Anatomy and Physiology

Understanding the Human Body

Robert K. Clark

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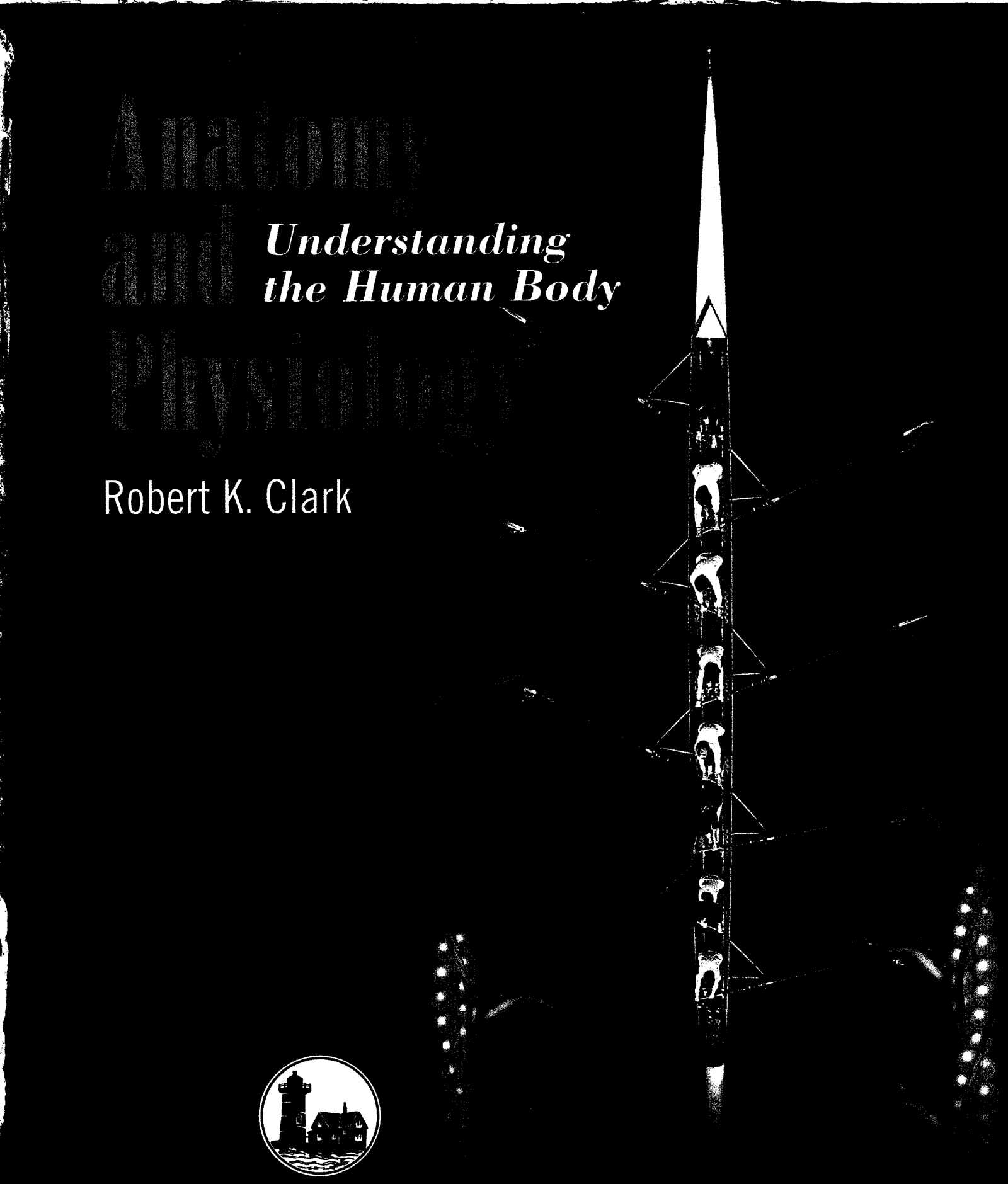

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About the Cover: A racing scull is propelled through the water by the coordinated action of the oars. Likewise, the contraction of muscle requires the coordinated activities of the proteins present in myofilaments within muscle cells. These molecular activities can be understood by considering rowing technique. In this textbook, this and similar analogies will help you to understand the molecular and cellular processes that occur in the human body.

