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## Preface

Cell movement is fundamental to the development and other vital functions of organisms. Many motile cells can detect shallow gradients of specific chemical signals in their environments and migrate accordingly. This directed cell movement is called chemotaxis and is essential for various cell types to carry out their biological functions. This book includes state-of-the-art methods for investigating cell migration behaviors, studying molecular components involved in detecting extracellular signals and directing cell movement, visualizing spatiotemporal dynamics of the components in signaling networks of chemotaxis in real time, and constructing quantitative models that simulate chemoattractant-induced cell responses.

Various methods to investigate cell movement are presented in Chapters 1–16. These chapters contain experimental procedures to visualize and measure migration behaviors of different kinds of organisms, including bacterial movement in chemoattractant gradients, light-induced responses of prokaryotes, *Chlamydomonas* and *Dictyostelium discoideum*, electric field-directed movement of eukaryotic cells, chemotropism in the budding yeast, cell migration of *D. discoideum*, *C. elegans*, *Drosophila*, zebrafish, and mouse, chemotaxis of *D. discoideum*, and neutrophil-like cell lines. The volume also contains microscopy procedures to study breast cancer cell migration, tumor cell invasion in vivo, and neuronal chemotaxis. These methods provide quantitative measurements and description of cell migration behaviors.

Significant progress has been made in recent years toward identifying the molecular components and understanding the molecular networks that underlie chemoattractant sensing and cell migration in various organisms. Chapters 17–20 describe the methods to study signal transduction pathways involved in chemotaxis in the model system, *D. discoideum*. Chapter 21 introduces the role of chemokine receptor signaling in HIV infection.

Fluorescence microscopy permits us to directly monitor dynamics of many signaling events in single cells in real time. Chapters 22–29 describe methods that measure spatiotemporal dynamics of chemoattractant concentrations, activation of receptors, heterotrimeric G-proteins, small G-protein Ras signaling, and actin cytoskeleton assembly using different imaging techniques. Several chapters introduce cutting-edge imaging techniques, such as FRAP, FRET, and single-molecule microscopy, to determine mobility of receptors and other signaling components. These techniques allow us to reveal dynamics of signaling components in live cells and to track signaling events in single cells in space and time.

Computer-based quantitative models that address the complexity of a signaling network with its many interacting components are valuable for studies of chemotaxis. Chapter 30 summarizes a computer program that quantifies movement of amoeboid cells. Chapter 31 introduces mathematical calculations on experimentally generated chemoattractant gradients. Finally, Chapters 32 and 33 introduce two computational models that are constructed to simulate spatial–temporal dynamics of signaling networks for eukaryotic chemosensing.

We are grateful to all the authors for contributing their expertise and believe that this book will provide the reader with an overview of and practical guidance on the diverse methodologies that are propelling chemotaxis research forward.

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