The central purpose of this book is to illustrate the premiss that theoretical analysis of the kinetics of biological processes can give valuable information concerning the underlying mechanisms that are responsible for these processes.

Topics covered range from cooperativity in protein binding and enzyme action, through receptor–effector coupling, to theories of biochemical oscillations in yeast and slime mold, of liver regeneration, and of neurotransmitter release. Theories are always closely coupled to experiment.

The material of this book originally appeared as part of the volume *Mathematical models in molecular and cellular biology* (edited by Lee A. Segel). However, each chapter has been revised and updated.

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PREFACE

The central purpose of this book is to illustrate the premiss that examination of the kinetics (time course) of biological processes can give valuable information concerning the underlying mechanisms that are responsible for these processes. To extract this information it is usually necessary to construct a mathematical model that embodies hypothesized mechanisms. Solution of the resulting equations shows whether the hypotheses are consistent with the data.

Considerable material concerns steady-state solutions. These can be regarded as the limiting behavior, in many instances, of the kinetic equations.

On the molecular level, the discourse ranges from fairly classical analyses of cooperativity in protein binding and enzyme action, through studies of enzyme induction and receptor–effector coupling, to theories for biochemical oscillations in yeast and slime mold. Models for the triggering of secretion in slime mold and in nerve cells, and for liver regeneration, are at the intersection of molecular biology, cellular biology and physiology. In addition, an introduction to the explosively growing theoretical topic of chaos concludes with references that chronicle tentative attempts to apply chaos theory in physiology (cardiac dynamics and immunology).

The material of this book originally appeared as part of *Mathematical models in molecular and cellular biology* (Lee A. Segel, ed., Cambridge: Cambridge University Press, 1980), which is now out of print. Each contribution has been revised and updated. (Unfortunately, Sol Rubinow has passed away. His contribution appears with permission of his widow, Shirley Rubinow, and has been updated by Lee A. Segel.)

The mathematical requisite for most of the material is a good command of basic calculus. A brief summary of the required mathematical ideas can be found in the Appendices of 'MDP', *Modelling dynamic phenomena in molecular and cellular biology* by Lee A. Segel (Cambridge: Cambridge University Press, 1984). Indeed, one of the uses to which the present book might be put is as a supplement to MDP, or to other texts in theoretical biology. There is substantial overlap with MDP in only one topic, cAMP secretion in slime mold. However, the coverage of this topic in the present volume – although perhaps less detailed mathematically – is more comprehensive and up-to-date.

It is hoped that this volume will be of interest to students and researchers alike, in both biology and applied mathematics. Readers should find a number of interesting case studies that show how mathematical modeling can illuminate important areas of modern biology.