CD-ROM

MARTINI

FUNDAMENTALS OF

Anatomy & Physiology

FIFTH EDITION

FIFTH EDITION

R3

Fundamentals of Anatomy & Physiology

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with

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Dr. Martini received his Ph.D. from Cornell University in comparative and functional anatomy. His publications include journal articles, technical reports, magazine articles, and a book for naturalists about the biology and geology of tropical islands. He is the coauthor of five other undergraduate texts on anatomy or anatomy and physiology. He is currently on the faculty of the University of Hawaii and remains affiliated with the Shoals Marine Laboratory, a joint venture between Cornell University and the University of New Hampshire. Dr. Martini is a member of the Human Anatomy and Physiology Society, the American Physiological Society, and the American Association of Anatomists. He is also a member of the National Association of Biology Teachers, the Society for College Science Teachers, the Society for Integrative and Comparative Biology, the Western Society of Naturalists, and the International Society of Vertebrate Morphologists.

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Dr. Ober received his undergraduate degree from Washington and Lee University and his M.D. from the University of Virginia in Charlottesville. While in medical school, he also studied in the Department of Art as Applied to Medicine at Johns Hopkins University. Dr. Ober is currently on the faculty of the University of Virginia in the Department of Sports Medicine. He is also part of the Core Faculty at the Shoals Marine Laboratory.

Claire W. Garrison, R.N.

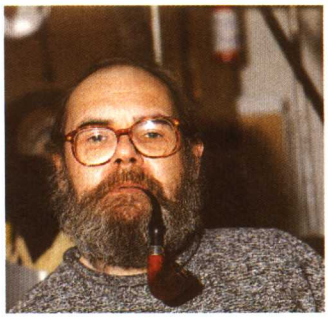
Illustrator

Ms. Garrison practiced pediatric and obstetric nursing for nearly 20 years before turning to medical illustration as a full-time career. She has been Dr. Ober's associate since 1986, following a five-year apprenticeship. Ms. Garrison is also a Core Faculty member at the Shoals Marine Laboratory.

Dr. Kathleen Welch

Clinical consultant

Dr. Welch received her M.D. from the University of Washington in Seattle and did her residency at the University of North Carolina in Chapel Hill. For two years, she served as Director of Maternal and Child Health at the LBJ Tropical Medical Center in American Samoa and subsequently was a member of the Department of Family Practice at the Kaiser Permanente Clinic in Lahaina, Hawaii. She has been in private practice since 1987. Dr. Welch is a Fellow of the American Academy of Family Practice and a member of the Hawaii Medical Association and the Human Anatomy and Physiology Society.



Ralph T. Hutchings

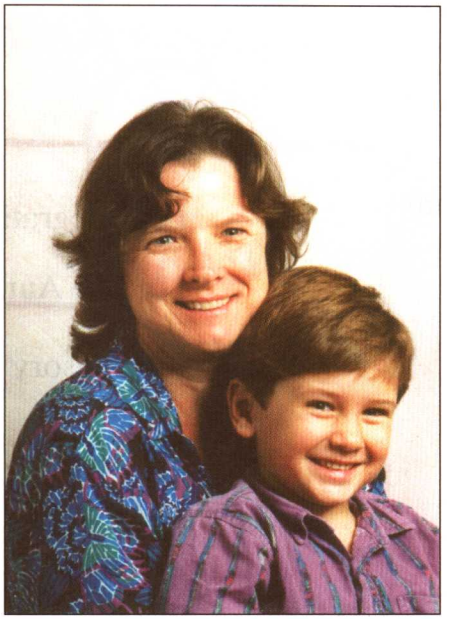
Biomedical photographer

Mr. Hutchings was associated with the Royal College of Surgeons for 20 years. An engineer by training, he has focused for years on photographing the structure of the human body. The result has been a series of color atlases, including the *Color Atlas of Human Anatomy, The Color Atlas of Surface Anatomy,* and *The Human Skeleton* (all published by Mosby-Yearbook Publishing, St. Louis, Missouri, USA). For his anatomical portrayal of the human body, the International Photographers Association has chosen Mr. Hutchings as the best photographer of humans in the twentieth century. He lives in North London, where he tries to balance the demands of his photographic assignments with his hobbies of early motor cars and airplanes.

