

Preface

Hands-on Engagement

One of the most effective ways to master a subject and make it one's own is to meet it directly by hands-on engagement. A laboratory accompanying a course in comparative vertebrate anatomy provides this direct, practical experience. Students are encouraged to become active participants in their own mastery of vertebrate design. Although there is no single "vertebrate morphology" and no single way to run a laboratory, a course in vertebrate anatomy includes modern expectations in a discipline that should be a centerpiece of a university curriculum in organismal biology. First and foremost, the basic animal architecture—the anatomy—should be understood in a clear and concise way. Second, the significance of the discovered anatomy must be considered, beyond the business of putting names on parts.

The anatomy raises questions about how the systems work and holds clues to the remarkable story of how vertebrates evolved. An understanding of these form-and-function relationships and the evolutionary history gives meaning and significance to the structure that is studied. With this philosophy in mind, we have prepared a laboratory dissection guide that sets the foundations and the tone for instructors who wish to provide a challenging laboratory course.

Learning and Instructional Aids

We have prepared a richly illustrated laboratory manual that carefully guides students through dissections. Throughout the dissections, we pause strategically to bring the students' attention to the significance of the material they have just covered. Further, we have organized this laboratory guide to make clear to students how the text is used and to connect the dissections found here to related material in the textbook

*Vertebrates: Comparative
Anatomy, Function, Evolution, Eighth edition, by
Kenneth Kardong*

For the Instructor

- **Flexibility of Use**—In most chapters, instructors will find a depth of coverage that is sufficient for a traditional course, yet structured to allow less detailed coverage where desired, thereby providing the flexibility you may need. You can mix and match. Chapters are written to permit flexibility in the course sequence. Each chapter can be studied as a distinct unit, which gives instructors the flexibility to build

a laboratory that suits their needs. However, we believe the sequence of chapters in this laboratory guide is a reasonable compromise of practical and conceptual goals. For example, chapter 2 on protochordates introduces the historical background to the vertebrates. We have placed the examination of external anatomy just before the muscular systems, since most laboratories begin with "dry" material, then move later to "wet" preserved specimens. Dragging out wet, preserved cat, shark, *Necturus*, or other vertebrates during the first days of a course is much less convenient. Instead, bringing these preserved animals out just prior to the muscle dissections is an economical use of the instructor's time and makes a nice transition from dry to wet dissections for students.

- **Integration**—This laboratory manual, a self-contained guide to dissection of representative vertebrates, is designed to stand alone. However, many classrooms will be using the textbook *Vertebrates: Comparative Anatomy, Function, Evolution*, Eighth edition, by Kenneth Kardong. Users of the Kardong textbook may take note of these icons , which are cross-references from the dissection guide to supporting pages in the textbook. Their purpose is to integrate the laboratory with the lecture and the hands-on identification of anatomical parts with the functional and evolutionary significance of the discovered morphology. This is intended to reinforce our overall philosophy of getting students to think critically about the material, thereby increasing the usefulness of the textbook and the dissection guide.
- **Companion Website (www.mhhe.com/kardong8e)**—This dissection manual remains a centerpiece of the study of vertebrate architecture, addressing our first goal of providing a clear and concise guide to the examination of vertebrate anatomy. But students benefit from other activities that engage them further in thinking about the function and evolution of vertebrate systems. On our website, we provide functional labs, laboratory exercises that you can use as supplements or to extend the study of functional and evolutionary aspects of the anatomical material addressed in the laboratories. We have tested these activities in our courses and found students engaged in and appreciative of the connections between the laboratories and lectures. These functional and evolutionary laboratory exercises are organized with current ideas of instructional pedagogy in mind. Each exercise steps the student through an inquiry

system, building step by step, and concluding with insight into the functions and/or evolution of the anatomy examined in lab. Instructors facilitate and students engage in these critical thinking supplements.

In addition to the supplemental labs, you will find images from the eighth edition of Kenneth Kardong's *Vertebrates: Comparative Anatomy, Function, Evolution* on the website, ready for use in your course.

For the Student

For you as a student, perhaps coming to this subject for the first time, we have provided a variety of special features designed to support your efforts. If you use these resources and let them work on your behalf, it will greatly aid not only your work in the laboratory but also in the lecture part of the course. Here they are:

- **Integrated Illustrations**—The written descriptions that guide you through the dissections are accompanied by high-quality and informative figures. You will work through the written text to discover the anatomical parts for yourself, but the integrated figures allow you to do so in an efficient and economical manner. We are especially pleased with the depictions of usually difficult soft-tissue systems that appear throughout the dissection guide. The animals are posed in more helpful orientations that clarify different points in the dissection.
- **Student Art Notebook**—This icon beside a figure in the laboratory manual indicates that the figure is included in the Student Art Notebook, which is at the end of the manual. To facilitate the review of anatomical structures, the labels of these figures have been replaced with numbers referenced to a key, which is located on the same page as the art or on the facing page. The art notebook figures can also be removed to place homologous systems of various animals next to each other for easy comparison. This invites you to think in terms of comparison from group to group and to think of the evolutionary changes these representative animals help to illustrate.
- **Boxed Essays**—"Patterns & Connections" and "Form & Function" boxes invite consideration of the larger implications of the anatomy, moving from dissection to the significance. What is the functional significance of the positions, patterns, shapes, and interrelationships of the anatomy under dissection? What might this suggest about the evolution of characters that define derived groups of vertebrates? These questions help correlate the laboratory exercises with the lectures.



- **Design and Organization**—The text is organized to be accessible and to provide clear direction about what you are to do.
- **General Introduction**—To understand the context in which the dissections are undertaken, each chapter and some chapter sections begin with a general introduction to the anatomy. With this introduction, the text then carefully guides you through the material, using precise anatomical terminology to verify identifications.
- **Dissection Directions**—To distinguish between the background text and specific dissection directions, the dissection directions are set off with an icon and indentation from the textual narrative.
- **Keyed Terminology**—Anatomical terms and nomenclature are differentiated so that the student may easily refer to them. The anatomical structures that are feasible to locate are in **boldface**; important conceptual terms are in *italics*. A **Glossary** at the end of the dissection guide is a reference for quick review of some of these terms.
- **Relevant Roots**—Each chapter contains a list of word roots used in terminology in that chapter. Understanding the meaning of word roots allows us to predict the meaning of new terms.
- **Synonyms**—Common synonyms are indicated in parentheses.

New to This Edition

This latest edition of our laboratory manual incorporates valuable suggestions of expert reviewers and our students who use and edit the manual as we use it in our laboratories. For greatest clarity and accuracy, we have reformatted some of the illustrations, edited labeling, and rewritten anatomical descriptions. In addition, we have made the following changes.

- Added "Relevant Roots" boxes to every chapter to help students understand the word roots used most often in each chapter.
- Added a Master List of all Relevant Roots at the end of the lab manual for additional reference.
- Extensively updated chapters 2 and 3 to reflect our current understanding of basal chordates.
- The laboratory manual has been updated to direct students to related sections of the new eighth edition of the companion textbook *Vertebrates: Comparative Anatomy, Function, Evolution*, by Kenneth Kardong.