


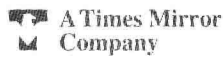
Anatomy & Physiology

The background of the cover is a photograph of a group of students in a laboratory or classroom. They are wearing orange and black striped lab coats and are gathered around a table, working with various pieces of equipment, possibly microscopes or sensors. The lighting is dim, with the students' lab coats providing a strong contrast.

THIRD EDITION

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Preface

Human anatomy and physiology courses present tremendous challenges to both students and teachers. Acquisition of basic anatomical and physiological facts is essential to the study of anatomy and physiology, but it is also important for students to develop the ability to solve practical, real-life problems related to the knowledge they have acquired. It is impossible to memorize all of the body's responses to all possible situations. Students who have accumulated background knowledge and who are prepared to reason effectively can accurately anticipate responses to new situations and are better prepared to be effective citizens and health care professionals.

Like the first and second editions, the third edition of *Anatomy and Physiology* is designed to help students learn basic anatomy and physiology. Information is presented in a readable form that seeks to explain concepts so that they may be truly understood rather than simply memorized. Relationships and some applications are explained to help students remember and understand concepts. When teaching beginning students, it is important not to obscure the "big picture" with an overwhelming deluge of detail. It is also important to provide enough pieces of information to allow the students to solve basic problems. It was our goal to present basic content at an appropriate level and in a way that supports the development of problem-solving skills.

Anatomy and Physiology compares very favorably to other excellent texts in respect to presentation of content, but it is unique in its approach to the development of problem-solving skills. The third edition provides the instructor with a great deal of flexibility. It can be used very successfully in the numerous courses that focus primarily on content and learning of new vocabulary. The third edition can also provide a gentle introduction to problem-solving techniques that can be emphasized to a greater extent as students progress through the course. Finally, it can be used for courses that strongly emphasize the development of problem-solving skills.

THEMES

We have chosen to emphasize the following two major themes throughout this text: *The Relationship between Structure and Function* and *Homeostasis*.

Just as the structure of a hammer makes it well suited for the function of pounding nails, the forms of specific cells, tissues, and organs within the body allow them to perform specific functions effectively. For example, muscle cells contain proteins that make contraction possible, and bone cells surround themselves with a mineralized matrix that provides strength and support. Knowledge of structure and function relationships makes it easier to understand anatomy and physiology and greatly enhances one's appreciation for the subject.

Homeostasis, the maintenance of an internal environment within an acceptably narrow range of values is necessary for the survival of the human body. For instance, if the blood delivers inadequate amounts of oxygen to the cells of the body, the heart and respiration rates increase until oxygen delivery becomes adequate. The emphasis in this book is on how mechanisms operate to maintain homeostasis. However, because failure of these mechanisms also illustrates how they work, pathological conditions that result in dysfunction, diseases, and possibly death are also presented. A consideration of pathology adds relevance and interest, makes the material more meaningful, and enhances the background of people who plan to pursue areas related to health. The two themes—the relationship between structure and function and homeostasis—combined with the book's strong problem-solving orientation and numerous clinical examples, make this text unique among anatomy and physiology texts.

GENERAL FEATURES

The following four general features distinguish *Anatomy and Physiology* from other texts:

1. Systematic presentation of content
2. Balanced coverage of anatomy and physiology

3. Relevant clinical examples and other examples used to encourage problem solving
4. Systematic presentation of questions that require solution of practical problems

Systematic presentation of content—Explanations are based on a conceptual framework that allows the student to tie together individual pieces of information. Simple facts are presented first, and explanations are developed in a logical sequence.

Balanced coverage of anatomy and physiology—Many texts emphasize the anatomy content at the expense of the physiology content. As a result, when health professionals return to school for further training, it is invariably because they need a better understanding of physiology. This text provides a solid foundation in anatomy as well as a thorough coverage of physiology. Two chapters in this text are particularly illustrative of the emphasis we put on providing adequate coverage of physiology. These are Chapter 9, “Membrane Potentials,” and Chapter 17, “Functional Organization of the Endocrine System.” Furthermore, the relationship between anatomy (structure) and physiology (function) is constantly stressed because this further enables students to solve problems. For example, if the structure and the location of a tissue are known, it is also possible to predict the tissue’s function.

Relevant clinical examples used to encourage problem solving—Clinical information should never be an end in itself. In some texts, mere clinical description or medical terminology represents a significant portion of the material. This text provides clinical examples to promote interest and demonstrate relevance, but clinical information is used primarily to illustrate the application of basic knowledge. The ability to apply information is a skill that will always be an asset for students, even after knowledge learned today is no longer current. Students using *Anatomy and Physiology* are encouraged in their professional or private lives to effectively use the knowledge they have gained through comprehending and solving basic clinical problems.

