

Epigenetics and Systems Biology

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An introduction and comprehensive overview of current research exploring the powerful combination of systems biology with experimental epigenetics. The book gives examples that are comprehensible to both disciplines, with the aim of inspiring each field to engage with the other.

Recent years have seen an explosion of interest in epigenetics. Vast amounts of epigenetic data have been generated and "epigenetic drugs" are entering the clinic. However, we are still far from understanding exactly how epigenetic regulation works in mechanistic and quantitative terms. We have reached a stage at which there is so much data that it is extremely difficult to formulate current knowledge in a manner that places rigorous constraints on whether proposed explanations of biological phenomena are feasible. A large gap in our understanding of many fundamental epigenetic processes is the lack of a coherent theoretical framework within which to study these systems. Systems biology uses mathematical and computational models to discover emergent properties of complex biological systems. The application of systems biology to epigenetics is immensely powerful but surprisingly rare. A major obstacle to uniting mathematics and biology is the barrier between disciplines.

This book collects examples of successful collaborations between experimental epigenetics and systems biology, written by experts in each discipline.

Key Features

- Original research is presented in a wider perspective and a simpler form than the primary publications.
- We explain the experiments in terms comprehensible to the modeler, and the models in terms comprehensible to the experimentalist.
- Each section covers one type of modeling, and one set of epigenetic questions to which such models have been successfully applied.
- The modeling approaches include machine learning, ordinary differential equations, stochastic simulations, and polymer models.
- The epigenetic questions to which these models are applied include genome-wide targeting of epigenetic regulators, in vivo dynamics of chromatin binding and modification, epigenetic memory, bistability and switching, and three-dimensional chromatin architecture.

The book will be a valuable resource for researchers working in the fields of systems biology, computational biology, or epigenetics, at graduate level and above. The examples given from current literature will enable scientists from each field to discover how cross-talk with the other field has brought synergistic results.



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