KEY EXPERIMENTS IN PRACTICAL DEVELOPMENTAL BIOLOGY

This unique resource presents twenty-seven easy-to-follow laboratory exercises for use in student practical classes, all of which are classic experiments in developmental biology. These experiments have provided key insights into developmental questions, and many of them are described by the leaders in the field who carried out the original pioneering research. This book intends to bridge the gap between state-of-the-art experimental work and the laboratory classes taken at the undergraduate and postgraduate levels. All chapters follow the same logical format, taking the students from materials and methods, through results and discussion, so that they learn the underlying rationale and analysis employed in the research. Chapters also include teaching concepts, discussion of the degree of difficulty of each experiment, potential sources of failure, as well as the time required for each experiment to be carried out in a practical class with students. The book will be an invaluable resource for graduate students and instructors teaching practical developmental biology courses.

Manuel Marí-Beffa is a Lecturer in Developmental Biology at the University of Málaga.

Jennifer Knight is an Instructor in the Department of Molecular, Cellular and Developmental Biology at the University of Colorado, Boulder.

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Edited by

Manuel Marí-Beffa

University of Málaga

Jennifer Knight

University of Colorado

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This book is dedicated to our families

"…causes and effects are discoverable, not by reason but by experience,…"
(David Hume [1748] An Enquiry Concerning Human Understanding.
Section IV. Part I.)

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Preface

Manuel Marí-Beffa

This handbook of laboratory exercises was first conceived at the Third Congress of the Spanish Society of Developmental Biology held in Málaga, Spain, in 2001. At the time, Professor Antonio García-Bellido suggested including collaborators from the United States and the rest of Europe to give the project a more international scope. The resulting book is a handbook intended to provide a bridge between top scientific researchers and practical laboratories taught at both the undergraduate and postgraduate level. Each chapter introduces a short, inexpensive, and, for the most part, straightforward laboratory project designed to be carried out by students in a standard lab environment. The book uses some of the most popular and best studied model organisms to examine the processes of development. Each chapter is written by specialists in the field describing, in most instances, original pioneering experiments that profoundly influenced the field. The book also demonstrates a historical bridge from classical embryological concepts, using Aristotle and Driesch's entelechia concept (Driesch, 1908) (Chapters 2 and 15) or morphogenetic gradient concept (i.e., Wolpert, 1969) (Chapters 1 and 16) to modern cellular, genetic, and molecular analyses of development such as homeotic genes (Chapters 11 and 20), compartmentalization (Chapter 14), or cell–cell interactions (Chapters 2, 13, and 22). In addition, the high-impact techniques of vertebrate cloning (Section IX) and embryonic stem cells (Section X), as well as the emerging discipline of evolution and development (Evo–Devo, Section XI), are also considered. Finally, although there is much still to learn in this field, Section XII is devoted to computational modelling in the search for a link between genotype and phenotype. During each laboratory exercise, it is our intent that the students imagine themselves working with these highly respected scientists, traveling the same road pioneered by the authors of each chapter.

The format of each chapter is intended to merge the format of standard scientific papers and practical laboratory protocols – a format inspired by texts with similar intent (Stern and Holland, 1993; Halton, Behnke, and Marshall, 2001). Each chapter also includes parts called "Alternative Exercises" and "Questions for Further Analysis" that will permit laboratory instructors or advisors to carry out an "inquiry-based" lab format as

