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# Developmental Biology Protocols

*Volume III*

*Edited by*

Rocky S. Tuan

Cecilia W. Lo



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METHODS IN MOLECULAR BIOLOGY™

# Developmental Biology Protocols

## *Volume III*

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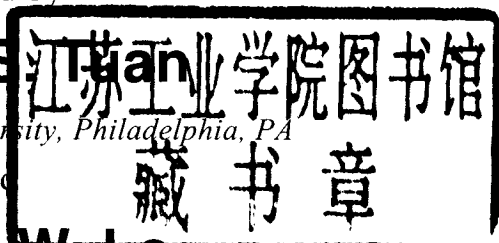
**Rocky S. Tuan**

*Thomas Jefferson University, Philadelphia, PA*

and

**Cecilia W. Lo**

*University of Pennsylvania, Philadelphia, PA*



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## To Chuck and our parents

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## Preface

Developmental biology is one of the most exciting and fast-growing fields today. In part, this is so because the subject matter deals with the innately fascinating biological events—changes in form, structure, and function of the organism. The other reason for much of the excitement in developmental biology is that the field has truly become the unifying melting pot of biology, and provides a framework that integrates anatomy, physiology, genetics, biochemistry, and cellular and molecular biology, as well as evolutionary biology. No longer is the study of embryonic development merely “embryology.” In fact, development biology has produced important paradigms for both basic and clinical biomedical sciences.

Though modern developmental biology has its roots in “experimental embryology” and the even more classical “chemical embryology,” the recent explosive and remarkable advances in developmental biology are critically linked to the advent of the “cellular and molecular biology revolution.” The impressive arsenal of experimental and analytical tools derived from cell and molecular biology, which promise to continue to expand, together with the exponentially developing sophistication in functional imaging and information technologies, guarantee that the study of the developing embryo will contribute one of the most captivating areas of biological research in the next millennium.

There is a demonstrated need for students of developmental biology to be knowledgeable of the breadth and depth of the available experimental methodologies, by necessity derived from multiple disciplines, which are applicable to the study of the developing embryo. In particular, because developmental biology deals with multiple model systems, from organismal to tissue and cell levels, as well as a wide range of “change”-related biological activities, the investigator is often frustrated as to how his/her findings relate to those obtained in another model system and/or by using different reagents or functional markers. Compared to other more strictly defined fields of biological research, the number of “reference” publications that deal specifically with the practical aspects of experimental developmental biology are, however, relatively scarce.

*Developmental Biology Protocols* grows out of the need for a comprehensive laboratory manual that provides the readers the principles, background, rationale, as well as the practical protocols, for studying and analyzing the events of embryonic development. This three-volume set, consisting of 142 chapters, is intentionally broad in scope, because of the nature of modern developmental biology. Information is grouped into the following topics: (1) systems—production, culture, and storage; (2) developmental pattern and morphogenesis; (3) embryo structure and function; (4) cell lineage analysis; (5) chimeras; (6) experimental manipulation of embryos; (7) application of viral vectors; (8) organogenesis; (9) abnormal development and teratology; (10) screening and mapping of novel genes and mutations; (11) transgenesis production and gene knockout; (12) manipulation of developmental gene expression and func-

tion; (13) analysis of gene expression; (14) models of morphogenesis and development; and (15) in vitro models and analysis of differentiation and development.

Throughout *Developmental Biology Protocols*, the authors have consistently striven for a balanced presentation of both background information and actual laboratory details. It is believed that this highly practical format will permit readers to bring the concepts and principles we present into their personal research practices in a most efficient manner. Specifically, the wide range of model systems and multidisciplinary experimental techniques presented here should lower the “activation energy” for the student of developmental biology to become a contributing member of this exciting scientific discipline. In addition, teachers of developmental biology at all levels should also readily find relevant and useful information to enrich the experience of their students.

The practice of developmental biology is currently in a state of constant change, reflecting the close relationship of the field to other rapidly developing fields of biological research, particularly cell and molecular biology, and imaging and information technology. The materials presented in this three-volume set are therefore the beginning of a project that will involve continuous update and upgrade to reach and enhance the scientific endeavors of developmental biologists at large.

