
Preface

The initial concept for *Mechanobiology Handbook* spawned from the insightful vision of a CRC Press editor, Michael Slaughter, who found potential in the growth of this field and took a chance to embark on this project with me. While the definition of mechanobiology may vary depending on whom you ask, in this book we will simply define it as "studies of the effects of mechanical environments on the biological processes of cells." Of course, "mechanical environments" can be interpreted as the forces that result from gravity, locomotion, weight-bearing, pumping of the heart, blood flow, containment of urine, and contraction of the muscles, or the mechanical properties of the surroundings of cells such as stiffness of the extracellular matrix or the viscosity of the blood and other fluids inside the body. "Biological processes" can be just as broadly interpreted to be morphological shift, cell growth or death, differential expression of genes and proteins, reorganization of the cytoskeleton, changes in cell membrane potential or intracellular ion concentrations, release of soluble compounds, or phosphorylation of kinases. Researchers have demonstrated that all of the stated mechanical factors influence all of these and a number of other cellular and molecular biological events, which, in turn, influence health, disease, and injury. Considering the complexity of both the mechanics and the biology of the human body, there is so much more to be studied than what we have already discovered. Aided by the continuous advancement of research tools in both mechanics and biology, more sophisticated experiments and analyses are now possible, and the field of mechanobiology is expected to continue growing.

A broad range of organ systems are currently studied by investigators including surgeons, physicians, basic scientists, and engineers. Due to this diversity in the field of mechanobiology, even if a discovery in one organ system or in one discipline may be applicable to other researchers, it may be overlooked and not fully appreciated. This is the reason I decided to put together a single-volume handbook that collects cutting-edge research findings from multiple laboratories in the hope that it will become a good reference to investigators in the field of mechanobiology from different technical communities. I was fortunate enough to receive many contributions from my own professional contacts, and their contacts, with whom I truly enjoyed working. Since mechanobiology is a growing field and many of the research questions are still unsettled, the viewpoints of the authors presented here may be contradictory or conflicting with each other. At the same time, there may be some overlapping information on issues that they all agree on. The goal of this book was not to force one unified theory, but to bring out many different viewpoints and approaches to stimulate further research questions. The handbook may then be updated to incorporate newer discoveries and theories in future editions.

The main goals of research in the field of mechanobiology are threefold: (1) to quantify or estimate the mechanical environment to which cells are subjected in health and disease, (2) to identify and quantify mechanosensitive responses and the molecular mechanisms of mechanically induced pathological conditions, and (3) to ultimately apply the knowledge obtained to the development of new therapies. To achieve these goals, investigators must be familiar with both the basic concepts of mechanics and the modern tools of cellular/molecular biology. However, the current literature contains numerous studies that incorrectly estimate or mimic the *in vivo* mechanical environments of interest, or misuse standard mechanics terminology. At the same time, those who are well versed in mechanics may be able to design elegant experimental setups, but may not be able to come up with appropriate molecular analyses. The aim of this handbook, thus, is not only to present the cutting-edge research findings in various fields, but also to provide the elementary chapters on mechanics and molecular analysis techniques that will hopefully help the reader plan their experiments better or understand the findings previously reported.