supported by the National Research Council of the United States (NRC, 2000). With the guidance provided in each chapter, students can design and carry out their own, related experiments, potentially culminating in the writing of original papers. For most of the laboratory exercises described, the standard laboratory safety protocols maintained in all labs are sufficient; where necessary, more information is given about the controlled use of hazardous substances. IN GENERAL, CAUTIONS MUST BE TAKEN. MANY OF THE CHEMICALS USED IN THESE LABORATORY EXERCISES ARE HAZARDOUS. TO PREVENT EXPOSURE TO THESE CHEMICALS, YOU SHOULD WEAR GLOVES AND SAFETY GLASSES AND WORK WITH THE CHEMICALS IN A FUME HOOD. THIS IS PARTICULARLY IMPORTANT WHEN WORKING WITH SUBSTANCES LIKE PARAFORMALDEHYDE, GLUTARALDEHYDE, RETINOIC ACID, DEAB, DAB XYLENE, OR CHLORAL HYDRATE. MORE DETAILED INFORMATION ON PROPER HANDLING OF THESE CHEMICALS CAN BE OBTAINED FROM MATERIAL SAFETY DATA SHEETS (MSDS), WHICH ARE SUPPLIED BY THE CHEMICAL MANUFACTURERS. The animals used in each laboratory exercise can be obtained from the curators of many international stock centers around the world. In most countries, Home Office approvals are required so that appropriate responsibilities must be taken by receiving departments.

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CONTRIBUTORS

A. Baonza
MRC Laboratory of Molecular Biology
Hills Road
Cambridge CB2 2QH
UK

G. Begemann
Department of Biology
University of Konstanz
Universitätsstr. 10
D-78464 Konstanz
Germany

M. Blum
University of Hohenheim
Institute of Zoology (220)
Garbenstrasse 30
D-70593 Stuttgart
Germany

H. R. Bode
Developmental Biology Center and
Department of Developmental and
Cell Biology
University of California at Irvine
5205 McGaugh Hill
Irvine, California 92697
USA

D. Bueno
Departament de Genètica
Facultat de Biologia
Universitat de Barcelona
Av. Diagonal 645
08028 Barcelona
Spain

S. Campuzano
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

S. Canevascini
Friedrich Miescher Institute for Biomedical
Research
Maulbeerstrasse 66
4058 Basel
Switzerland

J. Castelli-Gair Hombría
Department of Zoology
University of Cambridge
Downing Street
Cambridge CB2 3EJ
UK

F. J. Díaz-Benjumea
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

J. B. Duffy
Department of Biology
A504/A502 Jordan Hall
Indiana University
101 E. 3rd Street
Bloomington, Indiana 47405-3700
USA

D. Echevarría
Instituto de Neurociencias de Alicante (UMH-CSIC)
University of Miguel Hernández
Campus de San Juan
Carretera de Valencia, Km. 87
E-03550 Alicante
Spain

M. Ecke
Max-Planck-Institut für Biochimie
Am Klopferspitz 18a
D-82152 Martinsried
Germany

C. A. Ettensohn
Department of Biological Sciences
Science and Technology Center for Light Microscope Imaging and Biotechnology
Carnegie Mellon University
4400 Fifth Avenue
Pittsburgh, Pennsylvania 15213
USA

D. Foronda
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

Y. Gañán
Área Anatomía y Embriología Humanas
Departamento de Ciencias Morfológicas y Biología Celular y Animal
Facultad de Medicina
Universidad de Extremadura
E-06071 Badajoz
Spain

R. J. Garriock
Department of Cell Biology and Anatomy, LSN 444
University of Arizona College of Medicine
P.O. Box 245044
1501 N. Campbell Avenue
Tucson, Arizona 85743
USA

G. Gerisch
Max-Planck-Institut für Biochimie
Am Klopferspitz 18a
D-82152 Martinsried
Germany

J. B. Gurdon
Wellcome Trust/CRC Cancer UK Institute
Institute of Cancer and Developmental Biology
University of Cambridge
Tennis Court Road
Cambridge CB2 1QR
UK

J. C. Izpisúa-Belmonte
Gene Expression Laboratories
The Salk Institute for Biological Studies
10010 North Torrey Pines Road
La Jolla, California 92037-1099
USA

C. Karcher
University of Hohenheim
Institute of Zoology (220)
Garbenstrasse 30
D-70593 Stuttgart
Germany

C. Klämbt
Institut für Neurobiologie
Universität Münster
Badestrasse 9
D-48149 Münster
Germany

J. Knight
MCD Biology
University of Colorado
Boulder, Colorado 80309-0347
USA

P. A. Krieg
Department of Cell Biology and Anatomy, LSN 444
University of Arizona College of Medicine
P.O. Box 245044
1501 N. Campbell Avenue
Tucson, Arizona 85743
USA

