This valuable resource also includes self-quizzing to help students review each topic.
- **BioCourse.com** is an electronic meeting place for students and instructors. Its breadth and depth go beyond our Online Learning Center to offer six major areas of up-to-date and relevant information: Faculty Club, Student Center, News Briefing Room, BioLabs, Lifelong Learning Warehouse, and R & D Center.
- **PageOut®** is the solution for professors who need to build a course website. The following features are now available to professors:
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- Short on time? Let us do the work. Our McGraw-Hill service team is ready to build your PageOut website, and

PREFACE

The planning for the first edition of *Zoology* began in the late 1980s at a time when instructors and their students had few options in the choice of a general zoology textbook. In the first four editions of *Zoology*, we have tried to present zoology as an exciting and dynamic scientific field. We have made very deliberate choices in content and style to enhance the readability of the textbook, realizing that authority and detail of content are of little consequence if students find the book difficult to use. Many of these choices have been challenging, and the labor involved has at times been exhausting. With each edition we have received student and instructor feedback that has confirmed our approach and rewarded our efforts. We believe that the decisions we, and our colleagues at McGraw-Hill, have made have largely been the right decisions. This is why we are privileged to have a fifth edition of *Zoology* in your hands, while other books have not survived the rigors of “textbook selection.”

Our goals in preparing the fifth edition of *Zoology* were the same as in previous editions. We prepared an introductory general zoology textbook that we believe is manageable in size and adaptable to a variety of course formats. We have retained the friendly, informative writing style that has attracted instructors and students through the first four editions. Users of the fourth edition will quickly notice that the fifth edition of *Zoology* is 200 pages shorter. This change is in response to user requests for a text that is less expensive and more useful in one-semester course formats. Course sequences at many colleges and universities dictate that biological principles are taught in general biology courses rather than general zoology courses. All of these factors were carefully considered in the revision of this latest edition of *Zoology*.

CONTENT AND ORGANIZATION

We have retained the evolutionary and ecological focus of *Zoology*, believing that these perspectives captivate students and are fundamental to understanding the unifying principles of zoology and the remarkable diversity within the animal kingdom. We have enhanced the ecological perspective by expanding the use of “Wildlife Alerts,” which we included in a limited fashion in the fourth edition. Wildlife Alerts are now incorporated into each of the first 22 chapters of the book, and feature some issues related to endangered and threatened species of animals. In most cases, these readings depict the plight of a selected animal species. In other cases, they depict broader ecosystem issues, or questions related to preserving genetic diversity within species. In all cases, the purpose of these Wildlife Alerts is to increase student awareness of the need to preserve animal habits and species.

Zoology is organized into three parts. Part One covers the common life processes, including cell and tissue structure and function, the genetic basis of evolution, and the evolutionary and ecological principles that unify all life.

Part Two is the survey of animals, emphasizing evolutionary and ecological relationships, aspects of animal organization that unite major animal phyla, and animal adaptations. All of the chapters in Part Two have been carefully updated, including new examples and photographs. The coverage of animal classification and organization in Chapter 7 has been expanded from previous editions to include more background on cladistics and enhanced coverage of protostome/deuterostome relationships. As in previous editions, the remaining survey chapters (8–22) include cladograms to depict evolutionary relationships, full-color artwork and photographs, and lists of phylum characteristics.

Part Three covers animal form and function using a comparative approach. This approach includes descriptions and full-color artwork that depict the evolutionary changes in the structure and function of selected organ systems. Part Three includes an appropriate balance between invertebrate and vertebrate descriptions.

NEW TO THE FIFTH EDITION

- “Wildlife Alert” boxes now appear in all of the survey chapters, including many that are new to the 5th edition. Most of these readings feature a particular species, but some feature a larger ecosystem concern.
- Chapter 1 has been revised to focus on the evolutionary and ecological emphasis of the book.
- Instead of beginning Chapter 3 with classical (Mendelian) genetics, we begin with molecular genetics and explain classical genetics in terms of DNA structure and function. The concept of dominance is explained in molecular terms.
- Chapter 4 now begins with a discussion of evidence of evolution, to help students relate the evidence to the process.
- A section on “Higher Animal Taxonomy” is now included in Chapter 7, including a new table of higher taxonomic groupings, based on the latest information from cladistic analyses of the animal kingdom.
- Chapter 18 contains new information from molecular and cladistic studies on the origin of vertebrates and the relationship of vertebrates to other chordates. New information is also presented on the evolution of terrestriality in vertebrates.
- Chapter 19 contains a new section covering amphibians in peril, exploring possible reasons that amphibians around the world are declining at an alarming rate.

SUPPLEMENTARY MATERIALS

Supplementary materials are available to assist instructors with their presentations and general course management, to augment students’ learning opportunities. The usefulness of these supplements is

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*This chapter is available at www.mhhe.com/zoology (click on this book's cover).

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