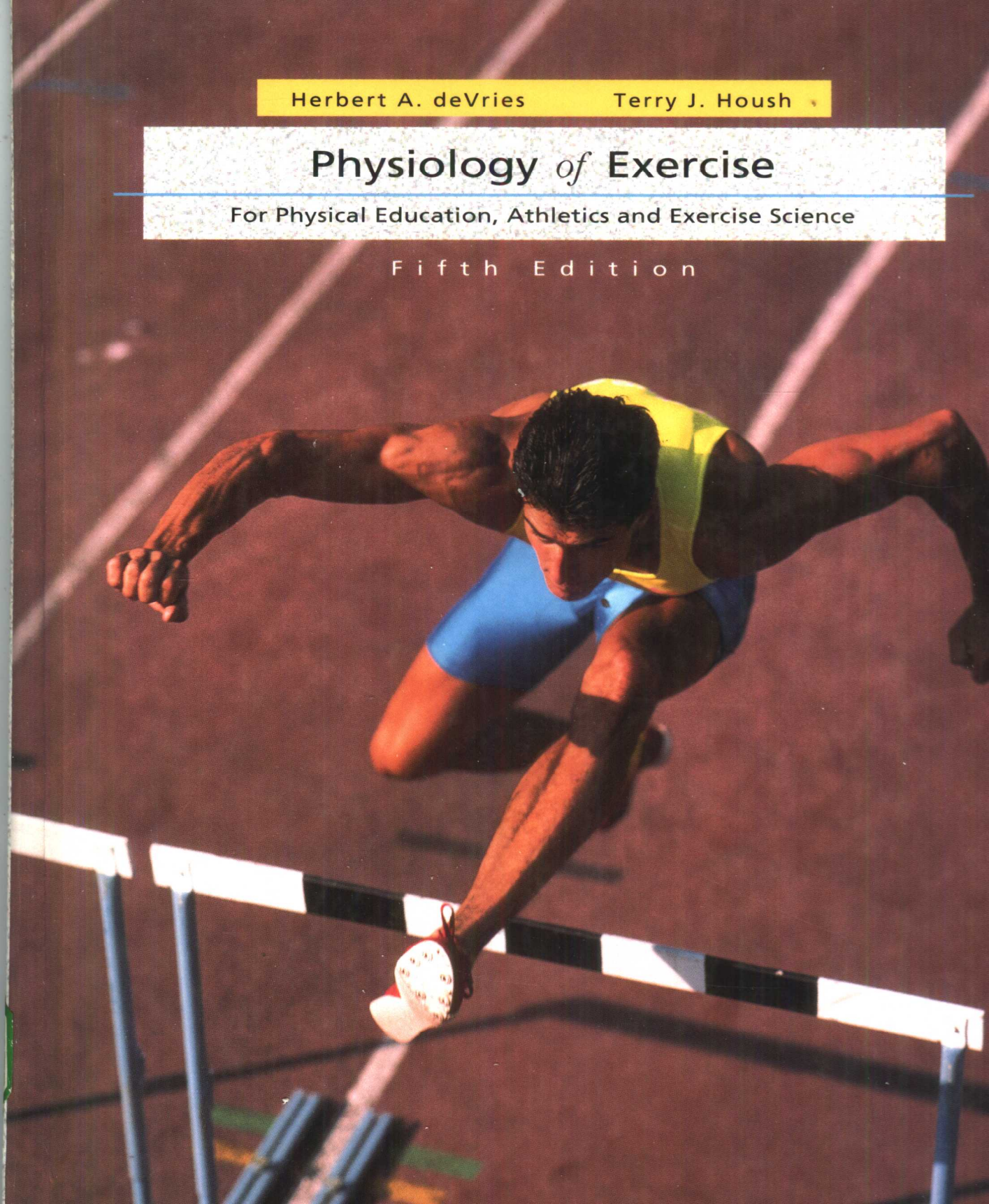
Herbert A. deVries Terry J. Housh

Physiology *of* Exercise

For Physical Education, Athletics and Exercise Science

Fifth Edition



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Preface

Over the years of working with undergraduate and graduate students in the physiology of exercise laboratory, I've noticed that theory and practice are not always related in the student's mind. Too often, the scientific method remains an ivory tower concept, never applied. Unfortunately, some coaches base their practices on the methods of a highly successful athlete, whose success may be totally unrelated to the fads used in his or her training. Because of such practices and conditions, I have made an effort to bring theory and practice closer together—adding the *how to* approach while at the same time respecting scientific investigations that provide the *why* for the *how to*.

