

Exercise Physiology

Theory and Application to Fitness and Performance

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EXERCISE PHYSIOLOGY: THEORY AND APPLICATION TO FITNESS AND PERFORMANCE, FOURTH EDITION

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Preface

imilar to previous editions, the fourth edition of Exercise Physiology: Theory and Application to Fitness and Performance is intended for students of exercise science, clinical exercise physiology, physical education, sport physiology, athletic training and sports medicine, and physical therapy. The goal of this text is to provide the student with an up-to-date understanding of the physiology of exercise. In addition, the book contains extensive practical applications, including work tests to evaluate cardiorespiratory fitness and information on exercise training for improvements in health-related fitness and sports performance.

This book is intended for a one-semester, upper-level undergraduate or beginning graduate exercise physiology course. Clearly, the text contains more material than can be covered during a typical fifteen-week semester. This is by design. The book was written to be comprehensive in order to afford instructors a large degree of freedom to select the material that they consider most important for the makeup of their class.

New to This Edition

The fourth edition of this book has undergone extensive revision. The major changes include:

- The new edition applies exercise physiology to sports performance and conditioning in The Winning Edge boxes, helping students better understand pragmatic applications of the field.
- Links exercise physiology to health-related fitness and rehabilitation concerns through Clinical Applications boxes.
- Includes up-to-date information on the effects of creatine supplementation on performance and lean body mass and other new developments in the use of ergogenic aids in sports performance in chapters 3 and 25.
- Offers the most current information on the effects of physical activity on health in chapter 16.

- Provides the latest research on the effects of endurance exercise training on skeletal muscle fiber types in chapter 8.
- Looks at new information on the role of diet composition on "syndrome x," diet supplements, drugs and weight loss, and fad diets and weight loss in chapter 18.
- Discusses the most up-to-date information on physical activity and health utilizing information contained in the Surgeon General's Report in chapter 16.
- Considers updates on resistance training from both a physiological and health-related perspective.

Contents and Organization

All topics in exercise physiology addressed within this text are presented in a contemporary fashion supported by up-to-date references. The text is divided into three sections: (1) Physiology of Exercise, (2) Physiology of Health and Fitness, and (3) Physiology of Performance. Section one (Physiology of Exercise) contains 13 chapters that provide the necessary background for the beginning student of exercise physiology to understand the role of the major organ systems of the body in maintaining homeostasis during exercise. Indeed, a major theme in section one is that almost all organ systems work to help maintain a relatively stable internal environment during exercise. Also included in section one are chapters covering an overview of biological control systems, bioenergetics, exercise metabolism, endocrine function during exercise, techniques for measurement of work, power, and energy expenditure, neuromuscular function during exercise, cardiopulmonary responses to exercise, acid-base regulation during exercise, temperature regulation, and the effects of endurance training on various organ systems.

The chapters in the first section provide an upto-date presentation of exercise physiology without consideration as to how that information is applied to fitness or performance. The purpose of the second and third sections of the text is to address these concerns. These least two sections distinguish between exercise programs that are appropriate for attainment of health-related fitness goals versus those needed to realize world-class or individual maximal performance goals. Section two of the text (Physiology of Health and Fitness) contains five chapters dealing with health-related fitness: (1) factors that limit health and fitness, (2) work tests used to evaluate cardiorespiratory fitness, (3) training methods for fitness, (4) exercise concerns for special populations, (5) body composition and nutritional concerns for health.

Section three includes seven chapters dealing with the physiology of performance: (1) factors affecting performance, (2) work tests to evaluate performance, (3) training techniques for improvement of performance, (4) training concerns for special populations, (5) nutrition, body composition, performance, (6) environmental influences on performance, and (7) ergogenic aids. A unique aspect of sections two and three of the book is the inclusion of two chapters on exercise training for special populations. These chapters include discussions of exercise for women, asthmatics, diabetics, and the elderly.