Systematic presentation of questions that require solution of practical problems—At best, some anatomy and physiology texts include a few “thought” questions that, for the most part, involve a restatement or a summary of content. Yet once students understand the material well enough to state it in their own words, it only seems logical for them to proceed to the next step—that is, to apply the knowledge to hypothetical situations. This text features two sets of problem-solving questions in every chapter, *Predict Questions* and *Concept Questions*, which provide students with that opportunity and challenge because we believe that practice in solving problems greatly enhances problem-solving skills.

A brief example will demonstrate the difference between knowing content and being able to use that

content. Suppose the following information has been given:

1. Within cells there are structures called *mitochondria*.
2. Mitochondria can transfer the energy in food molecules to adenosine triphosphate (ATP), an energy-storage molecule that is used by cells to perform the activities necessary for life.
3. The transfer of energy to ATP requires oxygen: The more oxygen that is available, the more ATP that is produced.

Typical questions requiring students to remember or understand the information might include the following:

1. In what structures is ATP produced?
2. When oxygen consumption increases, what happens to the number of ATPs produced?

On the other hand, it is quite possible to design questions that require the students to apply newly learned information to solve problems. In this way, material is not merely learned and regurgitated. Instead, that material is used in a practical scenario, a scenario that will certainly stay with a student much longer than a review question. For example:

1. Given two different tissue types and based on oxygen consumption rates, predict which tissue has the greatest number of mitochondria.
2. Given two different tissue types, propose (synthesize) an experiment that will determine which tissue has the greatest number of mitochondria.

This example illustrates that it is possible to do more with content than repeat or rephrase the information.

This text helps to develop problem-solving skills in several ways. First, all the information necessary to solve a problem is presented at a level that is sufficiently simple to avoid unnecessary confusion. Second, the opportunity to practice problem solving is made available through *Predict Questions* embedded within the chapter material and the *Concept Questions* found at the end of each chapter. Third, answers and explanations for these kinds of problems are provided. The explanations illustrate the methods used to solve problems and provide a model for the development of problem-solving skills. When students are exposed to the reasoning used to correctly solve a problem, they are more likely to be able to successfully apply that reasoning to future problems. The acquisition of problem-solving skills is necessary for a complete understanding of anatomy and physiology, it is fun, and it makes it possible for the student to deal with the many problems that occur as part of professional and everyday life.

ILLUSTRATION PROGRAM

The statement “A single picture is worth ten thousand words” is especially true in anatomy and physiology. Structure-function relationships become immediately apparent in the well-designed, accurate illustrations in this text. To maximize the effectiveness of the illustrations, they have been placed as close as possible to the narrative where they are cited, and special attention has been devoted to the figure legends, which summarize or emphasize the important features of each illustration. Although the anatomical drawings are accurate and the physiological flow diagrams and graphs are conceptually clear, the illustrations accomplish more than just presentation of important information. They have been designed to be nonintimidating and esthetically pleasing, features that encourage the student to spend time with the illustrations for maximum learning and pleasure. All of the artwork in this textbook is in full color, making the illustrations artistically attractive while emphasizing the important structures. In addition to the illustrations, numerous photographs bring a dimension of realism to the text. In many cases, photographs are accompanied by line drawings that emphasize important features of the photograph. Another feature is the *Mini-Atlas of Human Anatomy*, containing human cadaver dissections, which is found at the end of the text as one of the appendixes. Cadaver dissections are also used in many places within the actual chapters to visually reinforce a concept or description. These atlas-quality photographs provide a visual overview of the anatomy, helping to bridge the gap between illustrations and actual structures and to stimulate student interest in the subject.

DEVELOPMENTAL STORY

No matter how innovative our original vision for *Anatomy and Physiology* may have been, there is no doubt that, without the help of numerous instructors who were willing to help us implement our ideas, we would have not been able to produce this text. It was our goal to produce a text embodying our unique ideas, which would also be judged suitable for widespread classroom use. Fortunately, many of our reviewers were in agreement with our goals, for they too had often experienced frustrations with their existing texts.

We began preparing for the third edition of *Anatomy and Physiology* immediately after the second edition was published. We began keeping a detailed catalog of comments submitted to us by instructors using our text. These comments formed the basis of the first draft of our third edition.

We also held a launch meeting prior to beginning our text revision. Authors and editors met for several days to review the second edition of *Anatomy and Physiology* in detail and to discuss

reviewers' comments. A critical appraisal of the illustrations in the text was emphasized in the review process. Illustrations were evaluated in detail and reviewers' and users' recommendations were used to initiate revisions for the third edition. Finally, the entire manuscript was submitted to a reviewer panel after the first draft was prepared and again after the second draft was completed. Our reviews were extremely valuable in helping us to update the text and to improve the educational value of the illustrations.