Dr. Kathleen (Ireland) Flickinger

Media advisor

Dr. Flickinger teaches anatomy and physiology on campus and via multimedia distance technologies for the University of Hawaii–Maui Community College. She has worked in medical research for LSU MC, Drake University, the Lion's Eye Clinic in New Orleans, and DuPont Biochemical Corporation. She began teaching anatomy and physiology in Louisiana in the mid-1980s and received her Ph.D. in curriculum and instructional technologies from Iowa State University. Her current research involves distance education and the effective use of technology in higher education.



To my family, whose support makes this project possible, and to my readers, whose thanks and suggestions for improvement were deeply appreciated.

Preface

To the Instructor

CHANGING TIMES

When the First Edition of *Fundamentals of Anatomy and Physiology* was published in 1989, the options available for presenting, studying, and applying principles of anatomy and physiology (A & P) were much more limited than they are today. Our knowledge base has also expanded tremendously. As we proceed into the new millennium, we know much more than ever before about the biochemical and molecular foundations of many normal physiological processes, we understand the molecular origins of many diseases, and we are close to completing an initial survey of the human genome. This enhanced understanding has led to the development of effective new treatments, protocols, and interventions to combat disease, reduce suffering, and promote good health. Many of these advances could not have been made if they were not preceded by improvements in the speed and reliability of computers. Modern technology, especially computers and the Internet, has changed our daily lives and is reshaping our societies in many ways.

The emerging medical technologies allow us to perform complex surgical procedures on individual organs or to target specific cells within an organ. We can manipulate the DNA within cells, and we can even clone genetically identical animals, although we are still unable to repair even the simplest genetic defect in humans. Many people are horrified by what we can now do with technology; others are intent on pushing ahead without a clear idea of the ultimate destination. Nevertheless, all of us are affected by modern technology. Technology has become a means for acquiring and distributing information, and medical professionals have learned to use technology to increase their effectiveness as well as to improve the quality of medical care.

By enhancing the availability of *specific* information, modern technology has affected how each of us deals with information *in general.* In many cases, knowing where to look for information is preferable to trying to memorize specific data. That is certainly the trend in the training of medical and allied health professionals today. Students begin by mastering the terminology and memorizing a substantial core of basic conceptual information. In the process, they are also given (1) a "mental framework" for organizing new information, (2) the ability to access additional information when needed, by consulting relevant print or electronic data sources, and (3) an understanding of how to apply their knowledge to solve particular problems. The same skills are equally important to people in other career paths. To be effective in almost any job today, you must know how to access and absorb new information, to use (or learn to use) available technology, and to solve problems.

The ultimate goal of any anatomy and physiology course should be to empower students to use their conceptual understanding to solve problems. Preparation for this goal involves a substantial amount of memorization, but the burden of memorization is reduced if the relevance of the information is evident. *Fundamentals of Anatomy and Physiology* has been designed to place the information in a meaningful context and to help students develop their problem-solving skills. The electronic enhancements, including the enclosed CD-ROM and the Companion Website, make it easy for students and instructors to use current technology to access and manage information.

A & P TODAY

Over the last 5 years I have visited instructors and students at campuses throughout North America, Australia, and New Zealand. I have found that most instructors are aware of this relationship among information, technology, and problem solving. I have also found them seeking answers to similar questions, which could be summarized as follows:

- How do I find the time?
- How much material should I teach?
- Which media should I use?

These questions are asked by college faculty members in all courses; in fact, a very similar set of questions is asked by students. (See "To the Student" on page xxix.) The situation is probably more troublesome in A & P than in other courses, because this is the first college-level science course many of these students will take. They must learn not only a new vocabulary but also new ways of studying and organizing information. For most instructors, teaching anatomy and physiology has never been more challenging; in addition to teaching terminology, facts, and concepts, instructors must help their students be good problem solvers. Mastering terminology, facts, and concepts is of little value if that mastery cannot be used to solve problems. It would be analogous to a person's knowing all the parts of an automobile and the concepts behind the internal combustion engine without being able to back the car out of the garage and drive it away.

The focus of this text and its support materials has been to simplify the teaching and learning of anatomy and physiology. In the revision process, I've tried to address each of the above questions.