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Preface

Anatomy and Physiology: Understanding the Human Body was designed to meet the needs of a diverse group of students. We are living in an era of amazing technological advancements, and those of our health care system are perhaps the most astonishing of all. Those preparing for careers in the allied health sciences, including careers involving direct patient care and the many allied technologies, need to understand the human body in greater detail than ever before. I wrote *Anatomy and Physiology: Understanding the Human Body* at the depth and detail these students require, while not loosing sight of their overriding need for conceptual understanding and critical thinking skills.

Many students preparing for careers outside of the biomedical field also need to understand the human body. The range of disciplines that this is true for increases yearly, but includes such diverse fields as the social sciences, criminal justice, preschool through secondary education, athletics and fitness training and in some cases, the visual and performing arts. This book provides the pedagogic tools these students need to ensure their learning.

Additionally, many people today face difficult decisions about their own health and the health care of their loved-ones. Many of these people recognize that an understanding of the human body enables them to ask the types of questions of their health care providers that help them make informed decisions; decisions they will be comforted by. Increasingly, people enroll in basic biomedical science courses at community colleges for just this reason. This book has been prepared with these people in mind as well. The text was written in a way that will encourage these students to continue reading and stick with their course even if they have not previously been successful in the sciences.

Students who do not have a strong background in the sciences or who may be intimidated by science courses often report that their textbooks are dry, difficult to follow and more than a little daunting. *Anatomy and Physiology: Understanding the Human Body* was written using a conversational style and an informal manner, much the way a friend would explain anatomy and physiology to them. It builds confidence as it teaches.

Much of what we learn in anatomy and physiology requires an understanding of processes at the cellular and molecular level, the very processes that are often the most difficult to grasp. Without this knowledge, the functions of the organ systems become merely words to memorize, or "magical" activities that are beyond comprehension. When students see that they can understand molecular and cellular activities, their interest in their studies increases greatly. This text makes these processes easy to understand because it relates them to objects and activities that students see daily, or can easily imagine. These teaching analogies are clear and simple and sometimes humorous. This increases reader enjoyment, encouraging continued reading and studying. When difficult concepts are presented, the text directly encourages the reader and offers learning strategies, just as many effective educators do in the classroom. This helps to build student confidence and encourages those who might otherwise become frustrated and abandon their studies.

Pedagogical features that aid student success abound. The entire first chapter is aimed at helping students to become effective learners and to develop life-long learning skills. By teaching students how to evaluate the biomedical information they encounter in their daily lives, it also prepares them to be effective at the kind of critical thinking skills our information era requires. Each chapter begins with a *What You Will Learn* feature, a set of goals for that chapter. It presents, as simple statements, the types of information students should expect to learn from their reading of the chapter. A similar, but longer and more detailed feature called *What You Should Know* can be found at the end of each chapter. This too contains information from the chapter in the form of simple statements. An understanding of these statements is one way to assess accomplishment of the goals of the chapter.

Learning outcomes or student success can be further determined by using the questions in the *What Did You Learn?* feature that follows each chapter. Notice that Appendix B contains the answers to the multiple choice questions so students can quickly evaluate their progress.

Although this book primarily presents the normal activities of the body, pathologic processes (disease, injury, and the body's response to these conditions) are presented where it aids understanding of normal activities. This is done in two ways: short descriptions within the text and slightly longer discussions called *Breaching Homeostasis . . . When Things Go Wrong* strategically placed at the end of key chapters. These discussions are not intended as a complete presentation on these conditions but as a starting point from which student understanding can grow. Appendix C helps the instructor to locate the pathologies that are of interest. As students explore these diseases, they should keep in mind the material presented in Chapter 1 on how to find and evaluate biomedical information. This helps them to avoid the pitfalls of the misinformation about diseases that is so abundant today.

