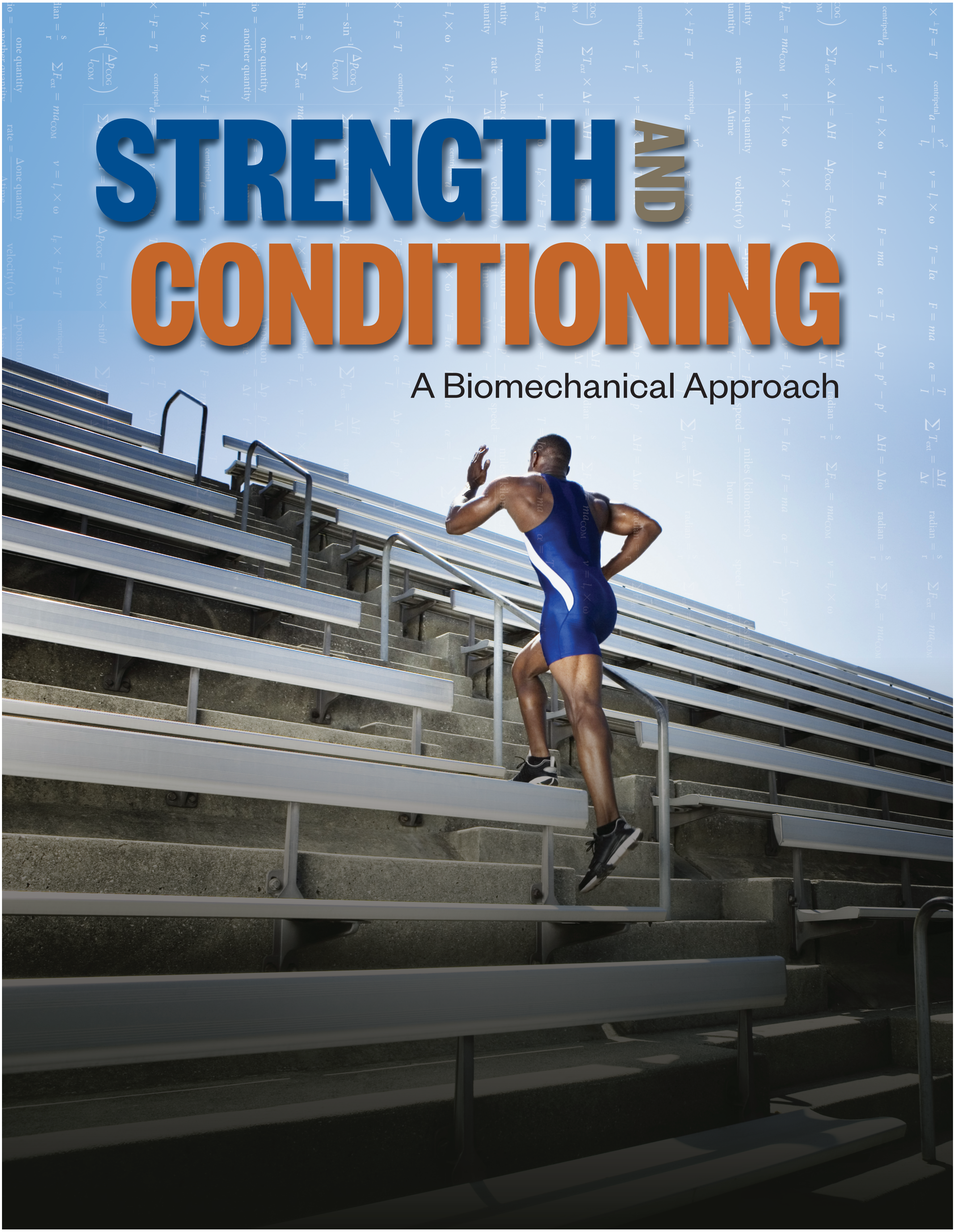
STRENGTH AND CONDITIONING
A Biomechanical Approach