Writing Style

The concepts in this text are presented in a simple and straightforward style. Illustrations and examples are commonly used to clarify or further explain a concept. Technical terms are defined as they are presented, highlighted in a box at the point-of-use, and are also organized in a glossary at the end of the book.

End of Book

Appendices

Exercise Physiology: Theory and Application for Fitness and Performance includes seven appendices that are valuable resources for the student. These include (1) Calculations of oxygen uptake and carbon dioxide production; (2) Estimated energy expenditure during selected activities; (3) Physical activity prescriptions; (4) Recommended dietary allowances for vitamins and minerals; (5) Estimated safe and adequate intakes; (6) Recommended energy intake;

and (7) Estimate of percent body fat from skinfold measurements.

Glossary

The end of book glossary is a helpful study aid, which provides quick access to the definitions of all the key terms.

Other Supplements

Computerized Test

The test bank software provides a unique combination of user-friendly aids that enable the instructor to select, edit, delete, or add questions, as well as construct and print tests and answer keys. The computerized test bank package is available for IBM Windows and Macintosh computers.

Exercise Physiology Videolabs

These videolabs show clear and complete demonstrations of common lab experiments to support students with limited access to labs. Also included is an Instructor's Guide which provides guidance on using the videolabs, and a **Student Video Manual** that reinforces concepts through worksheets and activities. This manual is available for student purchase.

McGraw-Hill's Exercise Physiology Supersite

The Exercise Physiology Supersite provides a wide array of information for instructors and students, from text information to the latest technology. It included professional organization, convention, and career information. Visit the website at

www.mhhe.com/hper/physed/exercisephys

Additional features of the supersite include: Up Close and Personal This link identifies who works on the exercise physiology list at McGraw-Hill, which conventions we attend, how to become a reviewer, and how to submit a book proposal.

By the Book To log onto the Powers/Howley Exercise Physiology: Theory and Application to Fitness and Performance home page, go www.mhhe.com/hper/physed/exercisephys

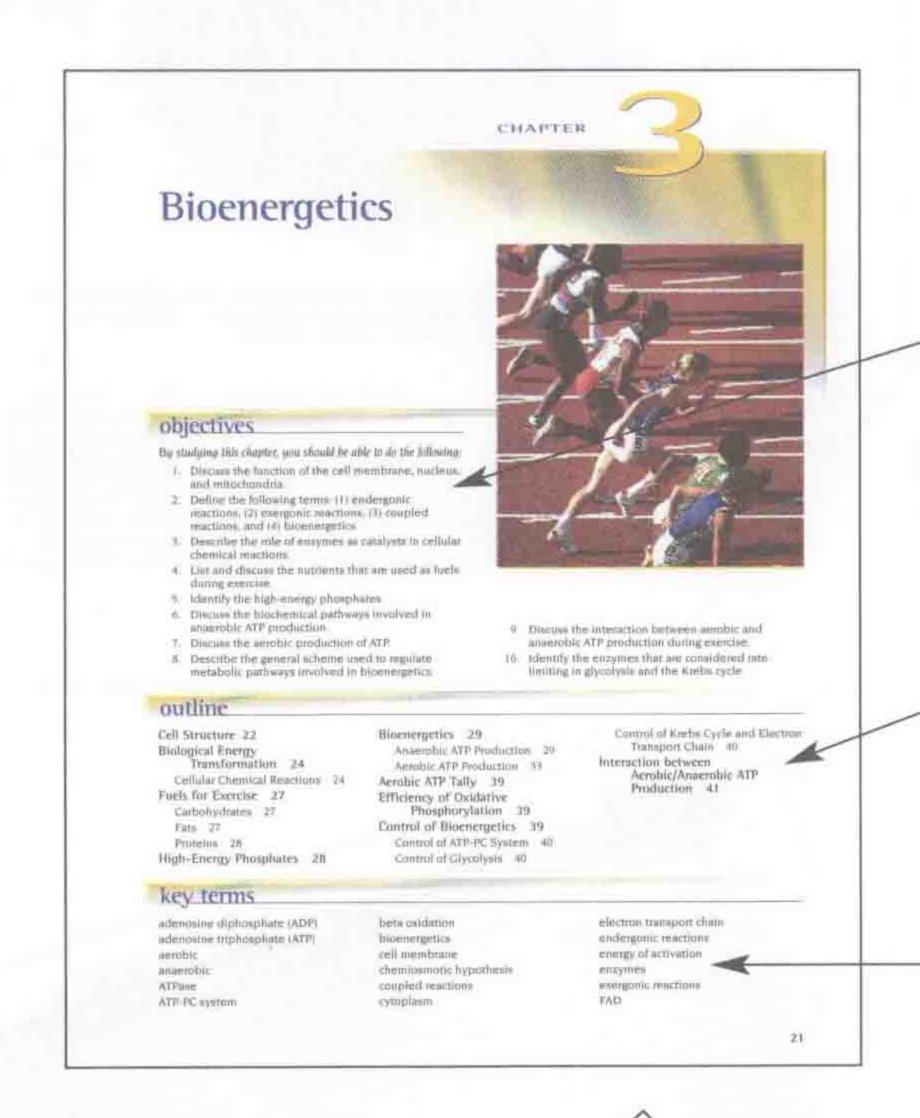
Personalize Your Course This includes sample simulations, journal articles, and additional features to assist in preparing for the profession of exercise physiology.