NEW TO THIS EDITION

It is impossible to list every change that has taken place in the third edition of *Anatomy and Physiology*, but the major highlights of the revision are listed below.

1. Care has been taken to make the text even more inviting to read. We have reduced the number of parenthetical phrases to make the text even more readable, we have increased the number of terms with pronunciations within the text to make the terminology easier for students, and we have refined explanations to make them even clearer. A major thrust of this text is to make it readable and easy for students to understand the explanations of structures and functions.
2. Introductions to chapters have been modified to provide a more gentle introduction to the information and to enhance student interest. In addition, the introduction emphasizes major functions carried out by the system discussed in the chapter.
3. We have increased the number of Predict and Concept Questions in the third edition. The Predict and Concept Questions have been reviewed to ensure that they address topics current and consistent with the concepts emphasized in the text. We have continued the emphasis on providing problem-solving practice for students, and we are confident that students who are encouraged to answer the Predict and Concept Questions will dramatically improve their problem-solving skills over the academic year.
4. Throughout the text, there is an increased emphasis on clinically related information to enhance relevancy and to illustrate normal anatomy and physiology. Clinically important information appears in the body of the text, in the form of Clinical Notes, Predict Questions, Concept Questions, and tables where it is appropriate. In all cases, the emphasis is placed on helping students understand basic anatomical and physiological principles, but the clinical orientations emphasize the importance of the information and establish relevancy for many students in a way

- that helps them to remember and motivates them to work harder at learning the information.
5. Summary Homeostasis tables provide an overview of the physiology and the regulation of many systems.
 6. There is continued emphasis on illustrations to achieve attractive full-color illustrations throughout the text and to have the illustrations designed to be easily understood, esthetically pleasing, and informative. Where it is appropriate, text has been placed directly in the figures to produce a strong conceptual presentation of the concept embedded in the figure.
 7. Many boxed asides are now clinically oriented and are called "Clinical Notes." They provide relevant clinical information or other pieces of information that enhance the text. In many chapters the number of asides has been increased.
 8. Each chapter that addresses an organ system contains a System Interaction page with an illustration of the major features of the system. These tables describe the functions of the system discussed in the text as well as the interactions of that system with other systems of the body. These tables constitute a quick review, which is another way to emphasize the "big picture" already addressed in greater detail within the body of the chapter.
 9. Revisions of several chapters have resulted in better presentations:
 - a. Chapter 1: A new presentation of homeostasis and negative feedback that includes the idea of set point theory has been developed. This chapter is consistent with the more explicit emphasis on homeostasis throughout the text.
 - b. Chapter 6: The sections on intramembranous and endochondral bone formation and increase in bone length at the epiphyseal plate have been rewritten and reillustrated.
 - c. Chapter 10: Illustrations of skeletal muscle cells have been redone to emphasize the role of organelles in the process of contraction. The text, tables, and illustrations are closely coordinated to help students develop a clear model of the basic process of muscle contraction.
 - d. Chapter 11: Tables have been modified to include pronunciations for muscles and references to all of the figures that illustrate the muscles listed in the tables. The combination of the figures and the tables provides a convenient means by which students have easy access to the anatomy and function of each muscle.
 - e. Chapter 12: A clearer explanation of the events occurring at the synapse has been developed.
 - f. Chapter 13: Diagrams of neural pathways have been modified to improve color coordination throughout the chapter and the remainder of the text.
 - g. Chapter 15: Major changes have been made in the illustrations for the senses. The eye and ear illustrations have been replaced with figures that are more lifelike and that more clearly depict the relationships between the functional components of the eye and ear.
 - h. Chapter 16: Clarification of the sympathetic nerve pathways, sympathetic chain ganglia, and collateral ganglia has been achieved.
 - i. Chapter 17: Illustrations of the hypothalamus and pituitary gland have been standardized so that there is better consistency between the illustrations in the text and similar illustrations in other chapters of the text. Membrane-bound receptor and intracellular receptor mechanisms have been updated to be consistent with the current state of knowledge for these receptor mechanisms.
 - j. Chapter 18: Tables describing the function of the endocrine glands have been organized to present the functional characteristics and regulation of hormone secretion even more clearly.
 - k. Chapter 20: The regulation of the heart has been updated, and the table summarizing the regulation of the heart simplified to make it current and easy to follow. The means by which the heart participates in maintaining homeostasis is emphasized in the homeostasis table.
 - l. Chapter 21: Illustrations of some blood vessels have been redone to make anatomical relationships easier to understand. In addition, homeostasis tables have been developed, which summarize local control of blood flow and the regulation of blood pressure in a way that allows students to develop a concise and accurate overview of how homeostasis depends on the cardiovascular system.
 - m. Chapter 22: Extensive update of immunology with an emphasis on lymphocyte activation and the major histocompatibility complex has been achieved.
 - n. Chapter 23: The regulation of respiration by respiratory reflexes is updated and made more consistent with current data. Homeostasis tables provide an up-to-date overview of the regulation of respiration in a clear and simple format.
 - o. Chapter 25: A new discussion on hyperthermia and hypothermia has been included.