The production of *Developmental Biology Protocols* would not have been possible without the outstanding work of the contributing authors who share here with the readers the hands-on wisdom they have earned in the laboratory. We are grateful for their intellectual contributions as well as their remarkable tolerance to our constant reminders. Tom Lanigan and his staff at Humana Press worked diligently on the project to ensure a final product of the highest quality. Chuck, our young son, persevered throughout the gestation period of the project, and constantly demonstrated to us the meaning of “developmental biology.”

Our heartfelt thanks go to Lynn Stierle, who expertly and single-handedly maintained the massive organization of the manuscripts and the correspondence (snail-mail and e-mail), as well as the sanity of the editors! Michelle Levinski also provided valuable assistance in proofreading the final production.

Finally, we hope that these volumes will find their place on the laboratory shelves, with their pages well soiled and their contents tried and tested, and prove their utility as an everyday resource for the students of developmental biology, the most exciting discipline of biology for many decades to come!

**Rocky S. Tuan, PhD**

**Cecilia W. Lo, PhD**

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## Contributors

- PETER G. ALEXANDER • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- JOSEPH C. AYOOB • *Department of Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*
- GEORGE L. BARNES • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- SONA BARTUNKOVA • *Beth Israel Deaconess Medical Center, Boston, MA*
- VAHE BEDIAN • *Pfizer Central Research, Groton, CT*
- VICKIE D. BENNETT (DECEASED) • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- ANNE-GAELLE BORYCKI • *Department of Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*
- PETER C. BROOKS • *Department of Biochemistry and Molecular Biology, University of Southern California School of Medicine, Los Angeles, CA*
- BELINDA M. CHAPMAN • *Department of Molecular and Integrative Physiology, University of Kansas Medical Center, Kansas City, KS*
- ALLEN W. CLARK • *Department of Anatomy, University of Wisconsin–Madison, Madison, WI*
- RONALD A. CONLON • *Department of Genetics, Case Western Reserve University, Cleveland, OH*
- CHRISTOPHER COX • *Department of Anatomy and Cell Biology, State University of New York Health Science Center, Syracuse, NY*
- BARBARA A. DANOWSKI • *Department of Biology, Union College, Schenectady, NY*
- PIET A. J. DE BOER • *Department of Anatomy and Embryology, Academic Medical Center, Amsterdam, The Netherlands*
- ANTHONY M. DELISE • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- CAMILLE DiLULLO • *Department of Anatomy, Philadelphia College of Osteopathic Medicine, Philadelphia, PA*
- MARIA P. DE MIGUEL • *Department of Microbiology and Immunology, Kimmel Cancer Institute, Thomas Jefferson University, Philadelphia, PA*
- PETER J. DONOVAN • *Department of Microbiology and Immunology, Kimmel Cancer Institute, Thomas Jefferson University, Philadelphia, PA*
- CAROL A. EISENBERG • *Department of Cell Biology and Anatomy, Medical University of South Carolina, Charleston, SC*
- CHARLES P. EMERSON, JR. • *Department of Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*