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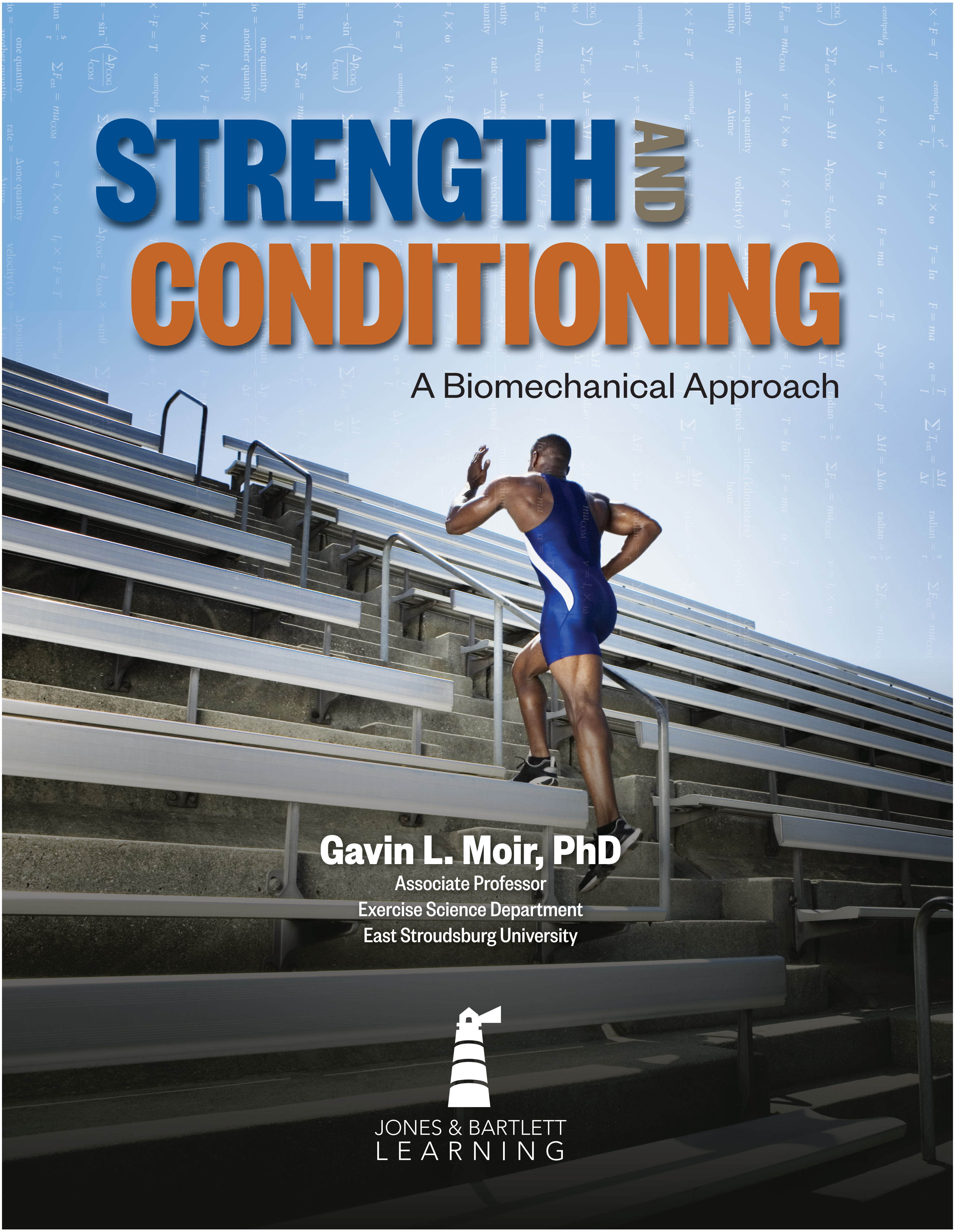

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Brief Contents

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Preface

Physical training is a process through which genetic potential is realized (Tucker & Collins, 2012), and strength and conditioning practitioners are tasked with implementing physical training to optimize the performance of their athletes. It is difficult to quantify the importance of strength and conditioning in the preparation of athletes, but the strength and conditioning coach is now a common element in the training process. The field of strength and conditioning is becoming more professionalized, as highlighted by the founding of organizations such as the Australian Strength and Conditioning Association, the National Strength and Conditioning Association, and the U.K. Strength and Conditioning Association. The academic preparation of strength and conditioning professionals is a high priority of each of these organizations.

Biomechanics is formally defined as the application of mechanics to biological organisms, where the action of forces on the organism is studied within a framework of Newtonian mechanics. The application of biomechanics to strength and conditioning is not well represented in existing texts, yet biomechanics informs our understanding of both the adaptations to exercise and the principles underlying sporting movements. Beyond the formal definition of the subject, Bartlett (2007) defines the focus of biomechanics as being the assessment of movement patterns of athletes, a description that holds great significance for a practitioner. The regrettable lack of emphasis on biomechanics in the study of strength and conditioning may stem from the difficulties associated with the counterintuitive concepts with which the student must grapple (Heishe & Knudson, 2008). Eschewing this subject, however, is unfortunate given the insight the practitioner can gain from an understanding of biomechanical principles.

