Cell and Matrix Mechanics

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Explores a Range of Multiscale Biomechanics/Mechanobiology Concepts

Cell and Matrix Mechanics presents cutting-edge research at the molecular, cellular, and tissue levels in the field of cell mechanics. This book involves key experts in the field, and covers crucial areas of cell and tissue mechanics, with an emphasis on the roles of mechanical forces in cell–matrix interactions. Providing material in each chapter that builds on the previous chapters, it effectively integrates length scales and contains, for each length scale, key experimental observations and corresponding quantitative theoretical models.

Summarizes the Three Hierarchical Levels of Cell Mechanics

The book contains 14 chapters and is organized into three sections. The first section focuses on the molecular level, the second section details mechanics at the cellular level, and the third section explores cellular mechanics at the tissue level. The authors offer a thorough description of the roles of mechanical forces in cell and tissue biology, and include specific examples. They incorporate descriptions of associated theoretical models, and provide the data and modeling framework needed for a multi-scale analysis. In addition, they highlight the pioneering studies in cell–matrix mechanics by Albert K. Harris.

The topics covered include:

- The passive and active mechanical properties of cytoskeletal polymers and associated motor proteins along with the behavior of polymer networks
- The mechanical properties of the cell membrane, with an emphasis on membrane protein activation caused by membrane forces
- The hierarchical organization of collagen fibrils, revealing that a delicate balance exists between specific and nonspecific interactions to result in a structure with semicrystalline order as well as loose associations
- The roles of matrix mechanical properties on cell adhesion and function along with different mechanical mechanisms of cell–cell interactions
- The effects of mechanical loading on cell cytoskeletal remodeling, summarizing various modeling approaches that explain possible mechanisms regulating the alignment of actin stress fibers in response to stretching
- The mechanical testing of cell-populated collagen matrices, along with theory relating the passive and active mechanical properties of the engineered tissues
- Cell migration behavior in 3-D matrices and in collective cell motility
- The role of mechanics in cartilage development
- The roles of both cellular and external forces on tissue morphogenesis
- The roles of mechanical forces on tumor growth and cancer metastasis

Cell and Matrix Mechanics succinctly and systematically explains the roles of mechanical forces in cell–matrix biology. Practitioners and researchers in engineering and physics, as well as graduate students in biomedical engineering and mechanical engineering related to mechanobiology, can benefit from this work.

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Amelia Brown:

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