- JONATHAN A. EPSTEIN • *Departments of Medicine and Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*
- JOHN F. FALLON • *Department of Anatomy, University of Wisconsin–Madison, Madison, WI*
- DIEGO FRANCO • *Department of Anatomy and Embryology, Academic Medical Center, Amsterdam, The Netherlands*
- SILVIO GAROFALO • *Centro Biotecnologie Avanzate, Istituto Nazionale Ricera per la Ricerca sul Cancro, Genova, Italy*
- PAMELA GEHRON ROBEY • *Craniofacial and Skeletal Diseases Branch, National Institute of Dental Research, National Institutes of Health, Bethesda, MD*
- MINDY GEORGE-WEINSTEIN • *Department of Anatomy, Philadelphia College of Osteopathic Medicine, Philadelphia, PA*
- JACQUELYN GERHART • *Department of Anatomy, Philadelphia College of Osteopathic Medicine, Philadelphia, PA*
- THOMAS GERSTER • *Biozentrum der Universität Basel, Basel, Switzerland*
- TROY A. GIAMBERNARDI • *Department of Cellular and Structural Biology, University of Texas Health Science Center, San Antonio, TX*
- ROBERT M. GREENE • *Department of Biological and Biophysical Sciences, School of Dentistry, University of Louisville, Louisville, KY*
- ANDREW R. HAAS • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- BRIAN K. HALL • *Department of Biology, Dalhousie University, Halifax, Nova Scotia, Canada*
- GISELBERT HAUPTMANN • *Institut für Biologie I (Zoologie), Albert-Ludwigs-Universität Freiburg, Freiburg, Germany*
- JACO HAGOORT • *Department of Anatomy and Embryology, Academic Medical Center, Amsterdam, The Netherlands*
- SUSAN HEYNER • *Center for Research in Reproduction and Women's Health, University of Pennsylvania, Philadelphia, PA*
- WILLIAM A. HORTON • *Research Department, Shriners Hospital for Children, Portland, OR*
- OLENA JACENKO • *Department of Animal Biology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA*
- BRIAN JOHNSTONE • *Department of Orthopaedics, Case Western Reserve University, Cleveland, OH*
- DANIEL S. KESSLER • *Department of Cell and Developmental Biology, University of Pennsylvania School of Medicine, Philadelphia, PA*
- ROBERT J. KLEBE • *Department of Cellular and Structural Biology, University of Texas Health Science Center, San Antonio, TX*
- KAREN A. KNUDSEN • *Department of Biochemistry and Molecular Pharmacology, Lankenau Medical Research Center, Wynnewood, PA*
- MICHAEL R. KUEHN • *Experimental Immunology Branch, National Cancer Institute, National Institutes of Health, Bethesda, MD*

- WOUTER H. LAMERS • *Department of Anatomy and Embryology, Academic Medical Center, Amsterdam, The Netherlands*
- PASCALE LEGOUX • *Sanofi Recherche de Labe 'ge, Labe 'ge Cedex, France*
- YI-HSIN LIU • *Center for Craniofacial Molecular Biology, University of Southern California School of Dentistry, Los Angeles, CA*
- CECILIA W. LO • *Department of Biology, University of Pennsylvania, Philadelphia, PA*
- LINDA A. LOWE • *Experimental Immunology Branch, National Cancer Institute, National Institutes of Health, Bethesda, MD*
- ADESOLA MAJOLAGBE • *Craniofacial and Skeletal Diseases Branch, National Institute of Dental Research, National Institutes of Health, Bethesda, MD*
- ROBERT E. MAXSON, JR. • *Department of Biochemistry and Molecular Biology, Kenneth R. Norris Cancer Hospital and Institute, Los Angeles, CA*
- PARMENDER P. MEHTA • *Department of Medicine, Sylvester Comprehensive Cancer Center, University of Miami School of Medicine; and Geriatric Research, Education, and Clinical Center and Research Service, VAMC, Miami, FL*
- MARIA ALICE MELLO • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- RICHARD K. MILLER • *Department of Obstetrics and Gynecology, University of Rochester Medical Center, Rochester, NY*
- ANTOON F. M. MOORMAN • *Department of Anatomy and Embryology, Academic Medical Center, Amsterdam, The Netherlands*
- MARK MURPHY • *The Murdoch Institute, Embryology Laboratory, Royal Children's Hospital, Parkville, Victoria, Australia*
- MEHRDAD NADJI • *Department of Pathology, Sylvester Comprehensive Cancer Center, University of Miami School of Medicine and Geriatric Research Education and Clinical Center, Miami, FL*
- DONALD F. NEWGREEN • *The Murdoch Institute, Embryology Laboratory, Royal Children's Hospital, Parkville, Victoria, Australia*
- CHRISTOF NIEHRS • *Deutsches Krebsforschungszentrum, Heidelberg, Germany*
- STEVEN A. OBERLENDER • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- DAVID S. PACKARD, JR. • *Department of Anatomy and Cell Biology, State University of New York Health Science Center, Syracuse, NY*
- CARLOS PEREZ-STABLE • *Department of Medicine, Sylvester Comprehensive Cancer Center, University of Miami School of Medicine; and Geriatric Research, Education, and Clinical Center and Research Service, VAMC, Miami, FL*
- THOMAS J. PETERS • *Department of Molecular and Integrative Physiology, University of Kansas Medical Center, Kansas City, KS*
- ERIC PETITCLERC • *Department of Biochemistry and Molecular Biology, University of Southern California School of Medicine, Los Angeles, CA*
- M. MICHELE PISANO • *Department of Biological and Biophysical Sciences, School of Dentistry, University of Louisville, Louisville, KY*