- *How do I find the time?* Nothing I can do can give any of us more time. But I have tried to help you make better use of the time you do have. My approach has been (1) to provide a range of options for reducing preparation time for classroom presentations, and (2) to improve the delivery of information in the text and supplements package so that it can assume more of the teaching load.
- *How much material should I teach?* The answer will vary from class to class and from instructor to instructor. Some courses have prerequisites, many others do not; some courses are taught to prenursing students, others to physical education students, and still others to general biology students. Few instructors cover all the material in the textbook. Therefore, I have tried to assist both instructors and students by making the chapter organization clear at the outset and by providing an internal structure that helps instructors decide—before they read the section—whether the material in it is relevant for their class. Sections can be assigned or skipped as needed without interrupting the flow of information.
- *Which media should I use?* Instructors vary widely in their need for media products. This variety reflects differences in teaching styles and in classroom facilities. I have visited schools where "multimedia" means colored chalk and other schools where every seat in the lecture hall has a response pad and a data port for a laptop computer. My answer to this question, then, is "How do you want to deliver the key information?" All lecturers rely on visual support of one kind or another. The resources available with this textbook run the gamut from transparencies to a videotape and laser disk, to digital video, and a CD-ROM with an Image Bank and PowerPoint Gallery of slides for computer presentations. For those interested in Web courseware, you can start simply and easily with the Syllabus Manager at the Companion Website to supplement the lecture or lab work, or use WebCT or Blackboard to design distance-learning or Web-based courses. The content is consistent across the various formats. For example, all art in the textbook is prepared by a team of two medical illustrators, so the art is consistent from figure to figure and chapter to chapter. That same art appears on the image bank, in the PowerPoint slides, and on the website, and it forms the basis for the animations and tutorials. In short, the key information is available to you, however you choose to deliver it.

I have often heard the statement "all A & P books are the same." Well, yes and no. All books in this market are about the same size and length, and they all have a similar organization, colorful illustrations, and an assortment of supplements. However, that does not mean that all A & P books are exactly alike, any more than all cars are alike simply because they all have engines and tires and can transport you from one place to another. This textbook has been designed to meet specific needs. How were those needs determined? Personal experience has helped, but no one person has a complete view of any situation. So, wherever and whenever possible, I have met with instructors and students to learn more about shared problems, solutions, and perspectives. Prentice Hall has sponsored student focus groups and instructor focus groups, giving me the opportunity to get direct feedback and to "test-drive" new features. I have received hundreds of letters, phone calls, and e-mail messages from instructors and students with comments and suggestions about this textbook and its supplements. The result is a package that is more than just "reliable transportation"—it will help you negotiate the curves and avoid the potholes. The textbook's important and distinctive features are explained in "To the Student" (page xxix). I urge you to read it before your course gets under way.

WHAT'S DIFFERENT ABOUT THE FIFTH EDITION

Each new edition requires some revising and updating, and that was certainly the case here. In the process, I reexamined the material within each chapter to see what steps could be taken to improve the delivery of information and clarify key concepts. This reexamination was the key to demonstrating the relevancy and applicability of the material, to integrating the components of the learning system more effectively, and to providing additional opportunities for enhancing student understanding during lectures, lab periods, and study times through the use of appropriate technologies. To give you an idea of the scope and nature of the changes, I will begin with changes to the textbook and then consider changes to the teaching and learning system as a whole.

CHANGES TO THE NARRATIVE

The basic chapter sequence and organization of the text remains unchanged. However, in response to instructor and student feedback, I have streamlined the delivery of key physiological concepts and developed a new feature, called a *Navigator*, to help students keep track of their progress through the material. Simply put, a Navigator is a flow chart that includes the key topics covered within a section. This new feature is presented first as a full-size figure, accompanied by a narrative overview. It then reappears in simplifed form each time the reader "steps" from one key topic to another. The Navigator concept, which sounds simple, actually entailed more than just creating new artwork and adding

overviews. In some cases, it involved the resequencing of material and led to the creation of summary tables that review key concepts before the next "step" is taken. This approach is suitable neither for all topics nor for all chapters, but it is a big help in getting through tough sections that deal with abstract physiological concepts. For instance, Navigators are used in Chapters 12 (neurophysiology), 21 (cardiovascular physiology), 22 (immunity), 23 (respiratory physiology), and 25 (cellular metabolism). A comparable pattern of presentation—overview followed by blocks of text and art accompanied by summary tables—has been used throughout, even in chapters that do not contain Navigators.

