Preface

During the academic year 1977–78 the authors undertook to present to graduate students at the Courant Institute of Mathematical Sciences (CIMS) a course devoted to mathematical models in developmental biology. Much of the material introduced in this course at the time reflected the most active research areas, dealing primarily with bifurcation and catastrophes, biochemical pattern formation, and mechanical morphogenesis. Inevitably, though, the course evolved in unexpected directions and some original research was incorporated into the lectures. From time to time other researchers have requested copies of what were then mimeographed CIMS lecture notes, and recently interest arose for including an updated version in the present AMS lecture notes series.

In the intervening years there have been profound changes in the nature of and attitude toward the kind of modeling championed in these notes. The rapid advances in understanding of developmental processes at the molecular level have revealed in detail mechanisms that thirty years ago were highly speculative models. Perhaps the most dramatic changes have occurred in our understanding of the biochemical basis of pattern formation. As our knowledge of these systems has expanded, there also seems to be a new appreciation of the importance of mathematical modeling at the intermediate level between the molecular instructions for a developmental event and the description of the end result of that event.

The problem we faced in preparing this volume was how to give a sense of the original course, while also making some effort either to bring material up to date or else to offer references to later research. In fact, our choice of material in 1977, while perhaps reasonably timely then, can hardly be said to have fully anticipated the work of the subsequent decades. We also wanted to incorporate portions of lecture notes by one of us (Percus), given at the Courant Institute in 2006, which further expanded and extended the material. It seemed therefore preferable to preserve most of the content of the original lectures, grouping them appropriately for a monograph format, while adding a few notes to provide links to the more recent literature, and ignoring more polished versions presented in the intervening years. A few topics were dropped as tangential to the main interests of the notes. While far short of providing a state-of-the-art review, we hope the result will be useful to mathematicians interested in this exciting field of applied research.

Kenneth L. Ho prepared LaTeX files of the 2006 lecture series, and we thank him for permission to include portions of that work in the present volume.