- p. Chapter 26: Illustrations have been included that provide a highly visual summary of the functions of the nephron in urine formation and the means by which urine concentration is regulated. Illustrations that summarize the means by which substances are transported across the wall of the nephron have been updated.
- q. Chapter 27: Tables summarizing the means by which pH and electrolytes are regulated in the body fluids have been made more visually attractive and organized so that they are easier to follow.

LEARNING AIDS

As the amount of information in a textbook increases, it becomes more and more difficult for students to organize the material in their minds, determine the main points, and evaluate the progress of their learning. Above all, the text must be an effective teaching tool. Because each student may learn best in a different way, a variety of teaching and learning aids are provided.

Objectives. Each chapter begins with a series of learning objectives. The objectives are not a detailed cataloging of everything to be learned in the chapter. Rather, they emphasize the important facts, topics, and concepts to be covered. The chapter objectives are a conceptual framework to which additional material will be added as the chapter is read in detail.

Vocabulary Aids. Learning anatomy and physiology is, in many ways, like learning a new language. A basic terminology must be mastered to communicate effectively. At the beginning of each chapter are the *key terms*, a list of some of the more important new words to be learned. Throughout the text, these and additional terms are presented in **boldface print**. In cases where it is instructionally valuable, the *derivation* or *origin* of the word is given. In their original language, words are often descriptive, and knowing the original meaning can enhance understanding and make it easier to remember the definition of the word. Common prefixes, suffixes, and combining forms of many biological terms appear on the inside of the front and back covers of the text and provide additional information on the derivation of words. When pronunciation of the word is complex, a *pronunciation key* is presented. Often simply being able to pronounce a word correctly is the key to remembering it. The *glossary*, which collects the most important terms into one location for easy reference, also has a pronunciation guide.

Related Topics. Knowledge of anatomy and physiology is interrelated and cumulative, with new information building on previous information. It is difficult to understand advanced material without

mastering the basics. This section at the beginning of each chapter points out material that should be understood or reviewed before proceeding with the new chapter material.

Clinical Notes. The Clinical Notes are designed to emphasize concepts, provide relevant and interesting examples, and enhance the background of people who plan to pursue areas related to health. Other examples related to sports medicine or everyday experiences are included when they reinforce basic concepts. The advantage of the Clinical Notes is that they appear right after the concepts are presented. In this way the relevance of the concepts is immediately apparent, helping the student to better appreciate and understand them.

Clinical Focus Boxes. The boxed essays are expanded versions of the Clinical Notes that permit a more detailed or complete coverage of a topic. Subjects covered include pathologies, current research, sports medicine, exercise physiology, pharmacology, and clinical applications. They are designed to not only illustrate the chapter content but also stimulate interest.

Predict Questions. The Clinical Notes or Clinical Focus boxes can illustrate how a concept works, but the Predict Question requires the application of the concept. When reading a text, it is very easy to become a passive learner; everything seems very clear to passive learners until they attempt to use the information. The Predict Question converts the passive learner into an active learner who must use new information to solve a problem. The answer to this kind of question is not a mere restatement of fact but rather a prediction, an analysis of the data, the synthesis of an experiment, or the evaluation and weighing of the important variables of the problem. For example, "Given a stimulus, predict how a system will respond." Or, "Given a clinical condition, explain why the observed symptoms occurred." The Predict questions are practice problems that help to develop the skills necessary to solve the Concept Questions at the end of the chapter. In this regard, not only are possible answers given for the questions, but explanations are provided that demonstrate the process of problem solving.

Tables. The book contains many tables that have several uses. They provide more specific information than that included in the text discussion, allowing the text to concentrate on the general or main points of a topic. The tables also summarize some aspect of the chapter's content, providing a convenient way to find information quickly. Often, a table is designed to accompany an illustration, so a written description and a visual presentation are combined to communicate information effectively. Homeostasis tables are included to provide a summary of the function of a system and the means by which that system

regulates a parameter within a narrow range of values. Homeostasis is a major theme of this text, and the Homeostasis tables reinforce that theme effectively.

Chapter Summary. As the student reads the chapter, details may obscure the overall picture. The chapter summary is an outline that briefly states the important facts and concepts and provides a perspective of the “big picture.”

Content Review Questions. The Content Review Questions are another method used in this text to transform the passive learner into an active learner. The questions systematically cover the content and require students to summarize and restate the content in their own words.

