MBoC5: the Revolver edition

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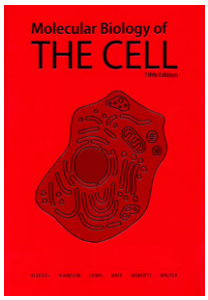
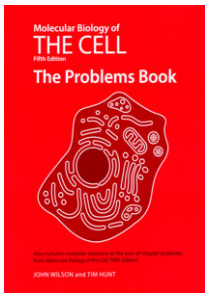


Molecular Biology of the Cell, Fifth Edition

By Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter

Garland Science (2007) 1392 pages (Student edition), 1728 pages (Reference edition)
ISBN 978-0-8153-4105-5 (Student edition), 978-0-8153-4111-6 (Reference edition)
$142.00/£99 (Student edition, chapters 1-20, hardback), $209.00/£110 (Reference edition, chapters 1-25, hardback)



Molecular Biology of the Cell, Fifth Edition: The Problems Book

By John Wilson and Tim Hunt

Garland Science (2007) 608 pages
ISBN 978-0-8153-4110-9
$39.95/£21.99 (paperback)

It has been 25 years since the first edition of *Molecular Biology of the Cell* (MBoC) was published, which means that roughly half of today's practicing scientists do not remember life without this cell biology 'bible'. The other half might recall how the book almost instantly filled a void with refreshingly clear and engaging writing illustrated with extensive diagrams and figures. The first MBoC provided much-needed ready access to basic background information on molecular biology and detailed explanations of current knowledge in cell biology at a time when personal computers were still new and a literature search meant days in the library rather than seconds at PubMed. MBoC has only improved over its several editions, growing with the rapid advances in the field to become an essential resource for students at all levels and a trusted first stop for researchers transitioning into unfamiliar areas of cell biology.

So what is new in the fifth rotation of MBoC? Is it worth spending a small fortune to purchase if you already own the fourth (Sgt. Pepper's) or even third (Abbey Road) editions? An enduring strength of the book is that it remains a comprehensive textbook. The overall organization is the same, from the molecules of biology and biochemistry to the organization of genetic information and gene expression, progressing to the cytoplasm and the complexities of compartments and traffic between them, and finally to the interactions between cells during development, in tissues, and in defense mechanisms. There are 25 chapters, which are divided into five parts: an Introduction to the Cell, Basic Genetic Mechanisms, Methods, the Internal Organization of the Cell, and Cells in their Social Context. The first part is an outstanding guide to the fundamentals of molecular biology, genetics and biochemistry, and the Methods section is both a reminder that the information in the book is derived from experiments, and a practical resource for those new to the lab.

The MBoC5 package is a fantastic resource and well worth the upgrade… you are likely to find what you need in a highly accessible, engaging and clear form

Each of the chapters in parts 1 to 4 has been updated extensively, much of it reflecting the explosion of information from genome sequencing and the elucidation of epigenetic regulation of gene expression. The expanded section on genome evolution has been moved towards the front of the book, into chapter 4 – DNA, Chromosomes, and Genomes – emphasizing the profound and pervasive impact of comparative genomics on our ability to decipher cellular mechanisms. New sections on the paradigm-shifting small non-coding RNAs have been added, although they barely keep up with this rapidly advancing field. For example, the newly discovered piRNAs did not make it into this edition.

Quantitative analysis of chapter length (made easier by the inclusion, at last, of page numbers for the chapter subsections) reveals that the most extensive additions to MBoC5 are in the fifth and final part of the book: Cells in their Social Context. This reflects the newest frontier in cell biology – the advances being made in our understanding of how cells communicate in tissues and organisms, the contributions of stem cells to tissue maintenance, and the orchestration of cell proliferation, dynamic cell movements and differentiation decisions made during plant and animal development. No less impressive is the progress in understanding defense mechanisms carried out by the immune systems and the many ways perturbation of cell biology can lead to cancer. One lesson that emerges from the added pages is the ever-increasing impact of cell biology research on human health. New sections on embryonic stem cells and their potential for studying and treating disease foreshadow what are likely to be the major advances included in the next edition of MBoC.

The laudable goal of producing a comprehensive textbook that includes basic information on cellular chemistry, genetics and genomics alongside precise descriptions of current affairs in cell biology, leads inexorably to bigger and bigger books. The fourth edition was 1463 pages, and no scale in my lab measures high enough to determine its weight. The Reference edition of MBoC5 is a remarkable 1728 pages. Since there are limits to what can be carried in a book bag, something had to give. The decision for MBoC5 was to produce chapters 21-25 in PDF form, and offer a reduced-size softbound Student edition (1392 pages) with chapters 1-20 in print. My first reaction was utter dismay that the 'good stuff', especially from the point of view of a developmental biologist, is left out of the Student edition. However, my thinking quickly changed – the chapters are of the same high quality as the printed chapters, they are fully updated, printouts are much less heavy to carry around than the whole book and, best of all, the PDFs are searchable. This teaser – making only five chapters available in PDF form – amounts to a concession that publishing in print-only is behind the times. One suspects that 'bean counters' who fear fewer book sales are behind the decision to withhold the rest of the PDFs.