While biomechanics is underrepresented in strength and conditioning texts, skill acquisition is rarely mentioned at all. This is an enormous oversight for a field in which the practitioners are implicitly concerned with how athletes are able to coordinate their movements in a given situation. When reading the coverage afforded to skill acquisition in extant literature related to strength and conditioning, one may easily infer that the role of the practitioner is to specify which movements the athlete should employ in their given sports. These movements can then be trained for, it would seem, through the administration of specific drills that are repeated until the coach deems that the movement has been learned. This repetitious, drill-based approach to motor skill acquisition is necessarily predicated on the assumption there is a single, optimal model for a given movement task. An obvious corollary to such an approach is that the strength and conditioning coach is aware of such optimal models. This scenario would require the practitioner to demonstrate a clear understanding of biomechanical principles, something that is unlikely to be garnered from existing strength and conditioning texts. Moreover, the "cookie-cutter" approach to skill acquisition contained within the literature ignores the individual constraints that act upon each athlete that must preclude the existence of "optimal" models for specific movements. Indeed, some authors refer to this optimal model approach to coaching simply as *lazy* (Bartlett, 2007). This texts applies a constraints-led approach to skill acquisition (Davids, 2010). Within this framework, strength and conditioning practitioners are encouraged to develop training sessions and practices that allow athletes to explore the movements that are appropriate for them to achieve the goals of a specific task rather than prescribe specific movement patterns.

Another premise of this text is that the practices adopted by strength and conditioning practitioners should be guided by evidence. Evidence-based practice was developed in the medical fields in response to the perceived need to base practice upon evidence accrued from a number of often disparate sources. The call for an evidence-based approach to practice has been proposed in strength and conditioning specifically (English, Amonette, Graham, & Spiering, 2012) due to the misleading and often bogus information that abounds in this field. Before practitioners change their training practices to incorporate new devices or methods, they should have sufficient evidence of their efficacy. This text presents the latest evidence to support the claims made within each chapter.

Content Overview

Chapters 1 through 5 cover aspects of biomechanics pertinent to strength and conditioning. Topics discussed include Newtonian mechanics; the mechanics of biologic tissue, including muscle and tendon; bioenergetics; and the different indices of muscular strength and their importance for specific sports. Chapters 6 through 8 focus on some programming aspects of strength and conditioning, covering training methods to develop muscular strength and power, flexibility, and the development of effective warm-up regimens. Chapter 9 introduces performance analysis techniques in sport that enable the determination of the physiological, mechanical, and technical demands of specific sports in addition to the assessment of the techniques used in the execution of sport-specific skills. The constraints-led approach to skill acquisition is introduced in Chapter 10. Chapters 11 through 13 apply the concepts introduced in the previous chapters to the fundamental movements involved in jumping, landing, and sprint running.

Audience

This text is aimed at higher-level undergraduate students and graduate students studying strength and conditioning. However, it also provides a valuable resource for professionals in the strength and conditioning field. Due to the nature of the material contained within the text, it is expected that the reader has an understanding of basic anatomy and physiology and has completed an introductory class in biomechanics.

Pedagogy

The text contains the following pedagogical elements:

- *Objectives* are presented at the beginning of each chapter.
- *Worked Example* boxes employ real-world scenarios to give sample calculations of the mathematic principles discussed in the chapter.
- *Applied Research* boxes emphasize the research related to the chapter's topic.
- *Concept* boxes within each chapter highlight issues relevant to the chapter's topic.
- Each chapter closes with a *Chapter Summary* and *Review Questions and Projects*.
- An extensive glossary covers terms important to understanding the biomechanics of strength and conditioning.
- Appendices expand on some of the more complex mathematical techniques required to perform biomechanical analyses and offer useful resources to aid the student in locating and evaluating scientific evidence.

About the Author

Gavin Moir works in the Exercise Science Department at East Stroudsburg University where he teaches undergraduate and graduate classes in biomechanics, skill acquisition, and strength and conditioning. Dr. Moir is the Program Director for the MS Exercise Science degree at East Stroudsburg University and has published over 30 research articles and book chapters in the fields of biomechanics and strength and conditioning.

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