Concept Questions. Following mastery of the Content Questions and therefore chapter content, the Concept Questions require the application of the content to new situations. These are not essay questions that involve the restatement or summarization of chapter content. Instead, they provide additional practice in problem solving and promote the development and acquisition of problem-solving skills.

Appendixes. Appendix A is a full-color mini-atlas of human anatomy that illustrates the integrated relationships between the structures of different systems. These photographs of actual human dissections are taken from *Color Atlas of Human Anatomy*, edition 3, by R.M.H. McMinn and R.T. Hutchins (Mosby, 1993). Reference to these photographs helps students bridge the gap between the idealized illustrations of human anatomy in the textbook and the actual anatomical relationships they will see in the laboratory. Appendix B is a table of measurements that helps the student relate the metric system to the more familiar English system when determining the size or weight of a structure. Appendix C helps the student understand the shorthand of scientific notation. Appendix D explains the rationale behind how various solutions may be described. Appendix E explains the concept of pH and how it is measured. Appendix F contains tables of routine clinical tests along with their normal values of routine clinical and clinical significance. Reference to this appendix provides students with the homeostatic values of many common substances in the blood and urine. Also, the importance of laboratory testing in the diagnosis and/or treatment of illnesses becomes readily apparent to the students.

SUPPLEMENTS

Any textbook can be used alone, but thoughtfully developed supplements increase its effectiveness for both student and instructor. The supplements prepared to accompany the third edition of

Anatomy and Physiology have been designed and written to firmly support the pedagogical model developed in the text. The authors who joined us in producing this supplement package are committed to quality education and have eagerly shared their expertise in producing an outstanding array of support materials for both the student and the teacher.

Study Guide. The third edition of the study guide by Philip Tate and James Kennedy of Phoenix College and Rod Seeley of Idaho State University continues to support the text. It introduces the student to the content of anatomy and physiology using matching, labeling, and completion exercises. A Mastery Learning Activity consisting of multiple-choice questions emphasizes comprehension of the material, evaluates progress, and prepares the student for classroom testing. In addition, a Final Challenges section consisting of essay questions provides practice with questions similar to the Predict and Concept Questions of the textbook. Answers are given for all exercises, and explanations are furnished for the Mastery Learning Activity and the Final Challenges. Explanations are provided for higher cognitive level questions to help students understand the thought processes essential to arriving at a correct answer by bringing together information and creating an appropriate solution to the problem. The intent is to help students develop their problem-solving ability. Carefully reviewed by experienced instructors who currently teach anatomy and physiology, the study guide provides the reinforcement and practice so essential to the student's success in the course.

Laboratory Manual. The third edition of *Anatomy and Physiology Laboratory Manual* by Jay Templin of Gloucester County Community College has been extensively revised to include a number of interactive laboratory exercises that support the active learning model encouraged by the textbook. Now in full four-color, this third edition provides illustrations closely aligned with text for the best possible presentation for the student. Terminology has been carefully reviewed and revised for correlation with the textbook. Once again, the suggestions and corrections of reviewers with wide experience in teaching anatomy and physiology have been incorporated into the revision.

The accompanying Preparator's Manual provides detailed information necessary for the instructor to prepare for the lab. Answers to all questions on the lab reports in the Lab Manual are also included.

Instructor's Resource Manual. This invaluable resource, written by Margaret Weck of St. Louis College of Pharmacy, facilitates development and presentation of a well-integrated course. It suggests ways to organize the material and is keyed to relevant transparencies, illustrations, and laboratory ex-

ercises. Major points that deserve emphasis are included, hints on how to reinforce concepts are given, typical problem areas are noted along with ways to deal with the problems, and possible topics for discussion are considered. Answers for the Concept Questions at the end of each chapter in the text and for the essay questions in the test bank are found in the *Instructor's Resource Manual*. There are also 100 transparency masters, including key diagrams and tables from the text and additional material useful for student handouts. Each chapter includes an updated list of relevant audiovisual and software sources; the manual also contains an extensive list of laboratory supply houses.

A new feature of the *Instructor's Resource Manual* for this edition is a chapter in which active learning strategies and techniques are evaluated as related to their strengths and weaknesses. This is accompanied by a list of sources for more information on active learning. A second innovation is a listing of topics for active learning tasks appropriate to each chapter of the text, and a third innovation is a series of hints on integrating lecture and laboratory experiences.

Test Bank. There must be consistency between the material presented to students and what they actually see on the test. Written by Dorothy Martin and Sandra Larson of Black Hawk College, the test bank has been carefully integrated to complement both the text and the study guide. The test bank contains over 3000 items, including multiple-choice, completion, matching, and essay questions. Many new test items have been added to this third edition, which allows the instructor to evaluate the students' developing problem-solving skills. Graphics for labeling or as the basis for problem-solving questions are also included. Each question is classified according to the knowledge level it requires, and all answers are provided. As with all other materials that students will use, the test questions have been thoroughly reviewed by anatomy and physiology instructors and painstakingly polished to offer the best possible teaching tool.