CHANGES TO THE ART PROGRAM

Both anatomical structures and physiological processes must be visualized if students are to understand them. One of the greatest strengths of the art program in this textbook has been that all illustrations in all chapters have been created by the same two medical illustrators: Bill Ober, M.D., and Claire Garrison, R.N. Their efforts in previous editions have resulted in awards from the Association of Medical Illustrators and from the Text and Academic Authors Association. Having one team responsible for the visual presentation of information ensures that structures and processes are depicted in a consistent manner from figure to figure and from chapter to chapter; *Fundamentals of Anatomy and Physiology* is the only A & P textbook that has a unified art program. (To learn more about Bill and Claire, please see their brief biographies on page iii.) We work together as the manuscript evolves, and they read key sections of the manuscript to make sure that the visual and narrative presentations are in alignment. In addition, we have been able to work with Ralph Hutchings, a biomedical photographer recently cited as one of the best photographers of the twentieth century for his anatomical portrayals of the human body. Bill and Claire have incorporated many new photos into the textbook and the Companion Atlas of the *Applications Manual,* and Ralph's photos appear in the textbook, and in the media, Companion Atlas, and lab manuals that accompany the Fifth Edition.

A detailed examination of virtually any chapter in the Fifth Edition will reveal both subtle and dramatic improvements and additions to the illustration program. Dramatic improvements in the art program for this edition include the following:

- Chapters 7–9: New bone photographs have been supplied by Ralph Hutchings, and several photos have been enlarged. New views have been added, providing additional perspectives on the structure of the elbow, hip, and knee joints.
- Chapter 10: Several new illustrations have been added, and the sequence has been reordered to create visual links between succeeding figures and to help students better visualize the key aspects of muscle physiology.
- Chapter 11: New anatomical paintings have been included, depicting the muscles of the forearm and hip, and many figures have been enhanced and improved.
- Chapter 12: The art program for the neurophysiology section has been modified, with new Navigators and new art and illustrated tables linked to the discussions of graded potentials, action potentials, synaptic function, and neural processing.
- Chapters 13, 14, 20, 21, 22, 26, and 28 (among others): New anatomical art and new physiological diagrams have been added to accompany a revised coverage of reflexes, cardiovascular function, immune function, and renal function.

MEDIALABS

Each chapter of the Fifth Edition contains an integrated learning tool called a MediaLab. These innovative sections have been developed with the assistance of Kate Flickinger, Ph.D., of Maui Community College. Kate has extensive research and teaching experience in anatomy and physiology and specializes in media use and instructional design. (Her brief biography appears on page iv.)

Although computers continue to become more available to both faculty and students, relatively few instructors have used Web-based assignments in an A&P course. The reasons are that (1) instructors don't have time to cover the material already in the course syllabus and text; (2) there is no demonstrable link between the URL provided and the course material that will affect student grades; and (3) there are no guidelines for time expenditure—students could wander on the Internet for hours, when they might be better off spending that time studying their textbook and lecture notes. MediaLabs address these concerns by providing specific, time-constrained exercises with clearly stated objectives that relate the Web-based activities to the core chapter content. It is our hope that this feature will enable instructors to capitalize on the wealth of Web-based content as it provides students with alternative learning opportunities.

FORMAT AND DESIGN CHANGES

Introductory A & P students often need a lot of help with organizing and integrating the material, so this textbook offers a variety of pedagogical aids. The red figure locator dots, red checkmarks in Concept Check Questions, and Concept Link icons that distinguish this textbook from all others are important and effective learning aids that were, in many cases, suggested by students themselves. Focus-group

participants and reviewers who used the Fourth Edition—as students or as instructors—were virtually unanimous in telling me to retain these features in the Fifth Edition. These pedagogical aids were retained, but the design has been changed to soften their visual impact. As a bonus, this new design has enabled me to coordinate the narrative and illustrations more closely.

CHANGES TO THE LEARNING SYSTEM

One of the most important aspects of this new edition, from my perspective, is that I had the chance to look at the functionality and integration of all the components of the learning system developed over the last 12 years. That means examining not just the textbook and *Applications Manual,* for which I am largely responsible, but the study guides, CD-ROMs, websites, and other components that are created by others. As you know, each medium has its strengths and weaknesses. So, when I started dealing with content issues, reviewer comments, and so forth for the textbook revision, I also began working with the talented editorial and media staff at Prentice Hall to examine each element in the learning system. On the basis of feedback from faculty, students, and technical experts, we made decisions as to how the various components might be rearranged to make better use of the available media and to improve the delivery of the revised text content. I can give you a few specific examples here; others will become apparent as you become more familiar with the new edition.