The chemistry and cell biology chapters have been kept very simple, just enough to get these students started. Often our students are frustrated early in the course when they have to learn so much material that they don't consider to be "real" anatomy and physiology. Some of the larger concepts (i.e., the details of protein syntheses) are moved further into the text for inclusion after students have gained confidence and interest. Also included is a separate chapter specifically presenting the concept of electrical activity in cells. In this way, students learn the basics of this fascinating but sometimes challenging topic before moving into the specific activities of muscle cells or neurons. Instructors may choose to adopt the order of topics as presented here or to adapt the order of text chapters to follow their own syllabus. The text is flexible enough to instructors to do what works best for their students.

As you examine and use this text, I believe that you will find it distinctly different from others you have tried. I hope you enjoy using *Anatomy and Physiology: Understanding the Human Body.*

Ancillaries

Instructor's Tool Kit CD-ROM Compatible with Windows and Macintosh platforms, this CD-ROM provides instructors with the following traditional ancillaries.

The Instructor's Manual, provided as a text file, includes goals and objectives suitable to use as handouts and classroom exercises.

The Test Bank is available as text files and as part of the Diploma™ Test Generator software included on the CD. The Test Generator software enables you to choose an appropriate variety of questions, create multiple versions of tests, even administer and grade tests on-line.

The PowerPoint™ Lecture Outline Slides presentation package provides lecture notes and images for each chapter of *Anatomy and Physiology: Understanding the Human Body.* A PowerPoint™ viewer is provided on the CD. Instructors with the Microsoft PowerPoint™ software can customize the outlines, art, and order of presentation.

The Kaleidoscope Media Viewer provides a library of all the art, tables, and photographs in the text to which Jones and Bartlett Publishers holds the copyright or that are in the public domain. The Kaleidoscope Media Viewer uses your browser—Internet Explorer or Netscape Navigator—so you may project images from the text in the classroom, insert images into PowerPoint presentations, or print your own acetates.

Anatomy and Physiology On Line This text's Web site, www.bioscience.jbpub.com/anatomy, provides additional resources to expand the scope of the textbook and make sure students have access to the most up-to-date information in anatomy and physiology. Students can find a variety of study aids in the eLearning area, such as chapter outlines, flash cards, and review questions. Carefully chosen links to relevant Web sites enable students to explore specific topics in anatomy and physiology in more detail. A brief description of each link places the site in context before the student connects to it.

Acknowledgments

I would like to thank the many people who assisted and encouraged me in the preparation of this textbook. The administration and faculty of Cumberland County College in Vineland, New Jersey have been very supportive. Special thanks go to the following members of our college community: President Dr. Kenneth Ender, Vice President of Academic Affairs and Enrollment Services Dr. Thomas Isekenegbe, former Academic Dean Dr. Jack Lobb, and Health and Science Division Chair Ms. Jane Leggieri. I express special thanks to my esteemed humanities colleague, Professor John Adair, who bravely read and red-inked an entire early draft. Thanks also go to Mr. Amar Madineni for his tireless answers to my endless technology questions.

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The writing of this textbook was aided, in part, by a sabbatical leave from Cumberland County College, Vineland, New Jersey.

Robert K. Clark
Pilesgrove, New Jersey
January, 2005

About the Author

Dr. Clark is an associate professor in the Health and Science Division of Cumberland County College in Vineland, New Jersey, where he teaches Anatomy and Physiology I and II, Human Biology, Pathology, and Genetics and has been awarded the President's Award for Excellence in Leadership, Service and Scholarship. He was named 2001 New Jersey Professor of the Year by the Carnegie Foundation for the Advancement of Teaching.

He earned a Bachelor of Science Degree in Marine Biology from the University of New England and a Ph.D. from Hahnemann University (now part of Drexel University) in Experimental Pathology. His extensive research experience has led to numerous publications in the fields of cancer, stroke, and HIV/AIDS.

Commercial farmers for more than 21 years, Bob and Lise Clark raise specialty produce and goats on their southern New Jersey farm. He is shown here with week-old triplets, the results of the Clark's tinkering with goat coat-color genetics.