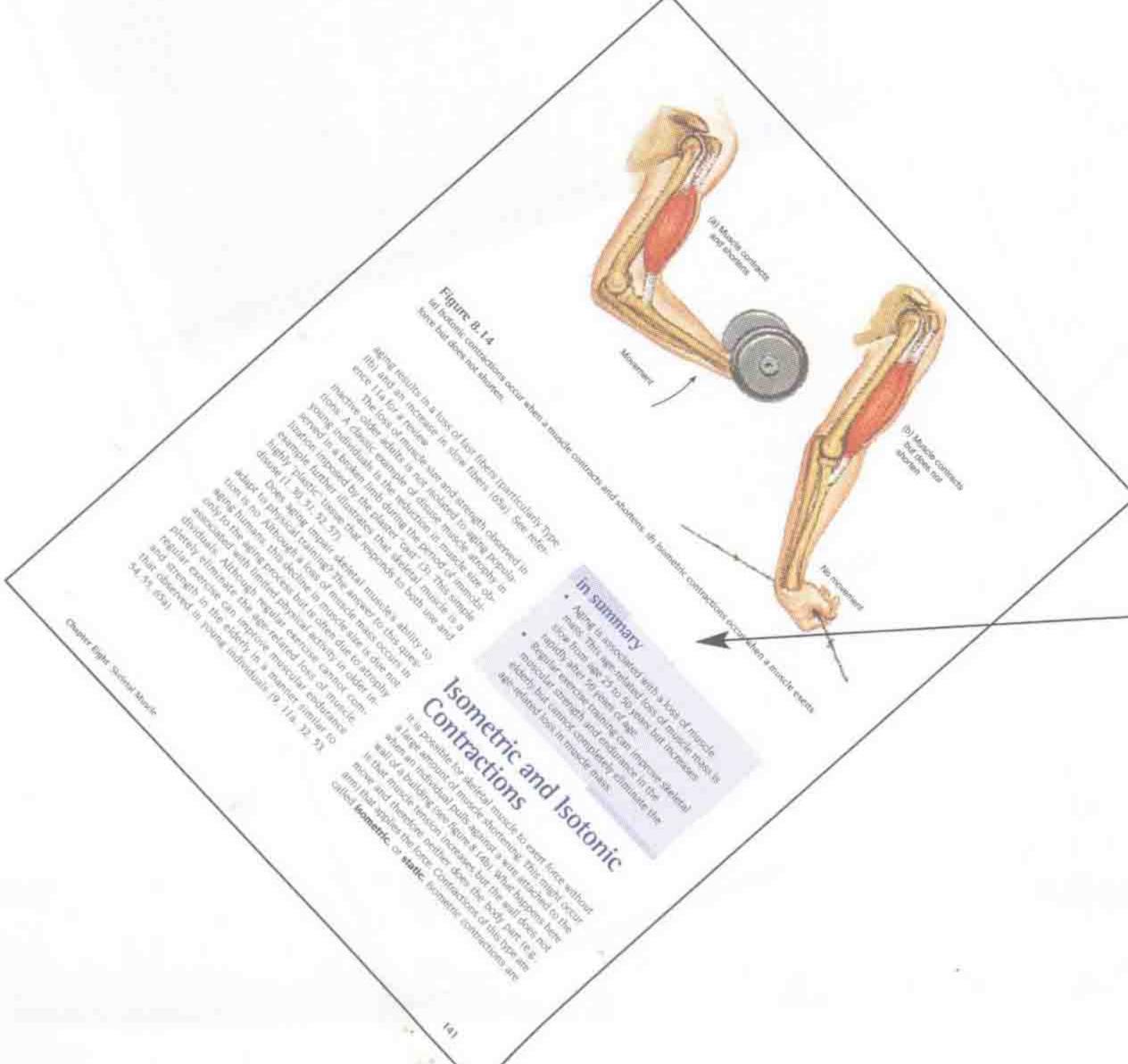
Especially McGraw-Hill This links to other resources McGraw-Hill has to offer.