Physiology of Exercise for Physical Education and Athletics is concerned with human responses and adaptations to muscular activity. The text provides a basis for the study of physical fitness and athletic training. It is written primarily for the upper-division undergraduate student who has a background in basic anatomy and general physiology. A knowledge of physics, chemistry, or mathematics beyond the high school level is not necessary. In addition, those who aspire to be athletic coaches will find within these pages the scientific basis for their profession. Since emphasis is placed upon the holes in our patchwork quilt of knowledge and since a substantially updated and expanded bibliography is provided at the end of each chapter, the text can also assist the graduate student who wishes to chip away at the frontiers of knowledge in this discipline. Those who use exercise as a therapeutic modality will also find guiding principles in this text.

Ever since the first edition this textbook has been divided into three parts, because I realize that students enter this field with greatly diverse backgrounds in the basic sciences. Thus, Part 1 selectively reviews the most pertinent areas of basic physiology. In classes where the students' background in general physiology is strong, the instructor can emphasize applications that are presented in Parts 2 and 3. We have maintained this organization because of its basic pedagogic soundness and its obvious advantages where homogeneity of lower-division preparation is not common.

In the third edition a clearer division and better definition of the second and third parts was possible. In the years since the second edition, it had become clear that physical fitness can contribute substantially to lifelong good health. The body of evidence that was previously only suggestive had rapidly become compelling. Therefore, the text was reorganized to recognize that the study of exercise physiology has two major interests for the physical educator. The first is the enhancement of health and physical fitness for the general population, and the second is optimization of performance in the various types and levels of competitive athletics. Thus, the third and fourth editions were organized quite naturally into three parts. The first deals with the basic physiology that provides the groundwork for application to our field. Although this is organized on a systemic basis, the potential applications are pointed out and emphasized. Recognizing the basic differences in interest between those who are primarily teachers of health and physical education and those whose future lies largely in the coaching of athletics, the second section deals with the physiology of exercise directed toward health and fitness, while the third section is devoted to the scientific improvement of athletic performance.

The foregoing is how I introduced the fourth edition of this text. I now have a much more important introduction to make. I have prevailed upon Dr. Terry J. Housh to join me in writing this fifth edition. It is with great pleasure and satisfaction that I welcome Dr. Housh to the rewarding task of communicating the body of knowledge in exercise physiology to the new generations of physical education teachers and coaches. He is, at a young age, already Director of the Human Performance Laboratory at the University of Nebraska-Lincoln. He has achieved eminence in our field and has had wide experience with both undergraduate and graduate students who are impressed with his enthusiasm as well as his erudition. Those who are familiar with the earlier editions will readily recognize the improvement that our collaboration has brought about in this fifth edition.

Herbert A. deVries
Laguna Beach, California

In the fifth edition we have added three new chapters. In the first section we have included a chapter (chap. 11) titled "The Immune System and Exercise." Anecdotal evidence suggests that exercise enhances an individual's resistance to infection, but coaches are often concerned about an increased number of infectious episodes particularly near the end of the competitive season. These conflicting testimonials indicate a need to discuss such important questions as: 1) the effect of acute and chronic exercise upon immune function; 2) the relationship of intensity, duration, and frequency of exercise and immune function; and 3) what clinical implications result from the foregoing relationships?

In the second section we have added a chapter (chap. 18) titled "Growth, Development, and Exercise in Children and Adolescents." The interest and participation of children and adolescents in recreational and competitive sports has increased dramatically in recent years. Therefore, professionals in our field must be knowledgeable in the areas of normal growth and development as well as the effects of exercise on young competitors. Chapter 18 attempts to satisfy this need.

In the world of physical education and most especially in the realm of athletic performance, we are constantly involved directly or indirectly with the concept of fatigue. In all events in which time or distance are criteria of success, we are of necessity concerned with an endpoint largely determined by this entity we call "fatigue." Since neuromuscular fatigue is so basic to performance we have added a new chapter (chap. 20) on this subject to the second section of the text.

The fifth edition contains many new and updated figures. In some instances, however, we chose to retain classic figures from older references. When communication could be improved, existing figures from the fourth edition were modified or new figures were added. However, when updating figures from more recent citations did not add to the clarity of presentation, we chose to retain the well established figures from the past. We believe that the primary responsibility of this text is to communicate, in the best possible way, with students who are studying to become physical educators, coaches, and exercise scientists. Part of our commitment to those students is to maintain a link with the rich heritage of exercise physiology, while also providing the most up-to-date information available. One way to

provide an understanding of the chronology of developments in exercise physiology is to include the classic works in the area along with the most modern citations and utilize some of the excellent diagrams and figures from the pioneer scientists in our discipline.

We are grateful to the hundreds of scientists around the world who have made this text possible. While it is not possible to acknowledge every contributor to this work we would like to recognize the following scientists who have been influential in the course of our professional lives: Martha Coryell, Stroudsburg State University; Roger J. Williams, University of Texas; J. Pat Meehan and Aileene Lockhart at University of Southern California; Glen O. Johnson, University of Nebraska-Lincoln; and William G. Thorland, Washington State University.

We also wish to thank our editors, Chris Rogers and Scott Spoolman of Brown & Benchmark Publishers, for their generous support.

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PART 1

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