Test-generating System. Qualified adopters of this text may request a computerized test bank package, compatible for use on IBM or Macintosh computers. The software package is a unique combination of user-friendly computerized aids for the instructor:

- **Testing:** A test generator allows the user to select items from the test bank either manually or randomly; to add, edit, or delete test items through a preset format that includes multiple-choice, true-false, short answer, or matching options; and to print examinations with or without saving them for future use.
- **Graphics:** Both IBM and Macintosh versions allow manipulation of the graphics included in the test bank. Additional illustrations may also be added.
- **Grading:** A computerized record keeper saves student names (up to 250), assignments (up to 50), and related grades in a format similar to that used in manual grade books. Statistics on individual or class performance, test weighting, and push-button grade curving are features of this software.
- **Tutoring:** A tutorial package uses items from the test bank for student review. Student scores can be merged into the grading records.
- **Scheduling:** A computerized datebook makes class planning and schedule management quick and convenient.

Transparency Acetates. Four hundred full-color transparencies with large, easy-to-read labels emphasize the major anatomical structures and physiological processes covered in the text. These images provide a common vehicle for communication between the instructor and the student as they enrich and further clarify lecture presentations.

ArtPak. A set of unlabeled full-color copies of the transparency acetates is provided for student convenience in following lecture presentations.

Human Body Systems Software. Available in an IBM format, this interactive software program, written by Kevin Patton and Kathryn Baalman of St. Charles County Community College, helps beginning students achieve success in anatomy and physiology. Individual modules introduce each of the eleven body systems. Each module contains an introduction, a tutorial with practice review questions, practical applications, and a final quiz.

Human Cadaver Dissection Video. This 60-minute video, narrated by Trent Stephens and produced at Logan College of Chiropractic, takes the student through a dissection of the musculature of the human body as well as the internal organs of the thorax and abdomen. Presented at an introductory level, this video provides vivid dissection close-ups with clear, precise commentary.

The Human Body Videodisc. Compact, versatile, and easy to use, this resource provides visual reinforcement for teaching anatomy and physiology. Containing over 1000 still images and over 50 minutes of moving images and animations, the human body videodisc provides an overview of the structure and function of each system in the human body. For each system, it includes anatomical artwork, photographs of gross anatomy, micrographs of relevant tissues, and moving sequences to show the system in action or how a process works. Animations were prepared specifically for use on this videodisc to enable students to visualize complex processes such as movement across a cell membrane, muscle contraction, the mechanics of breathing, and the formation of urine.

A Print Directory accompanies the videodisc. It lists all of the images available with their frame references and provides a copy of the narration for each of the moving sequences. The Lecture Guide, prepared by Frank Peek of the State University of New York in Morristown, contains lecture outlines with suggestions for using the videodisc in teaching anatomy and physiology. Barcodes to images and sequences on the disc allow immediate access.

BodyCheck. This new interactive tutorial in CD-ROM format includes gross human dissection photos, diagrams, x-rays, CT scans, and animations to provide visual support for the learning experience. It includes self-testing capability.

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Finally, we sincerely thank the reviewers and the instructors who have provided us with excellent constructive criticism. The remuneration they received represents only a token payment for their efforts. To conscientiously review a textbook requires a true commitment and dedication to excellence in teaching. Their helpful criticisms and suggestions for improvement were significant contributions that we greatly appreciate.

Rod R. Seeley
Trent D. Stephens
Philip Tate

Reviewers

First Edition Reviewers

James Aldridge
Palm Beach Junior College

Robert Allen
De Anza College

Bill Bednar
C.S. Mott Community College, Flint

Ken Bynum
University of North Carolina, Chapel Hill

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Eastern Washington University

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Colorado Springs

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Sinclair Community College

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Anoka-Ramsey Community College

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San Antonio College

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University of Missouri, St. Louis

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University of Wisconsin-Milwaukee

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Rosamund Wendt
Community College of Philadelphia

Philip C. Whitford
University of Wisconsin-Milwaukee

Stephen Williams
Glendale Community College

Clarence C. Wolfe
Northern Virginia Community College

William Young
University of Vermont

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Palm Beach Community College
 John Conroy
University of Winnipeg

Patricia O'Mahoney-Damon
University of Southern Maine
 Betsy Ott
Tyler Junior College
 Richard Satterlie
Arizona State University

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Parkland College
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University of Wisconsin at Milwaukee

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Duluth Community College

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Florida A&M University
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St. Louis Community College
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Old Dominion University
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Bloomsburg University
 Linda Tichenor
University of New England
 Steven Trautwein
Southeast Missouri State University
 John Vaughan
St. Petersburg Junior College
 Samuel Wages
South Plains College

About the Authors

Rod R. Seeley

Professor of Physiology,
Idaho State University

With a B.S. in zoology from Idaho State University and an M.S. and Ph.D. in zoology from Utah State University, Rod Seeley has built a solid reputation as a widely published author of journal and feature articles, a popular public lecturer, and an award-winning instructor. Very much involved in the methods and mechanisms that help students learn, he contributes to this text his teaching expertise and proven ability to communicate effectively in any medium.