D. Macías
Área Anatomía y Embriología Humanas
Departamento de Ciencias Morfológicas y Biología Celular y Animal
Facultad de Medicina
Universidad de Extremadura
E-06071 Badajoz
Spain

M. Maden
MRC Centre for Developmental Neurobiology
4th floor New Hunt's House
King's College London
Guy's Campus
London Bridge
London SE1 1UL
UK

M. Marí-Beffa
Department of Cell Biology, Genetics and Physiology
Faculty of Science
University of Málaga
E-29071 Málaga
Spain

S. Martínez
Instituto de Neurociencias de Alicante (UMH-CSIC)
University of Miguel Hernández
Campus de San Juan
Carretera de Valencia, Km. 87
E-03550 Alicante
Spain

H. Meinhardt
Max-Planck-Institut für Entwicklungsbiologie
Spemannstr. 35
D-72076 Tübingen
Germany

L. de Navas
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

N. Perrimon
Department of Genetics and Howard Hughes Medical Institute
Harvard Medical School HHMI
200 Longwood Ave
Boston, Massachusetts 02115-6092
USA

Á. Raya
Gene Expression Laboratories
The Salk Institute for Biological Studies
10010 North Torrey Pines Road
La Jolla, California 92037-1099
USA

J. L. Riechmann
Gene Expression Center
Biology
California Institute of Technology
102B Kerckhoff M/C 156-29
Pasadena, California 91125
USA

C. Rodríguez Esteban
Gene Expression Laboratories
The Salk Institute for Biological Studies
10010 North Torrey Pines Road
La Jolla, California 92037-1099
USA

J. Rodríguez-León
Instituto Gulbenkian de Ciência
Rua da Quinta Grande nº 6, Apt. 14
2780-901 Oeiras
Portugal

A. Rolletschek
In Vitro Differentiation Group
Dept. of Cytogenetics
Institute of Plant Genetics and Crop Plant Research (IPK)
Corrensstr. 3
D-06466 Gatersleben
Germany

R. Romero
Departament de Genètica
Facultat de Biologia
Universitat de Barcelona
Av. Diagonal 645
E-08028 Barcelona
Spain

S. Roth
Institut für Entwicklungsbiologie
Universität zu Köln
Gyrhofstr. 17
D-50923 Köln
Germany

L. M. Salgado
CINVESTAV-IPN
Dpto. Biochemistry
Apartado Postal 14-740
07000 México, D.F.
México

E. Saló
Departament de Genètica
Facultat de Biologia
Universitat de Barcelona
Av. Diagonal 645
E-08028 Barcelona
Spain

E. Sánchez-Herrero
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

A. Schweickert
University of Hohenheim
Institute of Zoology (220)
Garbenstrasse 30
D-70593 Stuttgart
Germany

P. Simpson
Department of Zoology
University of Cambridge
Downing Street
Cambridge CB2 3EJ
UK

N. Skaer
SkyLab, Department of Zoology
University of Cambridge
Downing Street
Cambridge CB2 3EJ
UK

S. Sotillos
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

M. Suzanne
Centro de Biología Molecular "Severo Ochoa"
Universidad Autónoma de Madrid
Cantoblanco
E-28049 Madrid
Spain

H. Vaessin
Neurobiotechnology Center
Dept. of Molecular Genetics
Comprehensive Cancer Center
The Ohio State University
176 Rightmire Hall
1060 Carmack Road
Columbus, Ohio 43210
USA

C. Wiese
In Vitro Differentiation Group
Dept. of Cytogenetics
Institute of Plant Genetics and Crop Plant Research (IPK)
Corrensstr. 3
D-06466 Gatersleben
Germany

A. M. Wobus
In Vitro Differentiation Group
Dept. of Cytogenetics
Institute of Plant Genetics and Crop Plant Research (IPK)
Corrensstr. 3
D-06466 Gatersleben
Germany