Guided Tour

As an aid to help students study and learn the material within Exercise

Physiology the following pedagogical devices are included in the text:





Learning Objectives

Each chapter begins with a list of learning objectives. Guided by these objectives, students know what material to focus their attention on as they explore each chapter.

Outline of Topics

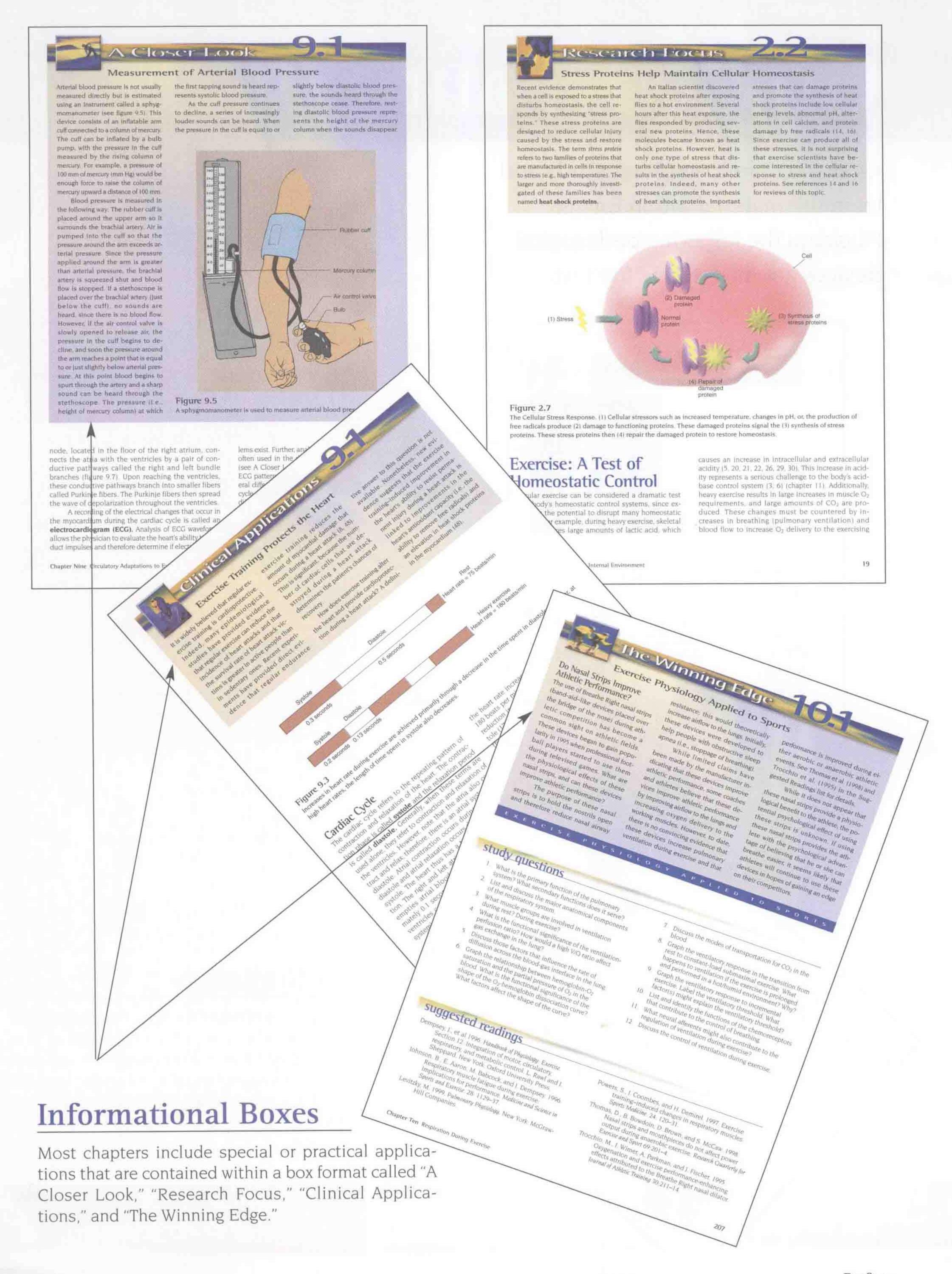
This provides students with a mental framework for organizing chapter topics; title page references help students locate topics quickly as they prepare for class and review for exams.