In addition to the comprehensive updating of every chapter, another reason to

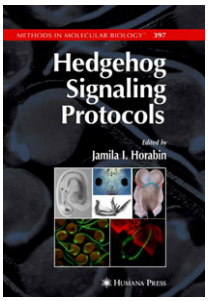
consider acquiring edition five is the improved integration of the print volume with an extensive array of videos and animations in the 'Cell Biology Interactive' provided on the accompanying DVD. Information in the Cell Biology Interactive was supplied with the fourth edition; however, new four-letter 'DNA' codes are used in MBoC5 to indicate the features, cleverly emphasizing the information-rich nature of four nucleotides. The movies and animations range from simple models that illustrate concepts (e.g. the enzymatic action of lysozyme) to elegant tomograms of a synaptic vesicle and mitochondrion. It does take extra time to navigate from the textbook to the right feature in the Cell Biology Interactive; however, the effort is well rewarded with a deeper and more dynamic understanding of cell biology. Nevertheless, there is room for improvement to the electronic information. The codes to the Cell Biology Interactive features in the PDFs of chapters 21-25 are not 'clickable' – one has to manually navigate to the interface and type in the four-letter code, risking flashbacks to the days of manual DNA sequence entry. And, sadly, only 23 of the 50 animations in the DVD were viewable on my computer, a problem to be aware of when purchasing your copy.

An unavoidable drawback of this textbook is that it is a textbook. Every well-written sentence is a distillation of an enormous amount of (largely unreferenced) experimental evidence, and little space is devoted to pointing out the huge gaps in our understanding of how genomes guide cell behavior, or the excitement of discovering new information in the lab. The Cell Biology Interactive, with lively narration by Julie Theriot, helps a great deal here. There are numerous movies of live cells undergoing development or being used in experiments that explore cellular dynamics. It is one thing to see a static drawing of the classic Spemann-Mangold axis duplication experiment, and quite another to watch it re-enacted in a video. In addition, many of the movies have a significant entertainment quotient – check out the ATP Synthase Disco and the sound effects for Myosin and Dynein (who knew they make popping sounds?). Another welcome improvement in MBoC5 helps link the textbook to the lab – there are now problems printed at the ends of the first 20 chapters. Whereas some are designed to facilitate information retention, the best problems stimulate thought and challenge the reader to think about experimental approaches for learning new things about cell biology. The problems printed in MBoC5 were carefully chosen from the companion Problems Book, which contains the answers. In addition, the Problems Book itself now has a CD with answers to all the problems, providing even more fodder for discussion. Importantly, the MBoC5 Problems Book has brand new questions for three chapters (Visualizing Cells; Cell Junctions, Cell Adhesion and the Extracellular Matrix; and Cancer), which deserves kudos. I hope the authors are tackling chapters 21-25 for the next edition.

Will the hybrid print/electronic format of MBoC5 be successful? This will depend on who is using it and for what purpose. For a student using MBoC5 for a class, the format is likely to be very frustrating. Getting the full value of the chapters requires constant access to a computer for viewing information on the DVD. This is OK, even great, if the student is reading any of chapters 21-25 because the PDFs can be stored on a laptop and the whole package easily transported to the nearest coffee shop or library. However, if the student is studying the print-only chapters, both a laptop and the heavy book must be lugged around, to the probable detriment of back muscles. The Student edition helps a bit; however, the soft binding of my copy took a serious beating from only a couple of trips in my backpack. Clearly, students would benefit from having a completely electronic version so the entire content is readily available (and searchable) on laptops. For graduate students, postdocs and faculty, MBoC5 is more likely to be a helpful reference for ongoing, though more sporadic, use rather than for intensive daily studies, making it fine to park the heavy print volume in a handy location. The Reference edition is the better choice for the lab to avoid the frustration of looking up something in the index only to realize you need to go the computer for the appropriate chapter. Still, maintaining ready access to the DVD makes the reading experience somewhat frenetic. Here, too, having a fully electronic version would be very welcome.

Even with the incomplete transition to a fully hybrid print/electronic format, the MBoC5 package is a fantastic resource and well worth the upgrade. Whether you need reminding of something you used to know or background on something new, you are likely to find what you need in a highly accessible, engaging and clear form. And having the printed copy is still essential. Opening the book to virtually any page reveals attention-grabbing information that can entertain through a lunch hour or incubation, or spark an idea for an experiment.

Helpful hints for Hedgehog, flies and more



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Hedgehog Signaling Protocols (Methods in Molecular Biology vol. 397)

Edited by Jamila I. Horabin

Humana Press (2007) 256 pages
ISBN 978-1-58829-692-4
$99.50 (hardback)

The primary aim of this book, *Hedgehog Signaling Protocols*, is to help Hedgehog researchers optimize their own practices, broaden their scope by adopting new methods and improve their understanding of more distant branches of the Hedgehog literature. The universally high quality of each chapter, authored by expert practitioners, guarantees some success in these objectives. Developmental biologists and educators with no special disposition towards Hedgehog signaling might also draw some benefit from this book as it provides a series of case studies that illustrate widely applicable methods. Some pragmatic details of the content of this book and some of its suggested uses are discussed below in order to help researchers and educators make a more precise personal evaluation of it.

Half of the sixteen chapters, each of roughly a dozen pages, are devoted to a fairly comprehensive coverage of current techniques and key reagents used in *Drosophila* Hedgehog research. Particularly noteworthy is the

conscientious compilation of GAL4 driver and UAS responder lines (Denise Busson and Anne-Marie Pret), which could save experienced researchers from having to comb through the literature and could also provide novices with instant familiarity with an important tool-kit. Also of note are the clearly explained benefits of a well-designed inducible RNAi vector (Eric Marois and Suzanne Eaton), which might not otherwise come to the attention of potential users. Two chapters on the use of *Drosophila* tissue culture cells for subcellular fractionation and the analysis of protein-protein interactions are written by experts (Melanie Stegman and David Robbins; Chao Tong and Jin Jiang) who have consistently achieved a standard in these areas that others try to emulate. Two other chapters focus on the detection of Hedgehog ligands and responses, highlighting honed immunocytochemical methods and reagents that are the fruits of the authors' extensive experience and success. The remaining four chapters focus on genetic methods for perturbing the Hedgehog pathway in *Drosophila* embryos and imaginal discs.