Brief Contents

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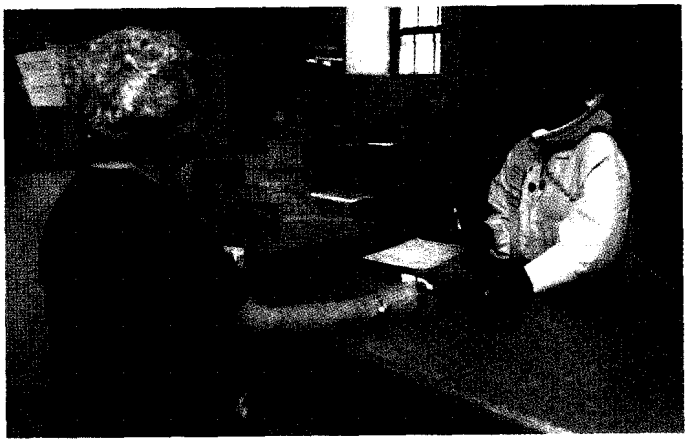

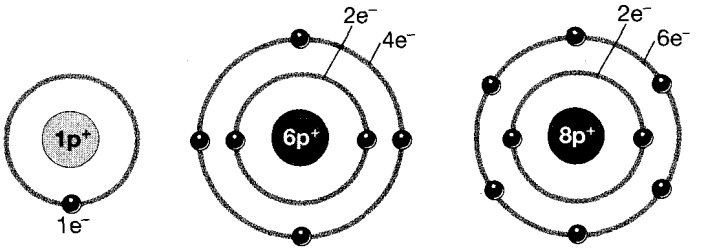

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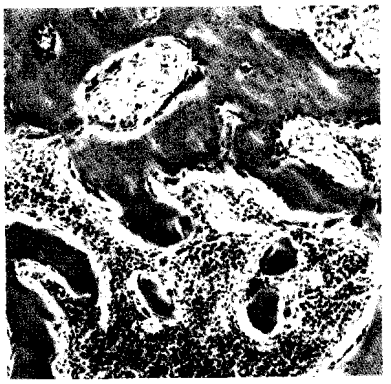
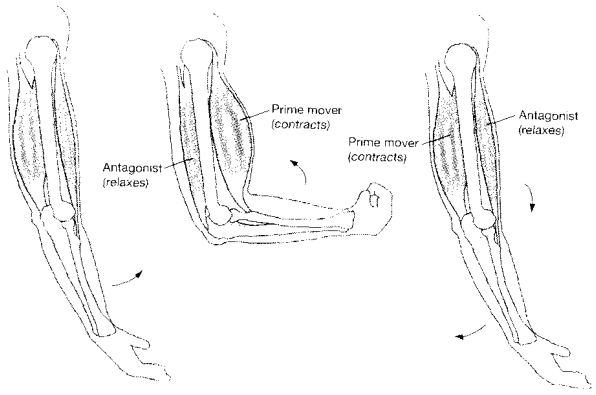
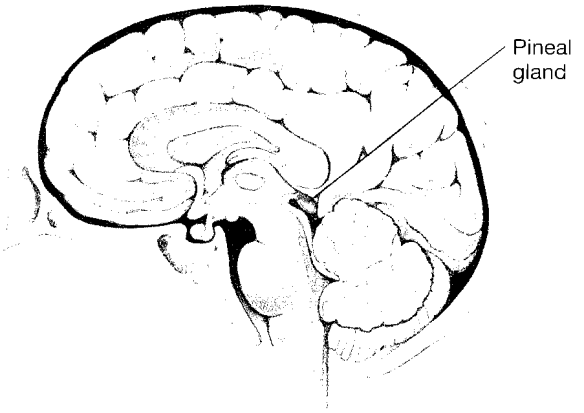
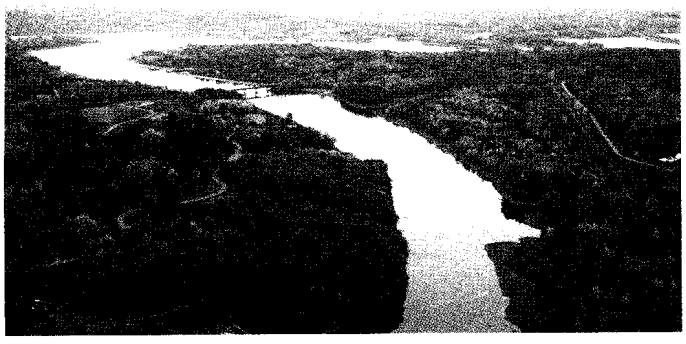
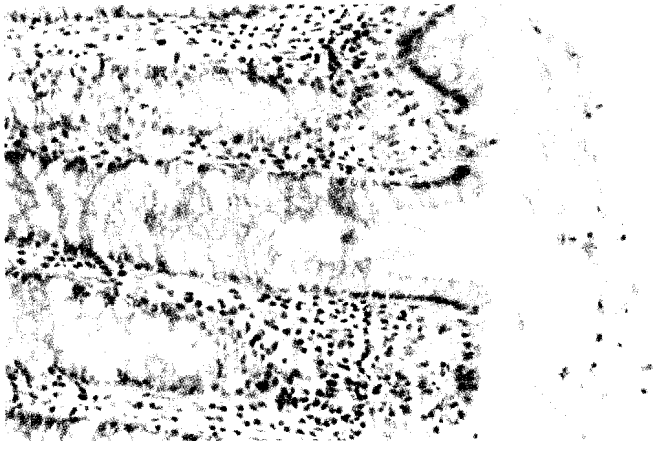
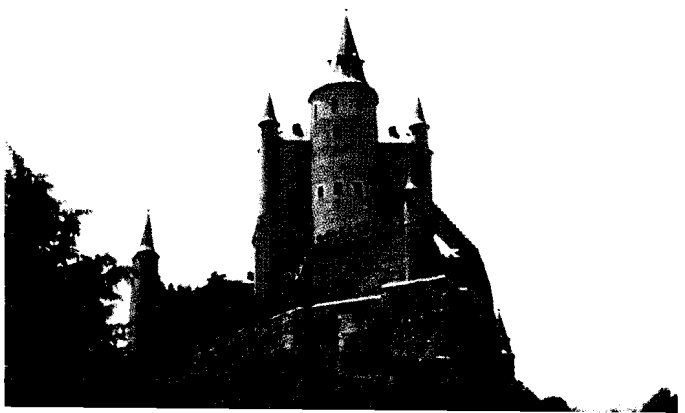






