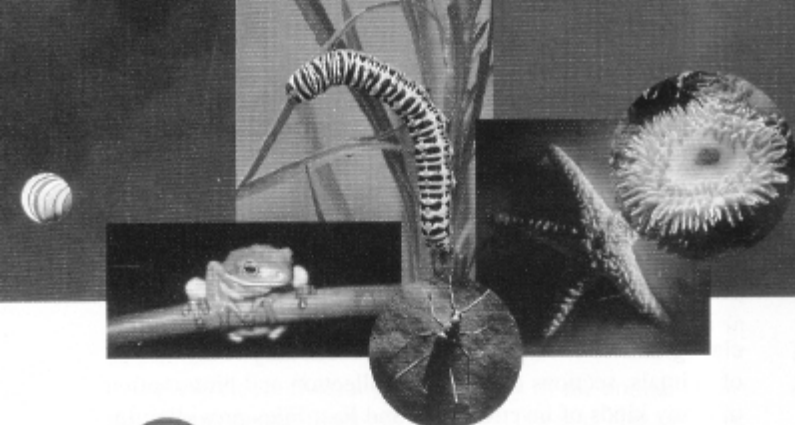




Preface

Our knowledge of animals and animal life has advanced rapidly in recent years due to the availability of new research methods and changing priorities for research. Increased appreciation for the importance of biodiversity and the challenges of environmental changes has stimulated new studies of animal ecology and behavior; discoveries of medically important compounds in marine animals have led to further investigations of biologically active compounds in a variety of invertebrates; and new biochemical and genetic techniques have provided new insights into the evolutionary relationships of animals. Major changes have been made in the classification of many groups of animals as a result of systematic studies. It is an exciting time to study zoology, and students should find zoology to be an interesting and rewarding subject.

It is important to remember that our knowledge of zoology, as of all science, is cumulative and builds on the work of previous scientists. Our understanding of animals and the processes by which they live is continuously changing as we gain new information from research. As additional knowledge is obtained, prior findings are confirmed, refuted, or revised as needed to reflect our current understanding. Since knowledge continues to be added, science is an ever-changing status report. We need always to keep our minds open for further change as new evidence is obtained and evaluated.

Zoology is the study of the evolution, classification, structure, and function of animals and how they live and interact with their environment. A good working knowledge of basic zoology is essential to understand the biology of animals. A solid foundation in the structure, function, and diversity of animals is critical for understanding the central issues in biology, such as the molecular mechanisms of cellular structure and function, mathematical analyses and modeling of animal processes, and the functioning of the nervous system.

Meaningful laboratory experiences are a vital part of learning zoology, and this book is designed to facilitate laboratory study of selected animals. In the laboratory, students learn the importance of careful observation, of following specific instructions, and of seeing relationships of structure and function. By carrying out well-designed scientific observations and

experiments in the laboratory, students learn to **do** science instead of merely listening to someone **talk** about science.

In writing this book, we have tried to remember our own days as students and the kinds of questions we had while studying various kinds of animals for the first time. We have attempted to provide descriptions, illustrations, and appropriate guidance for meaningful laboratory study of animals. Although we agree with the spirit of Louis Agassiz' admonition, "Study nature, not books," we believe that students can benefit most in their study of nature when guided by a good instructor and aided by appropriate instructions and illustrations.

We can remember some of our own frustrations in zoology labs when we attempted to follow some vague verbal description of anatomical structures with no illustrations or other visual aids to help us locate important structures or to give us some appropriate orientation. We have written the exercises in this book with the intention of reducing such frustration and with the intention of making student experiences in the zoology laboratory interesting, rewarding, and meaningful.

We continue to emphasize the study of living and anesthetized animals whenever feasible because students should learn that zoology is the study of animal life rather than the study of dead animals. Live animals give students the opportunity to observe and experiment with behavior and to do simple physiological experiments as well as to see the natural color and texture of body parts. Preserved specimens serve well for many anatomical studies, but students should always have the opportunity to observe and to work with living animals whenever possible. Few of us would choose a stuffed or embalmed dog or cat for a pet if given the option.

This book is written to aid students and teachers in many colleges and universities operating with different schedules, resources, and preferences, so we have intentionally included more material than can reasonably be covered in the time available in a two-semester general zoology course. We expect instructors to select those parts of the guide and those animals they deem most appropriate for their own classes. With judicious selection of chapters and of animal types, this book can also be used for one-semester and one-quarter zoology classes.



Changes in This Edition

Major revisions in the fifteenth edition include the addition of a new chapter on Systematics and Morphology (Chapter 5) and extensive revisions of Chapter 6, Animal-like Protista: Protozoa, and Chapter 13, Arthropoda. These revisions reflect the results of recent research, changes in classification, and new insights into evolutionary relationships. All chapters have been updated to reflect studies of cellular function, molecular biology, ecology, physiology, and systematics.

A new Chapter 5 is based on recent use of new biochemical and genetic techniques that have led to new interpretations of the evolutionary relationships of animal phyla and classes. This is a rapidly moving field and the chapter includes an overview of basic animal morphology to provide a holistic perspective for the understanding of structure and function related to the evolution of animals.