Key Terms

Key terms are highlighted when they are first introduced and defined in the text. The visual emphasis makes the terms easy to locate.

In Summary

At the end of major sections throughout the text, students are given a summary of the important ideas presented in the section. These summaries ensure that students grasp the key concepts and immediately reinforce the main ideas.



The Winning Edge

Exercise Physiology Applied to Sports

Do Nasal Strips Improve Athletic Performance? The use of Breathe Right nasal strips (band-aid-like devices placed over the bridge of the nose) during athfetic competition has become a common aight on athletic fields. These devices began to gain popularity in 1995 when professional football players started to use them during televised games. What are the physiological effects of these nasal strips, and can these devices (mprove athletic performance?

The purpose of these nasal strips is to hold the nostrils open and therefore reduce nasal airway

resistance: this would theoretically increase airflow to the lungs initially, these devices were developed to help people with obstructive sleep apnea (i.e., stoppage of breathing)

While limited claims have been made by the manufacturer indicating that these devices improve athletic performance, some coaches and athletes believe that these devices improve athletic performance by Improving airflow to the lungs and increasing oxygen delivery to the working muscles. However, to date. there is no convincing evidence that these devices increase pulmonary ventilation during exercise and that

performance is improved during either seroble or anaeroble athletic events. See Thomas et al. (1998) and Trocchio et al. (1995) in the Suggested Readings list for details.

