

Preface

DURING THE PAST DECADE, research in developmental biology has undergone a dramatic change brought about by the availability of whole genome sequences from diverse organisms, the availability of transcriptomes and epigenomes, advanced imaging techniques, and increased understanding of the role of stem cells in organ and tissue development and regeneration. These advances have been integrated with traditional approaches of genetic manipulations and detailed phenotypic analyses in experimental model organisms such as the mouse. The information obtained from these studies has dramatically increased our understanding of the cellular origins of organs and tissues and provided deeper insights into the regulation of gene activity in a multitude of developmental processes and the mechanisms coordinating cellular reorganization in morphogenesis. With the integration of these findings, new questions about developmental processes have arisen, along with the hope of potential interventions in developmental processes for tissue regeneration and disease therapies.

This book provides a contemporary overview of the conceptual framework of molecular and cellular mechanisms of mammalian development, and a glimpse into future directions in mammalian developmental biology and its relevance to cellular and tissue therapy. Major areas of focus are transcriptional and epigenetic switches and the activity of genetic networks in cell differentiation, the role of signaling pathways, and tissue modeling and organ formation. Another is the translation of basic knowledge of developmental processes into stem cell biology, directed differentiation of pluripotent or lineage-biased progenitors, and the potential for regenerative medicine.

The chapters are written by experts in these different areas of developmental biology and are organized into three main topic areas—Section I: Genome, Epigenome, Proteome, and Cell Signaling; Section II: Morphogenetic Processes; and Section III: Signals and Switches in Lineage Specification, Tissue Differentiation, and Organogenesis. The content showcases how genetic manipulation and a deep mechanistic understanding of cell function and tissue interactions in embryos together provide insights into the developmental mechanisms underlying lineage specification, cell differentiation, and morphogenesis. Chapters in Section III of the book cover a selection of organ and tis-

sue systems. The criterion for the choices of topics is that they provide a deeper knowledge of the morphogenetic processes at the cellular and tissue levels. These topics also highlight the intricacy of the intersection of signaling and genetic activity that control cell fate and differentiation, which has significant implications for our understanding of tissue repair and cell-based therapy.

The book is aimed at senior undergraduates interested in the scope of modern developmental biology, graduate students and postdoctoral fellows who are beginning to explore the mouse as a model system for studying vertebrate development and its relevance to human diseases, and established scientists in fields outside the traditional areas of developmental biology who are looking to apply their knowledge and expertise in new ways.

We are grateful to the authors who took time to contribute chapters to this book and many anonymous colleagues for their valuable input to the peer review of the manuscripts. This book would not have become a reality without the hard work of the staff at Cold Spring Harbor Laboratory Press: Richard Sever and David Crotty for their advice and guidance, Inez Sialiano for an excellent job managing the submission and review of manuscripts, and Diane Schuchbach, Kathleen Bubbeo, and other members of the production team who produced the electronic versions of the text and the printed book that you are about to peruse.

This book is dedicated to the memory of Dr. Larysa Pevny who co-authored the chapter on Eye Development and Retinogenesis. Sadly, she passed away before seeing this book appear in print. Larysa made many significant contributions to the field of Sox gene biology; moreover, she left an indelible impact on the new generation of developmental biologists, in part through her role as Instructor and Lecturer for the Cold Spring Harbor Laboratory Course on Molecular Embryology of the Mouse. The untimely loss of this fine scientist is felt widely in the developmental biology community, and we hope that this book will keep alive her achievements in the quest for a better understanding of mouse development.

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