Although specific reagents and examples of results are included in all chapters, the underlying principles, which are generally carefully explained, together with generally applicable, detailed protocols, occupy at least two-thirds of the text. One associated benefit of that balance is that researchers new to the field (new PhD students, post-docs or bold PIs) will gain a good understanding of the principles and general rationale that underlie the detailed recipes for the execution of experiments in this field. A second benefit is that these chapters are also very useful to those outside the field of Hedgehog signaling because they offer a group of methods that are generally applicable to fly developmental biology. This volume might therefore be valued by many *Drosophila* research laboratories, especially those interested in intercellular signaling. There are, of course, several extensive reviews, websites, older books and even a very recent book from Humana Press on *Drosophila* research methodology, and several of those sources are indeed more comprehensive in breadth and detail than the fly chapters included here. Remarkably, however, much of the material is complementary rather than overlapping.

Those seeking guidance on how to study Hedgehog signaling in vertebrates will find single chapters centered on chick, *Xenopus* and zebrafish, which do a particularly nice job of providing a brief historical perspective and a balanced evaluation of the virtues and limitations of the approaches discussed. These chapters are supplemented by a very detailed and illuminating discussion of methods for purifying Hedgehog proteins in a variety of states of modification, which will be of universal interest within this field. They also include some practical advice on retroviruses and flow cytometry and a rather specialized discussion of working with rat telencephalic explants. Perhaps surprisingly, there are no chapters on some major areas of investigation, including Hedgehog signaling in the neural tube, cilia as key sites of Hedgehog signaling, genetic strategies in mice (akin to the *Drosophila* chapters) and on the analysis of Hedgehog pathway target genes.

What the book adds to research papers, descriptions in textbooks and reviews is a texture of reality borne of first-hand experience

As with any book, limitations stem from constraints on space and from being slightly out of date even at the time of publication. The 250 or so pages of this book are mostly concise and clear, as exemplified by the editor's four-page overview of Hedgehog signaling, and deal with topics and methods that should have enduring value and applicability for at least five or six years. Wisely, the book largely presents methods and concepts rather than attempting to convey a detailed current understanding of Hedgehog signaling, which would quickly become outdated and would always be surpassed by more current papers and reviews.

Investigators who are already running a Hedgehog research enterprise will probably find it difficult to decide whether this book is cost-efficient as a research training or experimental aid. It would certainly be a useful book to hand to new researchers in the laboratory. As mentioned, most chapters concern widely applicable techniques and, as such, this book would be helpful to many developmental biologists in training, especially in fly research, simply because of the balance of the book. What the book adds to research papers and most descriptions of methods in textbooks or review papers is a texture of reality, borne of first-hand experience. This is manifest in many chapters by the technical hints and very specific recommendations that are provided and in others by the organization and emphasis on the rationale for choosing a particular method that is often difficult to find in other publications. For those who remember the early days of molecular biology, there will never be a protocol manual to rival the impact of the original 'Maniatis' volumes. Indeed, *Hedgehog Signaling Protocols* cannot be considered essential by that gold standard because it is not comprehensive or unique in its content, nor is it packed with secret tricks and treasures. However, the same memories might provoke the thought that a modest collection of methods books, spanning relevant disciplines and approaches, can be a very valuable resource in helping new arrivals to obtain a secure footing in a new field and to gain independence more quickly in a research laboratory.

Although this book is not written as a textbook, I can also imagine using it as a teaching device in graduate-level courses because it highlights certain methods accompanied by illustrative examples. This is a useful complement to research papers, which have the opposite emphasis, and to the discussion of methods in isolation, which can lack color and the important integration of means and objectives. This integration, coupled to suitably sophisticated and intellectually engaging genetics for a graduate course, are particularly noteworthy in the chapters on detecting the Hedgehog morphogen (Ainhoa Callejo, Luis Quijada and Isabel Guerrero), somatic clonal analysis (Christine Bankers and Joan Hooper) and on building a versatile RNAi vector (Eric Marois and Suzanne Eaton), all subjects that would find a place in many genetics and developmental biology courses. Of course, it might be a stretch to purchase a whole book in order to use only a few sections of it to augment a course based on additional materials. Unfortunately, analogous dilemmas of cost versus efficacy and fitting a text precisely to the complex demands of teaching or research are widespread. With *Hedgehog Signaling Protocols* you might not get exactly what you want, but if you try it out, as first vocalized more than a decade before the *hedgehog* gene was named, you might just get what you need!

An unabridged view of the TGF-β family

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The TGF-β Family (Cold Spring Harbor Monograph Series 50)

Edited by Rik Derynck and Kohei Miyazono

Cold Spring Harbor Laboratory Press (2008)
1114 pages
ISBN 978-087969752-5
$135 (hardback)

Which came first within the Transforming growth factor β (TGF-β) superfamily, the TGF-β subfamily or the BMP subfamily? Of course, the answer depends upon how one defines 'first': is it the first to come to the attention of researchers or the first to exist on the planet? The answer to the first version of this question can be found in *The TGF-β Family*, the new monograph from Cold Spring Harbor Laboratory Press that covers the TGF-β superfamily. For the answer to the second, one must read on.

In this review, I intend to do four things. First, I will try to put this book into perspective. Second, I'll share a few basic facts. Third, I'll give my impressions of the book's strengths and weaknesses and fourth, I'll provide my view as to who will be well served by keeping a copy of this book handy.