Trent D. Stephens

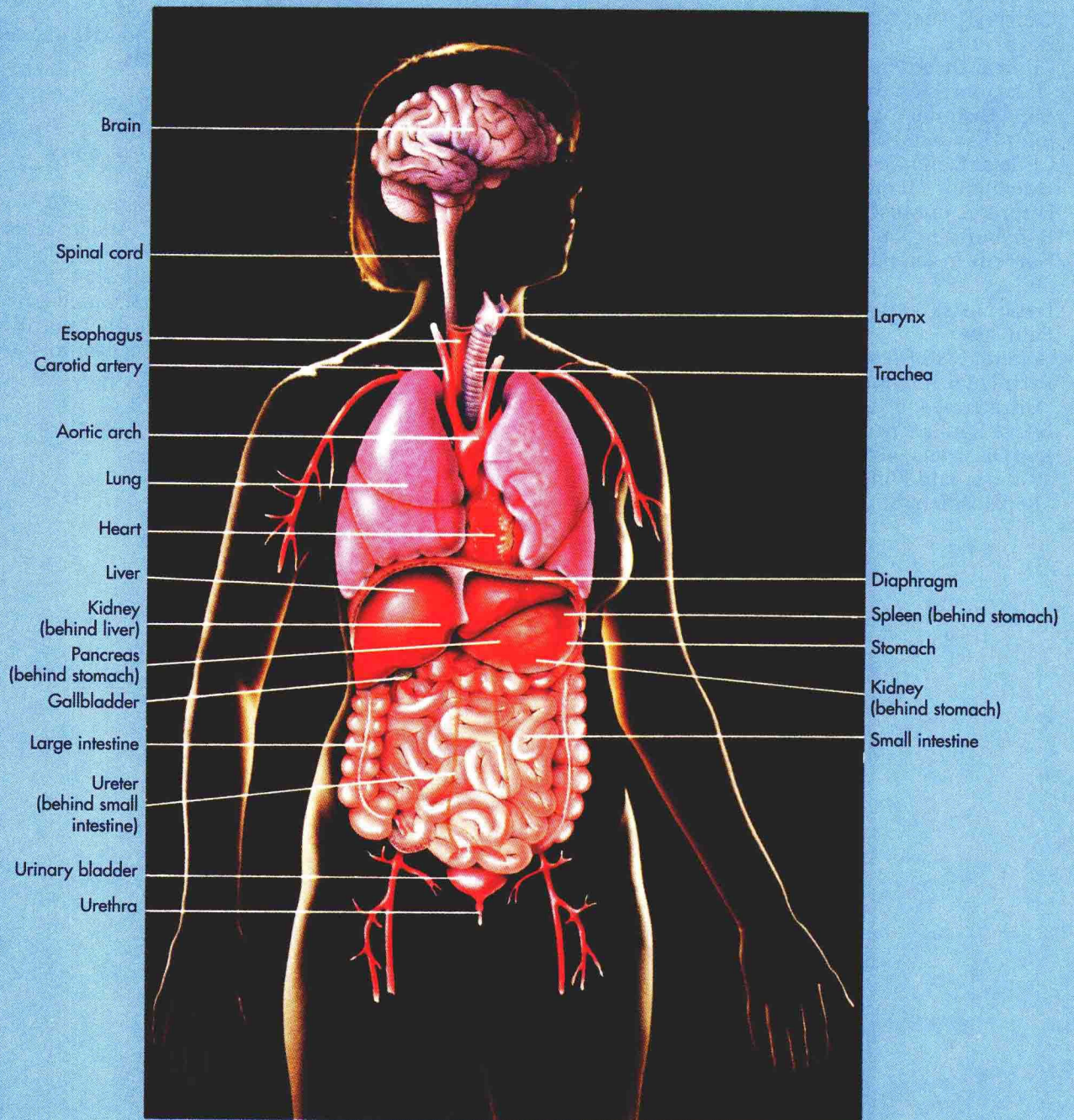
Professor of Anatomy and
Embryology, Idaho State
University

An award-winning educator, Trent Stephens teaches human anatomy, neuroanatomy, and embryology. His skill as a biological illustrator has greatly influenced every illustration in this text. With B.S. and M.S. degrees in zoology from Brigham Young University and a Ph.D. in anatomy from the University of Pennsylvania, Trent Stephens has also published numerous scientific papers and books. His students continually rate him highly on their evaluations—you will too!