While it does not appear that these nasal strips provide a physiological benefit to the athlete, the potential psychological effect of using these strips is unknown If using these nasal strips provides the athlete with the psychological advantage of believing that he or she can breathe easier, it seems likely that athletes will continue to use these devices in hopes of gaining an edge on their competitors

study questions

- What is the primary function of the pulmonary.
- system? What secondary functions does it serve? List and discuss the major anatomical components of the respiratory system.
- 3 What muscle groups are involved in ventilation. during rest? During exercise?
- 4. What is the functional significance of the ventilationperfusion ratio? How would a high V/O ratio affect. gas exchange in the lung?
- 5 Discuss those factors that influence the rate of diffusion across the blood-gas interface in the hing-
- Graph the relationship between hemoglobin O₂. saturation and the partial pressure of Op in the blood. What is the functional significance of the shape of the O₂-hemoglobin dissociation curve? What factors affect the shape of the curve?
- 7. Discuss the modes of transportation for CO; in the blood
- Graph the ventilatory response in the transition from rest to constant-load submaximal exercise. What happens to ventilation if the exercise is prolonged and performed in a hot/humid environment? Why?
- Graph the ventilatory response to incremental exercise Label the ventilatory threshold What factor(s) might explain the ventilatory threshold? List and identify the functions of the chemoreceptors.
- that contribute to the control of breathing. 11. What neural afferents might also contribute to the
- regulation of ventilation during exercise?

12. Discuss the control of ventilation during exercise.

suggested readings

Dempsey I et al 1996 Flandbook of Physiology Exercise Section 12: Integration of motor, circulatory respiratory, and metabolic control L. Rawl and I. Sheppard. New York: Oxford University Press.

Johnson H. E. Aaron M. Babcock and J. Dempsey. 1996. Respiratory muscle fatigue during exercise Implications for performance. Medicine and Science in Sports and Exercise 28: 1129-37

Levitzky, M. 1999: Pulmonary Physiology. New York: McGraw-Hill Companies

Up-to-Date References

content of each chapter.

The current reference list is a comprehensive guide to

relevant journal articles and texts that influence the

Chapter Ten Respiration During Exercise

Powers, S., I. Coombes, and H. Demirel. 1997. Exercise. training-induced changes in respiratory muscles. Sports Medicine, 24: 120-31

Thomas, D., B. Bowdoin, D. Brown, and S. McCaw. 1998. Nasal strips and mouthpieces do not affect power output during anaerobic exercise. Research Quarterly for Exercise and Sport 69:201-4.

Trocchio M. I. Wimer A. Parkman, and J. Fischer 1995. Oxygenation and exercise performance-enhancing effects attributed to the Breathe Right nasal dilator Journal of Athletic Training 30-211-14.

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references

 Allen, C., and N. Jones. 1984. Rate of change of. alveolar carbon dioxide and the control of ventilation during exercise. Journal of Physiology (London) 355:1-9

Study Questions

Suggested Readings

available at bookstores or public libraries.

Study questions help students check their under-

standing of the chapter content and prepare for exams.

Because students want to know more about a particu-

lar topic, a list of annotated readings is given at the

end of each chapter. These suggested readings are

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- Brice, A. et al. 1988. Ventilatory and PCO₃ responses. to voluntary and electrically induced leg exercise Journal of Applied Physiology 64:218-25. 15 Brown H. K. Wasserman, and B. Whipp 1976 Effect
- of beta-adrenentic blockade during exercise on ventilation and gas exchange fournal of Applied Physiology 41:886-92 16: Brown, D. et al. 1990. Ventilatory response of spinal cord-lesioned subjects to electrically induced
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Section One Physiology of Exercise