For perspective, take a moment to recall where you were in 1978 when the first partial purification of what would become known as TGF-β1 was reported. I was an undergraduate at that time and did not publish my first TGF-β paper until many years later, in 1994. Now, take into consideration the fact that a search of PubMed with the word 'TGF-beta' returned 39,641 entries in September 2008 (by comparison, the search term 'Wnt' returned 7496 entries). To date, a comprehensive review of the TGF-β field has been lacking and thus the book fills an important niche.

Next, a few basic facts. The 1114-page book begins with a Preface by the editors Rik Derynck and Kohei Miyazono, a Forward by Michael Sporn and two introductory chapters. The first of these chapters is written by Harold Moses and Anita Roberts, who provide a personal view of the context surrounding the discovery of TGF-β. The other introductory chapter is an overview of the field by the editors. These are followed by 31 chapters devoted to distinct topics of TGF-β research: three chapters of cell biology; ten chapters of signaling; 12 chapters of differentiation, development and physiology; and six chapters of cancer and disease.

One measure of the comprehensive nature of this book is the fact that 64 distinct authors representing seven countries contributed to its 33 chapters, with only three authors present on more than one chapter. Furthermore, authors appear to have been given full authority over their chapters, as many are lengthy: six are roughly 50 pages and several others are over 40 pages long. All chapters are accompanied by at least two illustrations. Frequently, these are nicely color-coded schematics or flow-charts representing 'take-home messages' identified by the authors for that topic. A few chapters contain color figures of original data, although only one chapter includes original data that do not appear to have been published previously.

One measure of the comprehensive nature of this book is the fact that 64 distinct authors representing seven countries contributed to its 33 chapters

This celebration of the TGF-β field is not without its somber side. With sadness, I note the inclusion of chapters co-authored by Anita Roberts (the historical perspective, with Harold Moses) and Kai Lin (on receptor assembly and specificity, with Senyon Choe), both of whom passed away in 2006. A brief retrospective describing the contributions of these investigators is contained in the Preface, and Figure 3C from the chapter by Kai Lin graces the book's cover.

In reflecting on the book's strengths and weaknesses, in my view the strengths are many and profound and the weaknesses are few. Let me begin with the strengths. As clearly stated, the editors intended to be as comprehensive as possible and, although I have one quibble (discussed below), there is really little doubt that they have succeeded. The breadth and depth of the coverage of current TGF-β research is the most compelling feature of this book. To illustrate the depth of coverage, the chapter on TGF-β signaling in *Drosophila* by George Pyrowolakis, Britta Hartmann and Markus Affolter encompasses 34 pages with four color diagrams and lists roughly 150 citations. The authors clearly describe the basic components of fly TGF-β pathways, several mechanisms of transcriptional repression employed by BMP signal transducers and the salient features of BMP gradient formation in embryos versus wing primordia. The chapter neatly ends with a set of currently unanswered questions. Looking beyond individual chapters, the book's subject index helps the reader to navigate towards the most relevant chapter, and frequent cross-referencing between chapters aids in stitching them into a cohesive volume.

Given these strengths, it is my recommendation that every principal investigator studying TGF-β should have a copy of this book for the following reason. In a multi-faceted field such as TGF-β research, the learning curve is extraordinarily steep for newcomers, such as graduate students, newly minted post-docs and even experienced PIs, who find themselves following their research program into the TGF-β world. Until now, those of us running TGF-β labs would spend a considerable amount of time guiding these newcomers as they compiled their library of relevant papers and in subsequent discussions of those papers, as they pieced together for themselves the current working hypotheses in the field. Now, this task is likely to be much easier as newcomers can begin independently by reading the most relevant chapters and making sense of the big picture, as sketched out by the authors. Once this framework is in place, current reviews in the primary literature can be digested more easily. For example, the chapter on growth control by TGF-β (Peter Siegal and Joan Massagué) can be followed up with a recent review on TGF-β in cancer (Massagué, 2008). Thus, the process of 'getting up to speed' becomes far less arduous.

The books strengths are also relevant to those of us who teach. Instructors in graduate specialty courses are often at their wits end in finding suitable materials above the textbook level (which the students should already know) but a bit below the primary literature (which can be too detailed, at least at the beginning for first year students). For the next few years, I believe this book will effectively fill that gap. At 40-50 pages, each chapter contains far more detail than any textbook, yet, in synthesizing existing knowledge, the authors inevitably weed out distracting details and conclude with an excellent summary that leads directly to the primary literature. Furthermore, the book's structure of 33 individual chapters is a nearly perfect fit to a course that meets once or twice a week for a semester. I recommend that faculty members teaching graduate courses in any discipline employed in TGF-β research (biochemistry, cell biology, development, genetics and oncology, to name just a few) consider adding this book to their syllabus.

Of the few weaknesses I noted, one is perhaps unavoidable in a work of this magnitude and another is likely to be beyond editorial control. First, the process of gathering, editing, proofreading and typesetting 33 distinct chapters is inherently time-consuming. As a result, the newest papers cited in the book are from 2006 and, in several chapters, from 2005. Second, in late 2004, many of the most prominent investigators were invited to contribute chapters to two books – this one and *Smad Signal Transduction*, edited by Peter ten Djike and Carl-Henrik Heldin and published by Springer (ably reviewed in these pages last year). The more focused (22 chapters) and strongly edited Smad book (in which the chapters were limited to 20 pages) was published in 2006. Of those invited to write for both books, many wrote chapters on distinct topics and these individuals should be applauded. Others wrote chapters on the same topic but presented the information in a new way. There were several authors who chose only to make minor changes. The latter might not have been visible to the editors of *The TGF-β Family* as both books were being compiled simultaneously.

