现代生物技术前沿

TISSUE ENGINEERING

〔美〕 B. Ø. 帕尔森
S. N. 巴蒂亚 著

组织工程

（影印版）

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内 容 简 介

本书是 Pearson Prentice Hall 出版社新近推出的生物工程原理与应用丛书之一,全面阐释了当前生物医学工程对重要生理组织的研究,涵盖心血管、内分泌、神经、视觉、听觉、消化和呼吸系统。主要分为四部分:定量细胞和组织生物学,包括组织块、组织动力学、形态发生、干细胞、细胞程序与调和等;细胞和组织分化,包括高通量生物学数据、细胞和组织特性、细胞和组织培养和基因转移等;工程学方法与设计,包括时间常数、缩放比例、细胞分离、生物材料成型与制作等;临床应用,包括常规方式、宿主适应和治疗性组织的生产等。

本书为读者提供了众多实用的定义、生理基础数据表格以及参考书目、索引,同时,还介绍了骨髓、骨骼肌和软骨等组织器官的组织工程。此外,还提出了组织工程研究中的一些难点和重点问题。通过阅读本书,读者会对组织工程及其细胞生物学基础有一个全面清晰的了解,也会获得更多创新的想法来进一步探索这一日益发展并且壮大的研究领域。

本书适合生物工程、生物材料、生物医学、生物化学、分子生物学以及医学等相关研究领域的高年级本科生、研究生以及教学科研人员参考使用。

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To
Bert Y.C. Fung
and
Edwin N. Lightfoot

For their inspiration and leadership

Preface

Tissue engineering holds the promise to repair or replace damaged organs. As a discipline, the field has evolved dramatically from its origins in the late 1980s. In particular, the rapid advances in stem cell biology have rekindled the enthusiasm to use cell-based approaches for the treatment of disease. For success in this area, we must learn to manipulate, produce, and deliver collections of cells as building blocks of tissues. Transplanted cells and tissue constructs are influenced by their microenvironment and can be manipulated to effectively interact with patients.

The underpinnings of tissue engineering are thus broad, and span a wide spectrum of scientific and engineering fundamentals. This list includes basic biological sciences (cell biology, physiology, embryology, and wound healing); engineering fundamentals (fluid dynamics, transport phenomena, materials science, mechanics, and chemical kinetics); many clinical aspects (surgery and transplantation, immunology, pathology, radiology, and medicine), and various relevant biotechnologies (cell culture, cell separation, and gene transfer). This long list of specialized knowledge makes it challenging to organize all the necessary background material for the student of tissue engineering in a clear and succinct manner.

In writing this book, we aimed to lay the foundation for students studying tissue engineering at both the undergraduate and the graduate level. We have attempted to provide a conceptual framework that includes exposure to all of the necessary background material. Thus, we cannot treat any particular subject in great detail but rather can provide the needed conceptual background in all areas. Instructors will find this text to be a useful framework since it is amenable to augmentation based on the instructors area of expertise and desired focus of a course in tissue engineering. The text is written primarily for senior bioengineering students or first-year graduate students and assumes a working knowledge of the engineering fundamentals. In this spirit, we have provided a series of engineering-style homework problems and solutions in order to allow students to work through the concepts presented. Nonetheless, we also hope that the text will be useful to traditional engineering students, material scientists, medical students, laypeople, and biologists.

We have chosen to present the material in four parts: quantitative cell and tissue biology, cell and tissue characterization, engineering methods and design, and clinical implementation. Throughout the text, we have emphasized relevant time and length scales of physicochemical processes in cell biology and medicine. Armed with these fundamentals, we seek to have students establish a conceptual framework within which to place further advances in the field. Many societal and technical challenges

still remain for the field to move forward, and we have highlighted these to the extent possible.

Writing a textbook like this one is a significant undertaking. There are many individuals and organizations to thank for helping us with various aspects of the writing process. The Whitaker Foundation generously provided financial support for this project through their Teaching Materials program. Their recognition that textbooks are required to build consensus and firmly establish a field will be an important part of their legacy. Two individuals were key in preparing this text. Marc Abrams tirelessly assisted in compiling all aspects of this text and prepared it using LaTeX, which made the production and publication an easier process. Salman Khetani made heroic efforts in reading all of the material in detail and offering perceptive criticism, suggestions, and input that significantly improved the quality of the text. He and Valerie Liu provided important feedback on their experience teaching from this text and help with preparing homework problems. Christophe Schilling, Ramprasad Ramakrishna, Jason Papin, Stephen Fong, and Timothy Allen also provided help with homework problems. Some individuals provided significant help with particular chapters; Nathan Price and Karl Francis with Chapter 6, Jason Papin with Chapter 7, and Markus Herrgard with Chapter 8. Michelle Williamson provided the original illustrations.

A number of individuals assisted in proofreading the text; including Tim Allen, Derren Barken, Markus Covert, Iman Famili, Steve Fong, Anu Raghunathan, Jennifer Reed, Sharon Wiback, Kanika Chawala, and Thuy Vo. Many of our colleagues have provided feedback, pointed us to important resources, or shared preprints and course notes. Thanks go especially to Francois Berthiaume, John Bischof, Christopher Chen, Tejal Desai, Jennifer Elisseeff, Robert Sah, Fred Schoen, Mehmet Toner, and Peter Zandstra.

Finally, we wish to thank our families for their support of this seemingly neverending project. In particular, Sangeeta thanks her husband, Jagesh, for his insight and love and her Dad, Narain, for his encouragement and wisdom.

Bernhard Palsson has a number of people and institutions to thank. The Fulbright and Ib Henriksen Foundations provided him with fellowship support to spend a leave at the Technical University of Denmark in 1996. Jens Nielsen and John Villadsen acted as his hosts and encouraged him to prepare a series of lectures on tissue engineering during his stay in Denmark. (Those lectures nucleated this book.) The Hougen Visiting Professorship at the University of Wisconsin in 2000 provided another leave during which portions of this text were written. He is grateful for the support and understanding of his wife Mahshid and children Shireen and Sirus who helped with the preparation of the index of this book.

Bernhard Ø. Palsson
Sangeeta N. Bhatia

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