We began by looking at the material in the textbook, the *Applications Manual,* student CD-ROMs, and Companion Website as though it were a single pool of resources. We then allocated content to take advantage of the strengths of each medium. After distributing assets, we evaluated each to determine how it could be enhanced and integrated with the whole to support an improved learning system. This evaluation led to several major changes from the approach used in the Fourth Edition.

- The Companion Website has been enhanced to include roughly four times as many exercises, many of them graphics-based. It also includes animations, the eBook version of the textbook, and more extensive links to other sites. The Companion Website now incorporates many components that were formerly distributed among different media, making it more convenient and accessible to students.
- Critical-Thinking Questions and Clinical Problems, formerly included in the *Applications Manual,* now appear in an interactive framework on the Companion Website. Adaptation and integration with the Companion Website have made it easier to seek answers, share results, and submit conclusions and opinions for review by study groups or to instructors.
- The content and approach of the interactive exercises used in the Fourth Edition CD-Study Guide has been adapted to the Companion Website for the Fifth Edition. Although the CD-Study Guide has been discontinued, the questions have been merged into a common resource on the Companion Website.
- The eBook version of the textbook, which in the Fourth Edition was part of the CD-ROM, has been moved to the Companion Website, where it can be linked to animations and related websites and used as a resource while you work through the review exercises. Like the Fourth Edition's eBook, this one includes art from the textbook as well as more than 75 animations developed directly from that art. The eBook also has linked Glossary terms and Concept Check Questions (with links to the answers).
- The CD-ROM accompanying the Fifth Edition contains animations, simulations, and tutorials that are either interactive or so graphics-intensive that, given the connect speeds available to most students, it would be impractical to deliver across the Internet. The CD-ROM also contains an audio-glossary to enhance the vocabulary of anatomy and physiology and Case Studies to support problem-based learning. Additionally, a search tool is available to help users easily locate the material most important to them. These resources are fully operational without an Internet portal, but if one is available, the CD-ROM includes a direct link to the Companion Website.
- With the exception of the application questions, which have moved to the Companion Website, and the Case Studies, which have moved to the CD-ROM, the scope and coverage of topics discussed in the *Applications Manual* remains comparable to that of the Fourth Edition. (Additional details are provided in a later section of this Preface.) However, the clinical content has been improved and updated, many new illustrations have been added, and the tables have been extensively revised.
- Images from the Fourth Edition *Applications Manual* have been combined with new images to create a Companion Atlas. This atlas, which appears at the back of the *Applications Manual,* contains many new photographs by Ralph Hutchings. Each image is cross-referenced to figures in *Fundamentals of Anatomy and Physiology.* By placing these images in the Companion Atlas, they can be presented in a larger format than would be possible were they included in the textbook itself, and they can be referenced as needed from many chapters. The Companion Atlas includes (1) color Embryology Summaries dealing with the developmental origins of each body system; (2) color plates of surface anatomy, skeletal anatomy, and cadaver prosections; and (3) a series of high-quality black and white images produced by CT, MRI, and contrast X-ray techniques.

Each of these components will be considered individually in the Supplements section next. But this brief overview should give you a sense of the nature and goals of the reorganization.

THE SUPPLEMENTS PACKAGE

The supplements team consists of talented A & P instructors, most of whom have been using this textbook since its First or Second Edition. Their efforts are coordinated by the supplements editors and multimedia editors at Prentice Hall. During the development of the Fifth Edition, they have worked with me as an extra team of reviewers. In return, I have provided them with additional suggestions and comments while their revisions were under way.

FOR THE INSTRUCTOR

Instructor's Preparation Box

Prentice Hall and I have tried to simplify the task of preparing lectures for this course. The Instructor's Preparation Box contains three sets of materials for each chapter. The first set contains traditional Instructor's Manual materials, including detailed lecture notes and an organizational grid of visual resources by chapter. This set also contains suggested demonstrations, analogies, answers to end-of-chapter questions, and mnemonic activities designed to engage students' interest and to provide some additional flavor for your lectures. The second set contains student handouts—including crossword puzzles and Quiz Art (line art without labels) for each chapter. The third set contains all the transparency acetates by chapter. Also included is a Lecture Presentation Notebook to help you organize your lecture material.
(0-13-019675-4)

Instructor's Manual

This useful resource includes a wealth of materials to help you prepare and organize your lectures, such as lecture notes, vocabulary aids, applications, and classroom demonstrations. To help you organize all the visual resources provided in the supplements package, this manual also includes a detailed grid that correlates each section of the textbook with the visual aids that support that section. At one glance you can determine which transparencies, animations, and CD-ROM images are available for your lecture. New to this edition are MediaLab Instructor Notes, designed to ensure successful and meaningful use of the MediaLab activities in each chapter of the textbook.
(0-13-019676-2)