Now it is time to return to my quibble and this also leads back to the opening question. In my view, an area of active TGF-β research absent from the book is computational biology. Here, I use this term to encompass a wide array of non-experimental approaches that include phylogenetics, kinetic and Boolean modeling, interactome construction and comparative genomics. Thus, I provide the answer to the second version of the opening question: the best evidence to date, from two species of sponge, suggests that the BMP subfamily pre-dated the TGF-β subfamily. Computational research is emerging as one of the hottest areas in the TGF-β field. This is particularly true in Europe, where strong sponsorship is provided by ENFIN, the European Network of Excellence in Data Integration and Systems Biology. In hindsight, it is true that four years ago when chapters for *The TGF-β Family* were being solicited, this area of research was far smaller than it is now.

In summary, I rank *The TGF-β Family* among the handful of books such as the 'Red Book' for fly geneticists or 'Maniatis' for molecular biologists that in their time provided definitive guidance for researchers. This book belongs in every TGF-β lab.

Reference
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Destiny is anatomy

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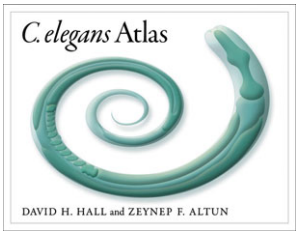

The *C. elegans* Atlas

By David H. Hall and Zeynep F. Altun

Cold Spring Harbor Laboratory Press (2008) 348 pages
ISBN 978-087969715-0
$125 (wire binding)

The destiny of an embryo is the anatomy of the organism. The development of the structure of an organism at any level is what we developmental biologists seek to explain. A good description of anatomy is thus a crucial prerequisite of our science, and often provides inspiration for new lines of research.

The strikingly invariant cell lineage of *Caenorhabditis elegans* leads to the essentially invariant anatomy described in the stunningly beautiful book, *The C. elegans Atlas*, by David Hall and Zeynep Altun. The images and description provided in it are a great resource for learning the anatomy of *C. elegans*, knowledge that is essential for a wide range of experiments. For example, if you can see a cell, you can kill it with laser irradiation and thereby assess its function. Such ablation experiments are performed routinely to investigate the developmental, behavioral and physiological consequences of deficits in particular cells, and not understanding the worm's detailed anatomy is a limiting factor in such analyses. The images in this atlas show one how to find many *C. elegans* cells.

The major content of the 348-page book is its 192 figures, most with multiple panels, which often consist of multiple images. The figures include informative schematics, Nomarski differential interference optic micrographs, epifluorescence images, scanning electron micrographs, and color-coded transmission electron micrographs. However, the book is printed in landscape format, 24 inches wide when open, nine inches high. This format works wonderfully on a table, but is inconvenient to place next to a microscope. When I first saw the book, I assumed it was designed to accommodate the elongated shape of these worms; however, only a few figures actually use the width of the pages, and only one stretches to nine inches. Also, there are no two-page spreads, something I expected and looked forward to. It is unclear whether the priority was to produce graphics for a web-accessible version.

I had a serious problem writing this review: my students repeatedly took this book from my office

That said, every few pages hold some new delight. Figure 4.1 shows the plumbing of the excretory system in a gorgeous schematic. The structure of the *C. elegans* nervous system with its 302 neurons has always been inspirational; this book makes it more accessible. For example, Figure 3.14 shows wiring bundles from the ventral nerve cord to the various commissures; if you were not

fascinated by axon guidance before, you will be after seeing these diagrams. Chapter 7 nicely describes the alimentary system and its development. In particular, a set of figures clearly illustrates the 180° twist that occurs in the intestine during embryogenesis. The chapter on muscle uses a wide array of images to explain the ultrastructure of *C. elegans* obliquely striated muscle at the level of the fibers, cells and muscle quadrants. The hermaphrodite reproductive system (chapter 8) is covered so extensively that I learned new and interesting details about body parts that I have been studying for decades.

By contrast, the pericellular structures are given short shrift (chapter 10). Even though there are nice reagents for visualizing extracellular matrix, this chapter relies more on text than on figures. Moreover, there is relatively little information on the male included in this atlas. Part of the reason is that the ultrastructure of the male is less well known; it is only now being elucidated by Scott Emmons, David Hall and colleagues. However, there is considerable information at the light microscopic level. Perhaps there will have to be a sequel to this book that includes this new information.

If you want to think about organogenesis, these images allow you to understand how the cells are arranged and what they contact. The cell lineage diagrams of John Sulston, H. Robert Horvitz, Judith Kimble and Einhard Schierenberg hint at a profound logic that underlies the development of this worm, but being able to see the positions of the cells is essential for understanding cell-cell communication, cell migration and morphogenesis. This atlas combines in a digestible fashion the cell lineage information with the positions and morphologies of specific cells. It allows the reader to visualize fully the end points of morphogenesis, and thus to comprehend the many developmental experiments that can be performed on this organism.

In the few descriptions of developmental anatomy and genetics in this atlas, some information is already out of date. However, the vast majority of the content is timeless, making this a reference work that one will want to go back to repeatedly.

As you might expect from a phylum comprising about a million species, there is considerable anatomical diversity, but many individual cells are easily recognizable among species. Thus, the detail presented about *C. elegans* has a high probability of applying to other nematodes.

I had a serious problem writing this review: my students repeatedly took this book from my office. Indeed, one student lamented that "there are not enough pictures". Overall, the authors have done an excellent job balancing completeness and readability. However, the authors' superb website, www.wormatlas.org, will presumably have all these images, and more, at some time. Nonetheless, any serious student of nematodes would want to have this book on their laboratory coffee table. And, anyone who is reading one of the now 10,000 *C. elegans* papers, will likewise want access to this book.