XVII Preface

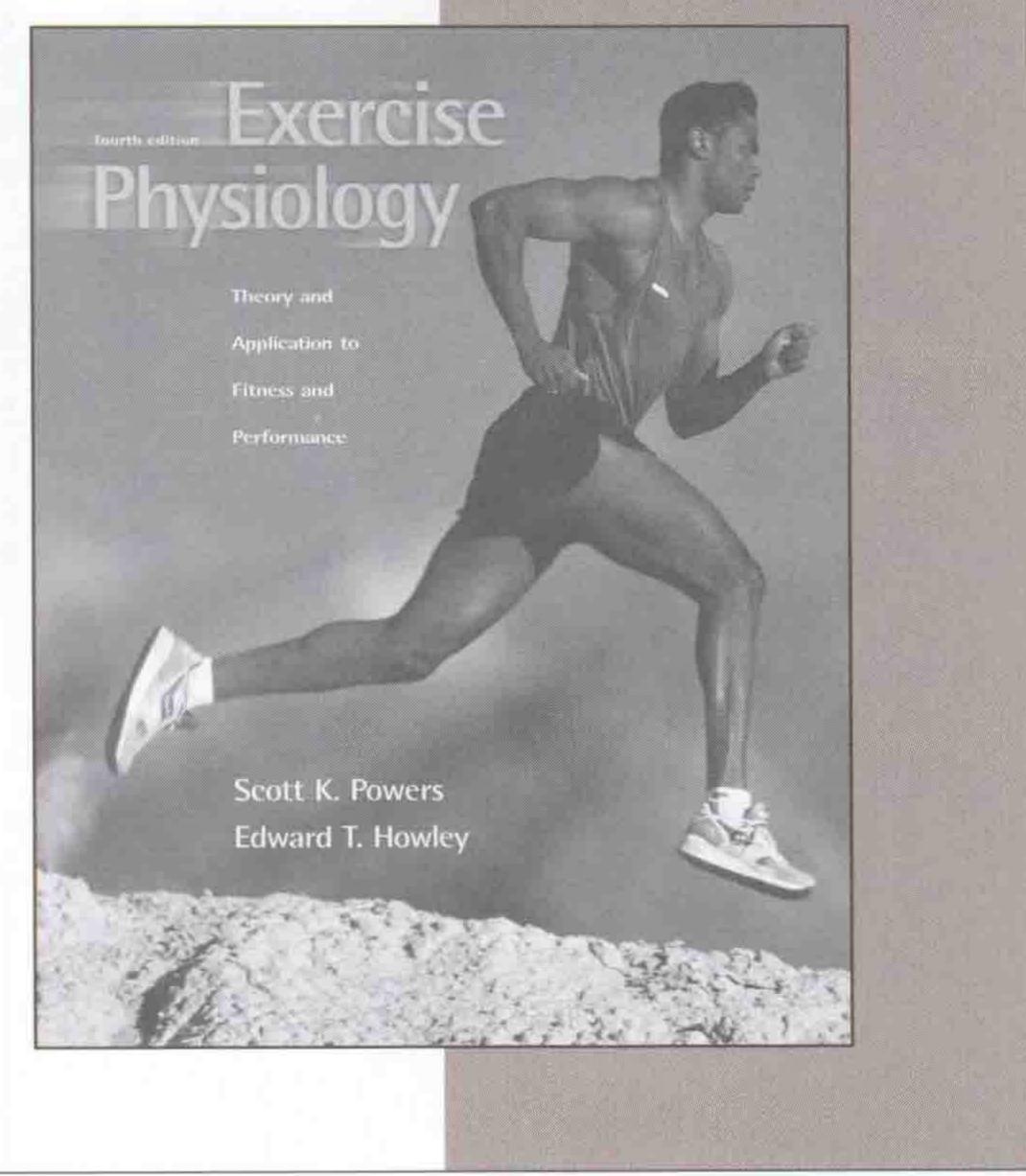
Supplements

Instructor's Manual

The instructor's manual provides a chapter-by-chapter overview of key concepts to be stressed by the instructor as well as a multiple choice test bank. The instructor's manual also provides suggestions for laboratory exercises.