New illustrations have been added in nearly every chapter, including more than two dozen new photographs and drawings. Several new color photographs of animals in natural habitats, diagrams of the life cycles of some invertebrates, and improved Questions for Critical Thinking have been added to stimulate student interest and analysis. We hope you find these changes helpful in your studies.



Basic Features of This Manual

In this edition we have continued the basic organization and pedagogical features of the previous edition. Important pedagogical features of the book include **boldface headings** within each chapter to indicate the major divisions of each exercise.

We also use **boldface** in the text to identify important terms (ideas, structures, processes) that students should remember and understand. The most important of these boldface terms are included in the list of **key terms** at the end of the chapter in which they are first introduced.

Several chapters provide space for students to add their own drawings of particular animals or structures to aid them in learning and remembering things observed during their laboratory study. The book also provides several blank tables and pages of graph paper for students to record and plot data from their laboratory observations and experiments.

Each chapter begins with a list of specific **objectives** that identifies important principles, concepts, and facts that students should learn as a result of their laboratory study. We have found that a specific list of laboratory objectives helps students focus their attention on the important material in each lab. We also suggest that instructors modify and add to these lists of objectives as appropriate for their own classes. Such lists of objectives can be most helpful in ensuring that students understand what they will be tested on and that the tests actually focus on students' understanding of the important principles, concepts, and processes.

Most chapters in this book start with a brief **introduction** with pertinent background material to help orient students for the exercises to follow. A **materials list** is provided showing the specimens and other materials needed for each exercise. Most chapters have one or more lists of suggested **demonstrations**, which are suggested to supplement the main studies of each exercise.

Other important features in many chapters include cladograms to illustrate possible evolutionary relationships of animals, sections on the field collection and preservation of many kinds of invertebrates, and Fact Files providing interesting information about various species and groups of animals. For instance, did you know that fossil shells of some molluscs can provide important clues to the climatic conditions of ancient times?

Within each chapter, student-directed questions have been placed in boldface type to trigger students to stop and think about the animal structure or procedure being discussed.

At the end of each chapter is a list of **key terms** introduced in that chapter, as well as Internet Resources and Suggested Readings for further study. Each chapter also ends with a list of **Questions for Critical Thinking** to help students review the important concepts and processes of the chapter. Most chapters also have blank space provided for students to add their own notes and sketches. If students use these pages to record their observations, they will have a consolidated record of their laboratory work bound in a single place instead of a scattered bunch of papers and drawings likely to be lost.

We have tried to make this laboratory manual a convenient, user-friendly companion for laboratory study. We hope every student has as much fun and satisfaction in zoology lab as we have had.



Anatomy Videos

From our many years of teaching zoology laboratories, we have learned that it is very helpful to give students an overview of the anatomy of an animal to be studied and/or dissected before they undertake the anatomical study on an actual specimen themselves. It's a lot like football players viewing game films before facing a major rival football team. They might do all right without knowing what kinds of plays the opposition typically runs and who their key players are, but they are not likely to win the championship without some good scouting information.

An excellent way to prepare for a serious anatomical study of an animal is to view a good video of the anatomy of that animal prior to beginning work with an actual specimen. Such preparation for the lab study gives students a better perspective and orientation and greatly increases their confidence. It also aids in their identification of anatomical structures, facilitates their recognition of relationships among various organs, and assists them in relating structure and function. Good videos also help students review their laboratory

work in preparation for a test and in comparing the anatomy of different animals.

We have collaborated with the staff of Carolina Biological Supply Company in the development of a series of videos specifically designed to aid in the study of nine of the more complex animals included in this manual. These videos illustrate the anatomy and dissection of these nine animals and parallel the descriptions of those animals in this book.

Each video illustrates the anatomy of the animal in detail, discusses the functions of various organs and systems, and demonstrates good dissection techniques. Each video is divided into sections according to organ system so that each system can be located easily and viewed separately if desired. Several of the longer videos are too long to be productively viewed in a single session.

The videos are available on VHS cassettes or DVDs from Carolina Biological Supply Company, 2700 York Road, Burlington, North Carolina, 27215. The videos and the corresponding chapters in this manual containing the exercises for the study of these animals are listed in the following table.



Acknowledgments

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Mark Blackmore, *Valdosta State University*
William Rogers, *Winthrop University*
Barry Campbell, *Delta State University*
Gary Hunt, *Tulsa Community College*
Brian Butterfield, *Freed-Hardeman University*

Chapter	Video	DVD
11. Mollusca	The Anatomy of the Freshwater Mussel (49-2365V)	492365D
12. Annelida	The Anatomy of the Earthworm (49-2372V)	492372D
13. Arthropoda	The Anatomy of the Crayfish (49-2403V)	492403D
	The Anatomy of the Grasshopper (49-2404V)	492404D
14. Echinodermata	The Anatomy of the Starfish (49-2369V)	492369D
16. Shark Anatomy	The Anatomy of the Shark (49-2655V)	492655D
17. Perch Anatomy	The Anatomy of the Perch (49-2662V)	492662D
18. Frog Anatomy	The Anatomy of the Frog (49-2704V)	492704A
19. Fetal Pig Anatomy	The Anatomy of the Fetal Pig (49-3075V)	493075A