Molecular navigation of the brain

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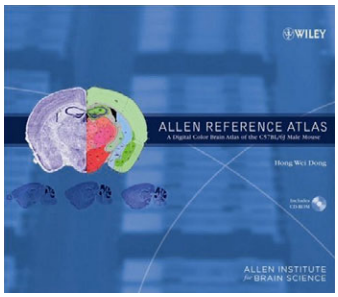

The Allen Reference Atlas: A Digital Color Brain Atlas of the C57BL/6J Male Mouse

By Hong Wei Dong

Wiley (2008) 376 pages
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With the completion of the sequencing of the human genome and of the genomes of other model organisms, there is a need to understand the function of each of those genes. One way to do this is to integrate this genome-wide information with patterns of gene expression, and, with this in mind, several projects have been initiated to examine global gene expression patterns during development and in the adult. The mammalian brain presents a particular challenge for an undertaking of this nature owing to the intricacies of its structure and the complexity of its gene expression patterns. In the early 1990s, the US National Institutes of Health launched what became the Brain Mapping Anatomy Project (BMAP), which had the ambitious goal of producing a systematic, three-dimensional map of gene expression in the mammalian brain (the brains of human, monkey and mouse) for all of the genes in the genome. The Allen Institute for Brain Science, founded in 2003, is devoted to this goal, and in 2006 it completed a comprehensive gene expression map for the brain of the C57BL/6J male mouse, using brains from 8-week-old mice prepared as unfixed, fresh-frozen tissue. This map is freely available online as the Allen Brain Atlas (ABA, www.brain-map.org), and the results were published in 2007 (Lein et al., 2007). Anyone who has used the ABA can attest to its usefulness, as well as its comprehensive nature; it is an indispensable tool for anyone interested in the molecular aspects of brain organization and function.

An online repository of information is needed for all of the data in the ABA, but the resolution of images is not always satisfactory and can be below that of the best and most useful atlases. For this reason, the Allen Institute has now published the *Allen Reference Atlas* (ARA) in book form. The goal of this book is to create a solid, detailed neuroanatomical reference book that integrates with the ABA online. In the book, which compares favorably with the best anatomical atlases, there are 132 fully annotated, high-resolution coronal sections evenly spaced at 100 μm intervals, as well 21 representative sagittal sections spaced at 200 μm of the 8-week-old C57BL/6J male mouse. These images are also reproduced online as full-color, high-resolution, web-based digital brain atlases. Brain regions are

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annotated using a systematic taxonomy of mouse brain structures, resulting in annotation that is as good as in any mouse brain atlas. The expression data are fully integrated into this annotated neuroanatomical atlas, allowing the ABA online to function as a detailed searchable gene expression database. In addition, the book has an introduction of 25 pages that describes the ABA and ARA, including their philosophy and approach to the problem, providing material that is not available online.

The Allen Brain Institute has of course succeeded magnificently in their goal to integrate the detailed ABA and ARA, and have given detailed attention to the expression patterns and neuroanatomy. There is no doubt that this will be the definitive atlas for gene expression in the mouse brain. It will be highly useful to anyone wanting to know the pattern of expression of a single gene or of groups of genes in the adult brain, or which genes are expressed in a particular structure. Unfortunately, there is no atlas for different developmental time points in the brain, but perhaps this will be a future project. I certainly hope that it is in the planning stages. There are currently two other projects at the ABA, which provide atlases for the adult mouse spinal cord and human cortex online, and a future project will examine gene expression during sleep deprivation and sleep states in the mouse brain. Given the level of detail in the current ABA and ARA on the mouse brain, these new resources will surely be equally indispensable.

Why does one need a book when the atlases are available online? In the introduction to the print version of the ARA, the author suggests that it could be used with the ABA, similar to the way one uses an anatomy reference book while looking down a microscope. For studying the intricacies of development or brain structure and function in histological sections, an anatomically detailed and high-resolution atlas is essential to orient the investigator to what he or she is seeing online or under the microscope. This seems to me the optimal way to visualize and conceptualize the online expression patterns, given that I have used books in this way in the past.

You may think that this is an old-fashioned approach. However, I left the book for a few months in my lab and asked my students and fellows to let me know what they thought of it. They were unanimous in thinking that it was very useful. Probably the best recommendation for this book is that it was always located either open by the microscopes or at someone's desk, and after exposure to my lab members, it was soon well worn. I cannot think of a better recommendation.

Reference

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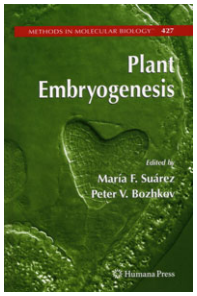
Plant embryogenesis: getting started



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Plant embryogenesis (Methods in Molecular Biology vol. 427)

Edited by María F. Suárez and Peter V. Bozhkov

Springer (2008) 184 pages
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£61.50 (hardback)

Plants, like animals, get their start during embryogenesis. Plants, however, only pattern a basic body plan during embryogenesis, with their adult body forms bearing very little resemblance to the embryo. Given this diversity in postembryonic development, it is remarkable that plant embryos from a wide range of species go through very similar stages of development, many with stereotyped, almost invariant cell division patterns. It is therefore tempting for plant embryologists to explore the underlying molecular mechanisms of this patterning in many different types of plants. Adding to this temptation is the fact that genomic information for a multitude of experimentally tractable plants is now available at the click of a mouse. But how does one even begin to grow all of these plants, much less isolate their embryos? Editors María Suárez and Peter Bozhkov attempt to answer these questions by compiling protocols on *Arabidopsis*, maize, barley and spruce in the book *Plant Embryogenesis*. This collection of protocols covers the gambit of plant techniques, from general plant husbandry to laser-capture microscopy, and does so in a way that is both detailed and easy to follow.