Philip Tate

Instructor of Anatomy
and Physiology, Phoenix
College

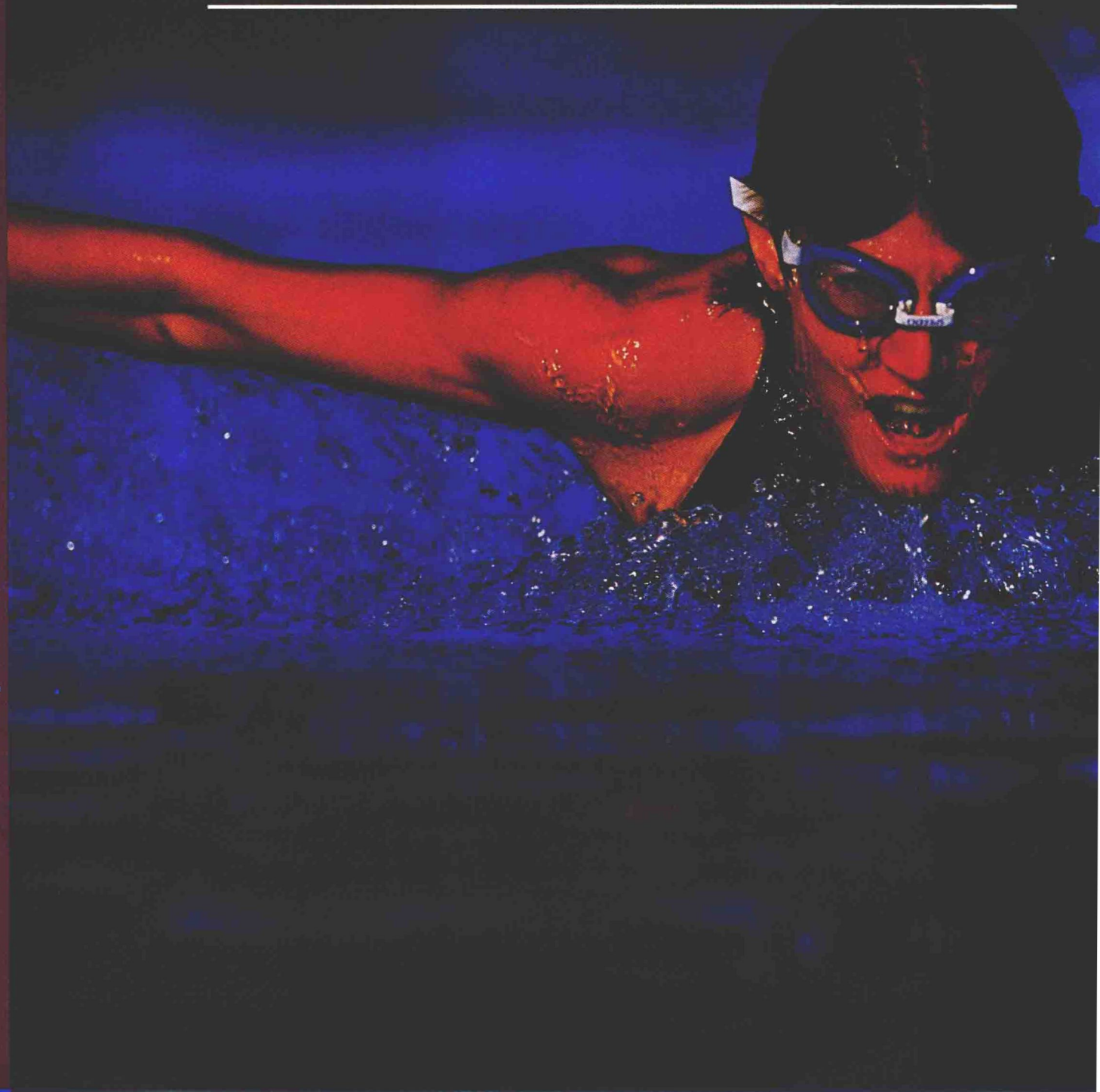
From the community college to the private 4-year college, Phil Tate has taught anatomy and physiology to all levels of students: nursing and allied health, physical education, and biology majors. At San Diego State University, Phil earned B.S. degrees in both mathematics and zoology and a M.S. in ecology. He earned his doctorate in biological education from Idaho State University.



Anatomy & Physiology

PART **1**

*Organization
of the Human Body*





1 The Human Organism

2 The Chemical Basis of Life

3 Structure and Function of the Cell

4 Histology: The Study of Tissues