- BRUNO M. POLLIOTTI • *Department of Obstetrics and Gynecology, University of Rochester Medical Center, Rochester, NY*
- THOMAS J. POOLE • *Department of Anatomy and Cell Biology, State University of New York Health Science Center, Syracuse, NY*
- JENNY E. ROOKE • *Department of Genetics, Yale University School of Medicine, New Haven, CT*
- BERNARD A. ROOS • *Department of Medicine, Sylvester Comprehensive Cancer Center, University of Miami School of Medicine; and Geriatric Research, Education, and Clinical Center and Research Service, VAMC, Miami, FL*
- MARIA A. ROS • *Departamento de Anatomía y Biología Celular, Universidad de Cantabria, Santander, Spain*
- JAN M. RUIJTER • *Department of Anatomy and Embryology, University of Amsterdam, Amsterdam, The Netherlands*
- JEAN M. SANGER • *Department of Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*
- JOSEPH W. SANGER • *Department of Cell and Developmental Biology, University of Pennsylvania, Philadelphia, PA*
- THOMAS N. SATO • *The University of Texas Southwestern Medical Center, Dallas, TX*
- ASAD U. SHEIKH • *Department of Obstetrics and Gynecology, University of Rochester Medical Center, Rochester, NY*
- DAVID SHIRE • *Sanofi Recherche de Laboratoire, Laboratoire Cedex, France*
- B. KAY SIMANDL • *Department of Anatomy, University of Wisconsin—Madison, Madison, WI*
- MALCOLM L. SNEAD • *Center for Craniofacial Molecular Biology, University of Southern California School of Dentistry, Los Angeles, CA*
- MICHAEL J. SOARES • *Department of Molecular and Integrative Physiology, University of Kansas Medical Center, Kansas City, KS*
- ALEJANDRO PERALTA SOLER • *Department of Biochemistry and Molecular Pharmacology, Lankenau Medical Research Center, Wynnewood, PA*
- EMANUELA STRINGA • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- NICOLE A. THEODOSIOU • *Department of Genetics, Yale University School of Medicine, New Haven, CT*
- ROCKY S. TUAN • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*
- MICHAEL J. TUCKER • *Reproductive Biology Associates, Atlanta, GA*
- CHARLES B. UNDERHILL • *Department of Cell Biology, Georgetown Medical Center, Washington, DC*
- TAMI VON SCHALSCHA • *Department of Immunology, The Scripps Research Institute, San Diego, CA*
- STEFAN WAWERSIK • *Department of Medicine, Brigham and Women's Hospital, Boston, MA*

## Contributors

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ELIZABETH L. WILDER • *Department of Cell and Developmental Biology, University of Pennsylvania School of Medicine, Philadelphia, PA*

WENDY A. WOODWARD • *Department of Orthopaedic Surgery, Thomas Jefferson University, Philadelphia, PA*

TIAN XU • *Department of Genetics, Yale University School of Medicine, New Haven, CT*

JIE YAO • *Department of Cell and Developmental Biology, University of Pennsylvania School of Medicine, Philadelphia, PA*

JUNG YOO • *Department of Medicine, Case Western Reserve University, Cleveland, OH*

LURONG ZHANG • *Department of Cell Biology, Georgetown Medical Center, Washington, DC*

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## INTRODUCTION