The book is divided into two parts, entitled Model Embryonic Systems and Cellular, Genetic and Molecular Mechanisms of Plant Embryogenesis. The first part introduces the reader to embryogenesis in *Arabidopsis*, maize and spruce. Chapter 1, by Soomin Park and John J. Harada, is a fairly comprehensive review of *Arabidopsis* embryogenesis that covers the patterning of the embryo from fertilization, discusses many known factors associated with specific embryonic stages/cell types, and touches on the roles and transport of the plant hormone auxin. Both the patterning of the apical/basal axis and the development of radial patterning are explored. A single figure depicts several developmental stages of *Arabidopsis* embryos, providing the reader with a reference for the descriptions in the text and protocols later in the book. After this smooth introduction, the next chapter on maize embryogenesis is a bit jarring. Instead of a review of the field, the chapter jumps right into protocols on growing maize in a greenhouse, generating immature embryo cultures, generating somatic embryos and performing in situ hybridizations. Although all of these protocols are well written and informative, the lack of a

This book will probably not replace a good collaboration, [but] provides enough information to start thinking about working in a different species

single depiction of maize embryogenesis and the paucity of references are a bit disappointing.

The next chapter falls somewhere in between the first and the second in terms of content. This chapter, by Sara von Arnold and David Clapham, focuses on spruce somatic embryogenesis and includes a nice description of embryonic cell lines and some of the experiments that are now possible using them. These somatic embryos can be synchronized, allowing researchers to collect large amounts of tissue at any given stage. Pictures of somatic embryos and a model of embryonic development are included in the introduction, as well as a review of some of the genes expressed in these cultures. Protocols on generation, maintenance and transformation are interspersed with short descriptions of the effects of different hormones and of the behavior of the cultures.

The second section of the book is almost completely dedicated to a wide variety of different protocols. The protocols are in a standardized, helpful format, starting with a brief introduction that is followed by a materials and methods section. A notes section is also included to better explain certain steps in the protocols and to point out derivations and tips to the reader. This section begins with a guide by Erhard Kranz, Yoichiro Hoshino and Takashi Okamoto on how to generate embryos and extra-embryonic endosperm in maize using in vitro fertilization, and how to micromanipulate the resulting tissue. There are several figures depicting both the techniques and the apparatuses used, making a daunting set of protocols more approachable.

A different approach for studying the early stages of *Arabidopsis* embryogenesis is presented by Michael Sauer and Jiří Friml in the next chapter. Here, the authors describe how to isolate and culture embryos as they develop within the ovule, which limits the number of developmental aberrations often seen in somatic embryogenesis systems. This protocol allows for the treatment of these embryos with drugs or hormones, which is difficult (if not impossible) to perform when embryos develop in the silique (seed pod). A brief description of microscopic analysis, including morphology, visualization of fluorescent proteins and histochemical detection, is also included. A final approach to generating embryos in culture is provided by Simone de F. Maraschin, Sandra van Bergen, Marco Vennik and Mei Wang. Here, the generation of haploid, microspore-derived embryos from barley is well described and illustrated. This process has traditionally been used by breeders to derive homozygous barley lines, but can also be adapted to study embryogenesis in the laboratory.

The book then shifts gears from generating embryos to manipulating and analyzing them. Among the techniques discussed is how to transform *Arabidopsis* with *Agrobacterium tumefaciens*, and a very helpful table that describes multiple plant transformation vectors, along with a description of the different strains of *Agrobacterium*, can be found in these chapters. Robert Blanvillain and Patrick Gallois also provide a related discussion on promoter trapping using T-DNA transformation in *Arabidopsis*, together with a useful PCR-based method for cloning genomic DNA that flanks the T-DNA insertion sites which can be applied to the insertion lines discussed in the preceding chapters. In chapter 11, Michael Sauer and Jiří Friml describe the use of auxin-specific antibodies to determine the spatial accumulation of this hormone during embryogenesis. They also discuss the pros and cons of using this technique as opposed to auxin-responsive transgenes. In chapter 13, Andrei Smertenko and Patrick Hussey present a different immunolocalization protocol, with an emphasis on studying the plant cytoskeleton. The inclusion of both protocols is helpful as one is applied to *Arabidopsis* and the other to spruce.

The remaining three chapters are a bit more specialized in the techniques they describe, covering laser-capture microdissection techniques, protocols for tracking intercellular macromolecule trafficking in *Arabidopsis* embryos, and a combined TUNEL and immunolocalization protocol to detect programmed cell death and a protein of interest in the same embryo.

As a methods book, *Plant Embryogenesis* does a good job of presenting a variety of techniques in a very digestible format. The notes sections of each protocol are particularly useful and make the protocols much more informative. I believe it would have been beneficial to include a little more background on each of the model organisms discussed (with the exception of *Arabidopsis*), but those types of reviews can be found elsewhere. Students and post-docs new to the field are likely to find the detailed protocols helpful, and it will make a nice addition to the reference collection of school libraries or individual labs. Although this book will probably not replace a good collaboration with another laboratory, it provides enough information for researchers to at least start thinking about working in a different species.

Interplay between cell cycle regulation and plant development

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Cell Cycle Control and Plant Development (Annual Plant Reviews Vol. 32)
Edited by Dirk Inzé

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£99.50/€134.40 (hardback)

The regulation of cell cycle transitions is one of the most widely studied phenomena in biology, and studies in several model systems have revealed the basic machinery that drives these transitions. Although the core cell cycle machinery is conserved across evolution, its regulation has to be tightly coordinated in both space and time during multicellular development. To gain insights into the complex interplay that occurs between developmental signals and the basic cell cycle machinery requires a unique synthesis of two distinct fields of research that have largely evolved

independently. A vast amount of information has been accumulated in the study of plant developmental patterning, as well as concerning the nuts and bolts of cell cycle transitions. *Cell Cycle Control of Plant Development*, edited by Dirk Inzé, attempts to bring together these two distinct fields in a series of review articles that provide comparative overviews of the components and regulation of the cell cycle machinery in diverse plant and animal systems.