Transparencies

The transparency set has been significantly improved and expanded. More than 800 acetates are included, with art and labels enlarged for use in large lecture halls. Where possible, complex figures have been divided into separate transparencies for improved clarity and teaching effectiveness. The selection of acetates and the quality of each image have been assessed by faculty reviewers to ensure that we offer the best possible presentation.
(0-13-019677-0)

Test Item File and Computer Test Manager

The Test Item File has been thoroughly revised and reorganized for easier selection of questions for every objective in the textbook. A test bank of more than 3000 questions organized around the three-level learning system (as seen in the textbook and Study Guide) will help you design a variety of tests and quizzes.
(Print format: 0-13-019678-9)
(Software: Windows 0-13-019679-7, Mac 0-13-019681-9)

Image Bank and PowerPoint Gallery

Available in both Windows and Macintosh formats, this CD-ROM includes both an Image Bank and a PowerPoint Gallery. The Image Bank contains more than 1100 illustrations, including line art and photos from the textbook, cadaver and cat dissection photos, MRI and CT scans, X-rays, and laboratory model photos. Of special note is the inclusion of a library of unlabeled art. This material can easily be used to develop art-based quizzes, customized to serve individual presentation needs, or printed within your course support material. In addition, the CD-ROM includes animations of more than 75 of the most difficult concepts in anatomy and physiology. To provide yet another resource, Prentice Hall has assembled a complete series of PowerPoint slides for the entire course. These slides can be customized to fit your particular needs, but the basic—and time-consuming—work has been done for you.
(0-13-019682-7)

Laser Disk

The Prentice Hall laser disk, *Anatomy and Physiology in Motion*, features a collection of professionally narrated animations of the most complex topics and processes in anatomy and physiology.
(0-13-751777-7)

The Martini Companion Website

http://www.prenhall.com/martini/fap5

The new Companion Website has been designed to make it easier to teach anatomy and physiology and to make it easier to incorporate Web-based activities into the core curriculum. One of the key advances is the inclusion of chapter-based MediaLabs. MediaLabs provide specific, time-constrained exercises, called Web Explorations, with clearly stated objectives that relate the Web-based activities to the chapter content. The Web Explorations have been designed (1) to enable instructors to capitalize on the wealth of Web-based content and (2) to provide students

with alternative learning opportunities. To help you implement these MediaLabs into your course, the Instructor's Manual offers instructions for their use.

The Companion Website also provides a wealth of other materials to help instructors enhance the course. One of these is the Syllabus Manager tool, which enables instructors to build easily and manage custom online syllabuses. This tool provides a seamless way for you to link to content provided by Prentice Hall and offered by other sources on the Web. If you've ever thought about offering Web-based or distance-learning options to your course, then you should consider this free resource.

In addition to the basic tools available on the Companion Website for this textbook, Prentice Hall provides rich and thorough course cartridges for both the WebCT and the Blackboard course management systems. Many campuses have already selected one of these course management tools to help instructors develop and deliver content for Web-based and distance learning.

I hope that as the year passes, you will use the Companion Website or my email address, listed at the end of the Preface, to contact me with suggestions for future improvements, new illustrations, or news of interesting research developments. Distance is no longer a limiting factor in our "global A & P village," and I hope that even more instructors and students will participate in the development of future editions.

FOR THE STUDENT

Applications Manual

Each new copy of the text comes packaged with an *Applications Manual,* which is written in collaboration with Kathleen Welch, M.D., my wife, who is also the clinical consultant for the text. This unique supplement provides access to interesting and relevant clinical and diagnostic information. It presents that information in a framework that helps students develop problem-solving skills. The book begins with an overview of the way diseases are diagnosed, and this leads to a discussion of the scientific method and to the use of logic and reasoning to evaluate health-related statements and claims. It then provides background information about chemical, cellular, and molecular disorders and techniques. Finally, it presents the major categories of disorders and important diagnostic techniques for each body system. Although it can be read separately, each major topic in the *Applications Manual* is cross-referenced to specific pages in the textbook.