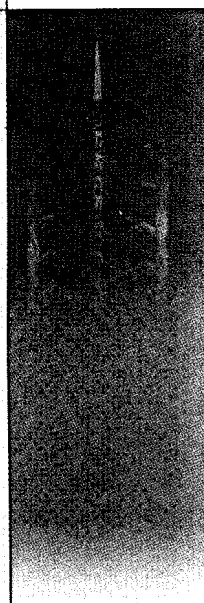






PART 1

Foundations For Understanding The Human Body



Why Must We Learn These Foundations?

We are about to embark on a study of the basic anatomy (form) and physiology (function) of the human body. These disciplines can be highly complex and we will need to develop a common language to understand what happens within the body. Some students approach these topics with a thorough background in the sciences. Others have not yet had the opportunity to develop this science foundation. In the first section of this text, we will work at developing a common level of science literacy. This will allow us to discuss the human body with the language of science and some basic knowledge of science as we move into the disciplines in which we are specifically interested: anatomy and physiology. We will also spend some time learning study skills and examination techniques that may help you to be more successful in your studies. Whether you are reading this book as part of a course or reading on your own to increase your understanding of your body, these techniques may assist you in reaching your goal.

Some students may be tempted to skip over this early information and move right into the chapters dealing with the organs or systems that interest them. That would be a mistake. We can only understand the organs if we understand the cells of which they are composed. We can only understand how these cells work if we have some knowledge of basic chemistry. Without this knowledge, the functions of our organs appear to be magic and beyond our comprehension. Rather than developing an understanding of the body, you would merely memorize a lot of terminology that you would quickly forget. The fact that you are reading this text shows that you have a desire to understand your body. Do not cheat yourself of this understanding by not laying a suitable foundation for it. Please spend some time on the chapters in this section now, and trust that this information will help you to develop the understanding you seek.