Development: nature and nurture

One of the fascinations of development is the sheer complexity of the process. At a basic level, the goal is to produce an organism with a coherent form, composed of cells that are properly differentiated, and located at the proper positions relative to one another. To do this, even the simplest organism needs to employ myriad genetic interactions to regulate correctly the developmental processes. Furthermore, it needs to be able to perpetuate the differences between genetically identical cells as the development of the organism progresses. Finally, it needs to respond to environmental cues that may play a role in determining how the organism develops.

The development of various organisms in a series of chapters contributed by different authors. In the words of the editors, the aim of the collection is to “…cover key concepts, key approaches, and many of the key systems.” They also intend the book to be useful to students entering the field of development, by introducing a wide range of developmental problems in a variety of systems, thereby enabling them to decide upon an organism to study. For the most part, the book does justice to its stated goals. It is, however, important to keep in mind that it is very much a modern view of the genetic basis of development, with the operative words being genetic and modern. As a result, little or no mention is made of widely used model systems in which the study of genetics is difficult or impossible (such as the frog and chick), or of processes for which the genetic basis is not well understood. The text also does not deal with classical, but nevertheless instructive, experiments such as those on inductive tissue interactions, the fates of embryonic tissues, or the movements of sheets of cells.

The book is divided into three sections, covering microbial systems (both prokaryotic and eukaryotic), plants and animals. The section on microbial systems has chapters on topics ranging from virus assembly to the control of the cell cycle in Asperigillus nidulans. Some of the other subjects covered in this section are the control of gene expression in prokaryotes, cell type determination in yeast, and the development of Myxobacteria.

The second section begins with a chapter providing an overview of plant embryogenesis. This is followed by chapters that cover root development in Arabidopsis, flower development in Arabidopsis and Antirrhinum and leaf development in Maize. This section also has chapters dealing with endosperm development, the developmental response of plants to environmental light and the symbiotic relation between bacteria and plants.

The third section, which makes up roughly half of the book, starts with four chapters on various aspects of development in the nematode Caenorhabditis elegans, including axis formation, cell fate determination and organogenesis. This is followed by chapters dealing with Drosophila axis formation, neurogenesis and imaginal disk development. Other chapters discuss vertebrate myogenesis, the role of neurotrophins in nervous system development, and olfactory receptor gene regulation. There are also chapters devoted solely to epigenetic phenomena such as X-chromosome inactivation, the role of imprinting in human disease, and DNA methylation as a mechanism for epigenetic modification.

The individual chapters have a fairly consistent structure, each beginning with a brief introduction to the system under discussion before plunging into the details of the problem being studied. They all end with a brief discussion of where the current research is likely to lead in the future, and a summary of what was discussed in the chapter. They also each include a fairly exhaustive list of references so that the interested reader can look up details.

The editors have done a good job of ensuring that the book as a whole is clearly written and easy to understand, even to a person unfamiliar with the field in question. Unfortunately, however, the figures and photographs (the majority of which are black and white) are of varying quality, having been contributed by different authors. They do not have a consistent style from chapter to chapter, and some suffer blurring from poor reproduction. While the book benefits from the wide perspective offered by many different authors writing about their fields of specialization, there is not enough tying the various chapters together, presenting them as a unified whole. The result is a collection of good articles, but not something that is greater than the sum of its parts.

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Unravelling the Net – Cytokines and Diseases

The Cytokine Network
edited by Fran Balkwill

Frontiers in Molecular Biology Series (seried editors B. D. Hames and D. M. Glover)

£29.95

Cytokines are small- to medium-sized proteins and glycoproteins that mediate highly potent biological effects on many cell types. They have critical roles in haematopoiesis, inflammatory responses and the development and maintenance of immune responses. Importantly, cytokines act in networks or cascades. Typical properties of cytokines in these networks are pleiotropy, redundancy, synergistic activity and antagonistic effects upon each other. Knowledge of how these networks are comprised and operate is important in understanding how cytokines mediate their diverse effects on biological systems. In The Cytokine Network, Fran Balkwill brings together some distinguished investigators to produce a survey, in eight independently written and concise chapters, of the complex cytokine and chemokine (chemotactic cytokine) networks present in mouse and man.

The ever-increasing complexity of cytokine networks is introduced in the initial chapter with a summary of the bioinformatics approach for the high throughput discovery of novel cytokines and chemokines. The burgeoning number of newly identified chemokines, chemokine receptors and TNF family members reminds us that our understanding of the cytokine network is extremely dynamic and that our interpretation of some pathways will change with the characterisation of new factors.

The following chapters address the interactions of the cytokines, both with reference to their signalling pathways (well summarised in chapter 2) and their biological roles. The point is made that cytokines should be studied as a network rather than individually and that in vivo models, including the generation of transgenic and gene knock-out mice, are powerful tools for doing so. Rheumatoid arthritis is presented as a well-studied example of how inappropriate regulation of pro- and anti-inflammatory cytokines mediates autoimmune disease, and examples of immunoregulatory cytokines that have both overlapping and independent regulatory effects on inflammation are demonstrated within this context.

The important Th1/Th2 paradigm receives a dedicated chapter. T helper type 1 and T helper type 2 cells produce distinct and restricted patterns of cytokines that cross regulate each other and thus mediate different types of immune response. The development of these subsets of T helper cells from a common precursor, as part of a developing immune response, has important effects on the cytokine network. The mechanisms of Th1/Th2 development together with modulating factors and associated intracellular signalling are well described. The chapter summarises well the role of Th1/Th2 development in human diseases with reference to transplantation immunology, neonatal development, autoimmune diseases, and atopic diseases.

A very interesting review of the relationships between cytokines and viruses is given. Cytokines are critically involved in mediating antiviral immune responses. However, homologues of cytokines, chemokines and their receptors, after being ‘hijacked’ from the host genome and undergoing evolution along with the viral genes, are utilised by viruses themselves to promote their replication and to suppress immune responses against them. The chapter describes several noteworthy examples of these virally encoded cytokines and receptors together with their roles in vivo.

This is a well-written book that provides a good introduction to understanding how cytokines and chemokines interact as a network in the immune system. The volume links together diverse subjects that include cytokine signalling, genomic polymorphism, disease processes and immunotherapies. The book does not aim to describe comprehensively the biology of all the currently known cytokines and chemokines and therefore alternative texts should be considered for this. While the chapter authors are clearly constrained by the deliberately limited scope of the book, an extensive bibliography at the end of each chapter allows for further investigation. This book will be of interest to clinicians, molecular biologists and immunologists seeking an introduction to these intriguing proteins and their complex roles in immunology and disease.

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