The *Applications Manual* is designed to demonstrate the relevance of key concepts presented in the textbook. By placing the material in a separate volume, topics can be covered in greater depth—or skipped—without interrupting the flow of information in the textbook. Few instructors will require their students to read the entire *Applications Manual,* but each student will refer to segments of particular importance to their career plans or their personal or family health. In subsequent courses, it becomes an invaluable reference that links the topics covered in more-advanced courses with the basic anatomy and physiology covered in their introductory-level course.

The *Applications Manual* also contains a Companion Atlas, which consists of Embryology Summaries for all organ systems; photographs of skeletal anatomy, surface anatomy, cadaver prosections, and plastic models; and representative images produced by CT, MRI, and contrast X-ray procedures.
(0-13-031117-0)

Study Guide

This very popular Study Guide, written by Charles Seiger, is an excellent way to review basic facts and concepts as well as to develop problem-solving skills. A variety of questions, including labeling and concept mapping, are keyed to every learning objective in the textbook and are organized around the three-level learning system used in the textbook.
(0-13-019691-6)

The Martini Companion Website

http://www.prenhall.com/martini/fap5

Not only will the new design and content of the Companion Website for *Fundamentals of Anatomy and Physiology* make it easier for instructors to use and assign material, but this website has also been redesigned to make it easier for students to learn anatomy and physiology. Notice that I did not say that the website makes it *easy* to learn this subject; rather, it makes the process of learning anatomy and physiology less stressful and more interesting. To do this, the Companion Website must be engaging, appealing to students with diverse learning styles and backgrounds. It must not just provide reinforcement and feedback, although those are important; it must also provide insights that help clarify difficult topics. The benefits of working with this website must be apparent and real. Students should come away with a better understanding of the material, and that understanding should be reflected in their performance on the next exam. To accomplish these goals, the media team has redesigned the website and integrated multi-level questions, image banks, links to other websites, guided activities, and the eBook version of the textbook. For logistical and copyright reasons, the more-comprehensive Companion Website resources are passcode-protected. Each new copy of the Fifth Edition comes with a passcode that, when activated by a student, remains "live" for 18 months. Passcodes can also be purchased online for a small fee. Each instructor receives a passcode good for the life of the edition.

Martini Interactive Student CD-ROM

This CD-ROM was designed to accompany your textbook. It is fully integrated with both the textbook and its Companion Website. The CD-ROM contains interactive tools to help you visualize anatomy and physiology; three-dimensional animations; fly-through panoramas of the heart and gastrointestinal tract; interactive tutorials; clinical case studies; an audio glossary; and a link to the Companion Website.

The animations were developed with data from the Visible Human Project, sponsored by the National Library of Medicine. An easy-to-use navigation bar allows you to rotate each structure 360°, peel away the layers of each image, and view the structures with the labels on or off. The interactive tutorials present the most difficult topics in anatomy and physiology so as to help you discover the underlying principles while you control the flow of information. Each tutorial includes audio narration throughout. The clinical case studies are organized into steps that give you the opportunity to practice and apply your knowledge of anatomy and physiology in a practical and realistic way. These case studies, derived from actual case histories, support problem-based learning.
(0-13-019692-4)

Science on the Internet: A Student's Guide 2000–2001

This guide is the latest in a series written by Andrew Stull and Harry Nickla to help you use the Internet. It is a handy reference to get you up to speed on the World Wide Web's vast resources, including the Companion Website for this book. The guide, a unique resource, gives clear steps to help you access regularly updated biology resources as well as an overview of general navigation strategies and techniques to help you critique material that you find on the Web.
(0-13-028253-7)

Video Tutor for Anatomy and Physiology

This videotape offers high-quality tutorials for anyone with access to a VCR. Each segment includes a professionally narrated animation that walks you through the most difficult physiological concepts and offers self-check questions that allow you to test your understanding of the material. Segments of the Video Tutor include membrane transport, protein synthesis, muscle contraction, action potential propagation, vision, auditory function, heart function, urine formation, and the immune response.
(0-13-751843-9)

The New York Times "Themes of the Times"

Prentice Hall's unique alliance with *The New York Times* enhances your access to current, relevant information and applications. Articles are selected by the textbook author and are compiled into a free supplement that helps you make the connection between your classroom and the outside world.
(0-13-089311-0)

FOR THE LABORATORY

Prentice Hall publishes a variety of laboratory manuals to meet the diverse needs of anatomy and physiology labs. Please see your Prentice Hall sales representative for more details. Here is a list of those manuals:

Laboratory Textbook of Anatomy and Physiology, Second Edition, by Michael G. Wood. This full-color, 700-page lab manual has been designed to complement *Fundamentals of Anatomy and Physiology* by using compatible line art and terminology. It features cat dissections.
(0-13-019694-0)

Laboratory Manual for Fundamentals of Anatomy and Physiology, Fifth Edition, by Roberta M. Meehan. Cross-referenced to the *Fundamentals* textbook and using compatible line art, this manual features both cat and fetal pig dissections.
(0-13-019693-2)

Laboratory Exercises in Anatomy and Physiology with Cat Dissections, Sixth Edition, by Gerard J. Tortora and Robert B. Tallitsch. This full-color manual features cat dissections and graphics.
(0-13-920323-0)

Anatomy and Physiology Laboratory Manual, Sixth Edition, by Gerard J. Tortora and Robert J. Amitrano. This full-color manual offers a variety of laboratory exercises with minimal mammalian dissections.
(0-13-089670-5)

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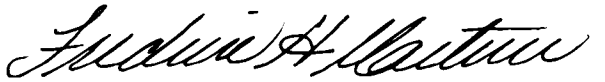
No one person could expect to produce a flawless textbook of this scope and complexity. Any errors or oversights are strictly my own rather than those of the reviewers, artists, or editors. To help improve future editions, I encourage you to send any pertinent information, suggestions, or comments about the organization or content of this textbook to me directly, using the e-mail address below. I will deeply appreciate any and all comments and suggestions and will carefully consider them in the preparation of the Sixth Edition.



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To the Student

Dear student,

Over the last few years, I've met with students in the United States and abroad. They've all expressed similar concerns, which can be boiled down to two basic questions: (1) *How do I find the time?* and (2) *What do I really need to know?* In preparing the Fifth Edition, I've tried to address both questions.

- *How do I find the time?* Although there's nothing I can do to give you more time to study A & P, I've tried to organize the material clearly and concisely and provide tips, checks, and aids—such as short summary tables within the chapters and Navigators (icons described in the walkthrough that follows). These features should help you understand the text discussions and make it easier to review the material as exam time draws near. In other words, I've tried to make sure that you get the most out of the time you *do* have.
- *What do I really need to know?* As you start the course, you may be intimidated by the sheer volume of material you will be expected to learn and understand. If you look at the text as just a block of facts you must memorize, you'd have every right to feel overwhelmed. But that's not the case, because there are general themes and patterns that appear over and over, regardless of the structure or body system you are considering. Once you recognize those themes and patterns, you will have a framework that you can use to organize information. Throughout the text, I have highlighted those patterns for you and present new information in that context. Let's face it—a year after you complete this course, you will probably have forgotten a lot of the details you memorized. But you won't forget the themes and patterns, and new (or rediscovered) details can easily fit into that framework.

A variation on the second question is *What do I need to know to be a* nurse, physical therapist, radiation technologist, and so on? Throughout this book are short boxes that relate the basic information in the text to specific diagnostic procedures or clinical conditions. For students who are especially interested in clinical applications, or who have personal questions regarding specific clinical conditions, my wife and I have prepared the *Applications Manual* that accompanies this book. This manual should be a useful reference that will form a bridge to later coursework, should you pursue a career in the health sciences.

Each of us has a learning style that fits our individual strengths and weaknesses. For some, it is the narrative; for others, the illustrations. Some people need to hear the information, whereas others need to see it, especially when dynamic processes are involved. With this edition, I've given you a lot of options to help you learn key concepts. For example, this textbook devotes more space to the illustration program than other texts do, giving you a lot of visual support. The accompanying CD-ROM offers ani-mated tutorials. If you need more practice and study drills, you can visit the Companion Website, which has interactive review questions tied to an electronic version of the text and hyperlinked to other tutorial sites on the World Wide Web. Study guides, video-tapes, and other supplements are also available. You don't have to use any or all of these supplements; you just need to know that if you cannot quite grasp a concept, plenty of options are at hand.

The next section walks you through the various features of this book. The learning aids introduced there have been built into the textbook to simplify your study of this material and to make that process more rewarding. They have evolved over the last 12 years through brainstorming sessions with students in campuses across the United States. Each year I hear from students, in person or by phone or e-mail, that this system really does work. Yet, it can help you only if you learn how to use it (preferably well before your first exam). This book will help you get the most from your course, so please take a close look at the walkthrough that follows and consult your instructor if you have questions about it.

Good luck and best wishes,