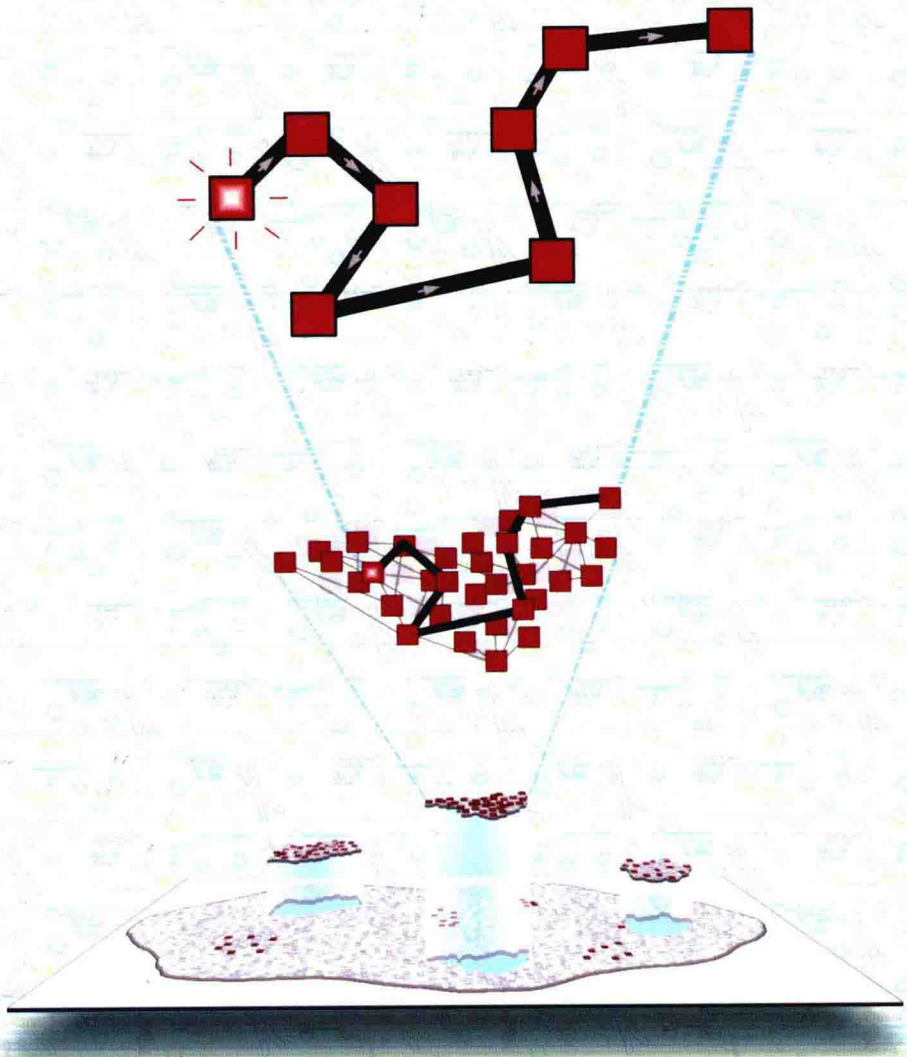




Advances in Molecular Biology and Medicine

Robert A. Meyers

# Systems Biology



# **Systems Biology**

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*Edited by*  
*Robert A. Meyers*

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## Preface and Commentary

Our project is based on the recognition that a true and complete understanding of biology and indeed, human disease must go beyond genomics. Genes and their transcripts and translation products are of course crucial, but in fact these molecules never act alone; they rather operate in tremendously complex and noisy networks. Consider it is now estimated that the human genome encodes about 20 000 to 32 000 distinct proteins, while the expression and alternative splicing of mRNAs indicates that humans may be able to produce  $10^6$  different proteins. Hence the need for the emerging discipline of Systems Biology. Thus, Systems Biology is a recently established field in life sciences that aims at promoting a global, top-down, mathematical, systems understanding of living matter through the integration of various scientific domains.

Our compendium is written for university undergraduates, graduate students, faculty and investigators at research institutes and is a team effort which began with overall guidance from our Board, which includes 11 Nobel Prize winners. Each article and author selection was then validated by several reviewers from major university research centers and each manuscript was then reviewed by peers from other universities. There is a glossary of terms with definitions provided at the beginning of each article for students and the articles average close to 30 print pages – which provides significantly more depth for advanced researchers than other systems biology reviews.

Our treatment consists of 22 articles or chapters, and begins with an overview of Systems Biology which the reader, at any level, can use as a roadmap to the content of our book. Then, the detailed articles are organized into five sections, the first of which is: the *Biological Basis of Systems Biology* (the chapters range from developmental biology to the Interactome and protein abundance variation); the section on *Systems Biology of Evolution* includes a chapter by Nobel Laureate and Board Member, Werner Arber; the *Modeling of Biological Systems* section includes chapters ranging from computer simulation methodology of specific systems such as the brain and cell migration as well as protein modeling. Considering that there are now about 21 000 distinct proteins encoded directly by the human genome while the expression and alternative splicing of mRNAs indicates that humans may be able to produce  $10^6$  different proteins, and we can only surmise the function of nearly half of these proteins – a systems approach is clearly needed. This section then includes top down mathematical modeling methods involving chaos, fractals, dynamics of biomolecular networks and informatics; the *Systems Biology in Medicine and Disease* section includes chapters on inferring networks for disease

(termed the diseasome) and culminates in a chapter on systems aspects in personalized medicine for prediction and prevention. Our concluding section is *Systems Biology of Organisms* which includes plant systems biology as well as two chapters from scientists at the J. Craig Venter Institute, one on microbiomes which encompasses metagenomics as well as the human gut microbiome which has recently been discovered to contribute to viral infection cycles, and the other on synthetic biology which describes methods and the recent creation of a synthetic cell.

Our team hopes that you, the reader, will benefit from our hard work – finding the content useful in your research and education. We wish to thank our Managing Editor, Sarah Mellor as well as our Executive Editor, Gregor Cicchetti for both their advice and hard work in the course of this project.

Larkspur, California, March 2012

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