Instructor's Manual and Test Bank

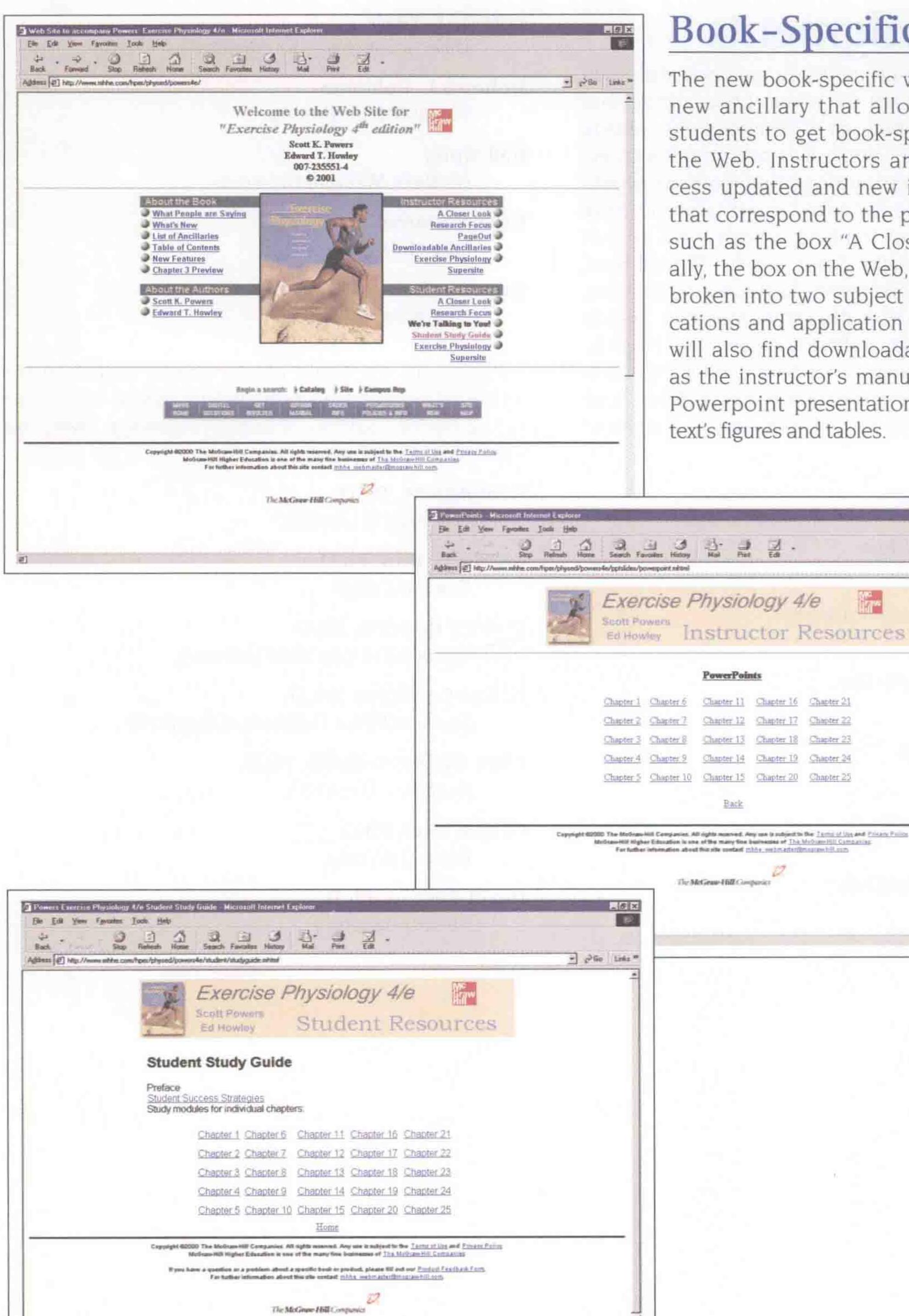
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Book-Specific Web Site

The new book-specific website is a special, new ancillary that allows instructors and students to get book-specific resources on the Web. Instructors and students can access updated and new informational boxes that correspond to the pedagogy in the text, such as the box "A Closer Look." Additionally, the box on the Web, "Research Focus," is broken into two subject areas: clinical applications and application to sport. Instructors will also find downloadable ancillaries such as the instructor's manual and lecture-ready Powerpoint presentations complete with the text's figures and tables.

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