
Preface

Mitosis is an extraordinarily complex and dynamic process that must be tightly regulated but sufficiently flexible to ensure the faithful segregation of genetic material from mother to daughter cells. How this is achieved has fascinated biologists for more than a century, both for its role in the generation of life as we know it and its contributions to diseases such as cancer that arise from mitotic defects. Over the past several decades our understanding of mitosis has grown by leaps and bounds driven by the application of an increasingly diverse array of methodological techniques in a variety of experimental systems. Our goal in this volume is to provide a state-of-the-art overview of some of the most important approaches currently used in mitosis research spanning from the analysis of single molecules in isolation to their utilization within the complex environment of the cell.

To aid the reader, this volume has been divided into three parts, each focused on methods pertaining to distinct aspects of mitosis research. The chapters in Part I (Chapters 1–5) present approaches for visualizing and analyzing the dynamic behaviors of the spindle apparatus, the microtubule-based machine that drives chromosome segregation. A particular goal of this section is to arm the researcher with tools to exploit diverse cell types—each with their own particular strengths—to understand how the fluidity of the spindle and the proteins from which it is composed are harnessed to accurately segregate chromosomes. Part II (Chapters 6–8) focuses more generally on methods for studying and manipulating the microtubule cytoskeleton in cells and complex cell-free extracts. Although not necessarily specific to mitosis, these approaches are highly relevant to mitosis researchers since microtubules and microtubule-associated proteins are the primary structural and mechanical elements within the spindle. In this same vein, Part III (Chapters 9–12) provides state-of-the-art biophysical and high resolution microscopy approaches for assessing complex interactions between microtubules and microtubule-associated proteins in isolation (Chapters 9–11) as well as microtubule structure in cells (Chapter 12). Finally, Part IV provides two “extras,” the first of which provides methods for studying the effects of cell shape on cell division (Chapter 13) while the second describes methods for quantifying aneuploidy (aberrant chromosome number) which frequently results from mitotic defects and has been linked to human maladies ranging from birth defects to cancer (Chapter 14).

In sum, this volume is meant to serve two purposes. First and most obviously, it is for researchers who already have an experiment in mind, or at least a specific question that they want to answer, and want a tested and successful protocol for carrying it out. But secondly and somewhat less obviously, we hope that this volume and the diverse methods presented herein inspires some readers to expand their methodological repertoire by employing new techniques to address new (or old) questions related to the mechanisms of mitosis.

Bronx, NY

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Mitosis

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