Although not a useful reference for emerging concepts, this book is an excellent source of information on the cell cycle machinery and its regulation

The book consists of 15 chapters written by researchers who study the cell cycle machinery and its regulation, and is broadly divided into two parts. The first seven chapters are dedicated to describing the various components that mediate cell cycle transitions, including the structural diversity among components and their regulation, and the complexes that these different proteins form. To a limited extent, the signals that regulate the expression and that modulate the biochemical activities of cell cycle components are also described. The second part of the book is mainly dedicated to studies that aim to link cell cycle regulation with specific developmental events and with plant hormones.

The spatiotemporal regulation of cell cycle transitions through G1 to S phase and through G2 to M phase is mediated by the regulated synthesis and destruction of phase-specific Cyclin proteins. Cyclins, in turn, form heterodimeric protein complexes with Cyclin-dependent kinases (CDKs) to produce pulses of CDK activity. Activated CDKs then phosphorylate proteins important for cell cycle progression. In chapter 1 (by Dénes Dudits and colleagues), the structural diversity of CDKs that have been identified in various plants is described, as grouped into eight classes. Subsequent chapters discuss the regulation of CDK activity, such as CDK association with Cyclins (chapter 2 by Jeroen Nieuwland, Margit Menges and James Murray), the binding of a CDK inhibitor to the CDK complex (chapter 3 by Hong Wang and colleagues), the regulated proteolysis of Cyclins and of CDK inhibitor (CKI) proteins (chapter 4 by Pascal Genschik and Marie Claire Criqui), and the reversible phosphorylation of CDKs (chapter 5 by Akie Shimotohno and Masaaki Umeda). Chapters 6 (by Elena Ramirez-Parra and colleagues) and 7 then cover the transcriptional regulation of cell cycle transitions. Chapter 7 by Wilhelm Gruissem, in particular, elaborates on the functions of the retinoblastoma-related protein (RBR) in the developmental regulation of germ cells and stem-cell maintenance. The discussion of the implications of the evolutionarily conserved function of RBR in both the maintenance of a differentiated cell state and cell cycle progression is illuminating.

Overall, the first seven chapters are well organized and complement each other nicely. The illustrations provided in chapters 3, 4 and 5 allow the reader to synthesize the complex and exhaustive information that is provided. However, the very nature of the subject matter discussed, which is mainly cataloging information, and the lack of a consistent format between the chapters, renders them difficult to read. Moreover, the regulation of the cell cycle machinery is discussed in individual chapters, which is the theme for the next part of the book. This leads to some redundancy, and therefore the book struggles to achieve the right balance between integrating the information on the cell cycle machinery and its regulation.

The second part of the book begins with the role of the plant hormone auxin in cell cycle regulation, with a specific focus on the process of lateral root initiation, which involves the reactivation of the cell cycle in a set of differentiated pericycle cells, as outlined in chapter 8 by Steffen Vanneste, Dirk Inzé and Tom Beeckman. This chapter also highlights the antagonistic roles played by the plant hormones auxin and cytokinin in this process and discusses auxin signaling, post-transcriptional mechanisms and polar auxin transport. Chapter 9 by Andrew Fleming turns to cell cycle regulation in leaf development, which is used as a model system to study the dynamic interplay between developmental signaling and different modes of cell cycle regulation. The author makes a sincere effort to provide in this chapter a conceptual framework for studying the cell cycle control of development, and discusses the existing experimental evidence on the causal relationships between the cell cycle and development within the framework of two alternative theories of the cellular basis of development (the organismal view and the cellular theory of development).

The next four chapters discuss the molecular mechanisms, significance and regulation of endoreplication (a condition in which no cytokinesis occurs between two successive rounds of DNA replication) in various developmental contexts, and the functions of auxin and cytokinins in establishing and maintaining the dividing populations of cells within the apical meristems. This chapter by Peter John also provides an in-depth account of the influence of these hormones on cell cycle regulators, both at G1 to S and G2 to M transitions, and concludes with a stimulating discussion on the mechanisms by which concentrations and ratios of auxin and cytokinin might function to influence growth and patterning in the shoot and the root apical meristems.

Over the years, much information has been accumulated from diverse plant species, animal models and unicellular model systems, both on the components and the regulation of the cell cycle. From this view point, the timing of this book's publication is appropriate as it brings together the complex diversity of the cell cycle under one roof. The synthesis of cell cycle regulation with environmental cues and with developmental patterning is attempted, both in individual chapters dedicated to describing the cell cycle machinery and also in the second part of the book that is dedicated to cell cycle control. This makes the book rather repetitive at times, which could have been avoided by a reduction in the number of chapters to achieve a better synthesis. And although it might not be a useful reference for students and teachers interested in learning about the emerging concepts in either field (cell cycle or development), this book can serve as an excellent source of information on the cell cycle machinery and its regulation. I would, therefore, highly recommend this book to researchers interested in exploring the developmental and environmental control of the cell cycle for use as a quick reference guide.

Other recent books of interest

Inborn errors of development, second edition
Edited by Charles J. Epstein, Robert P. Erickson and Anthony Wynshaw-Boris
Oxford University Press (2008) 1617 pages, £160 (hardback)

Genomes, browsers and databases: data-mining tools for integrated genomic databases
By Peter Schattner
Cambridge University Press (2008) 328 pages, £65 (hardback)