Teaching the Essential Principles of Development

Essential Developmental Biology. (2001). Jonathan Slack. Blackwell Science Ltd, Oxford. vi + 321 pp. $~50.00. ISBN 0-632-05233-3.
Principles of Development, 2nd edition. (2002). Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith. Oxford University Press, New York. xxv + 542 pp. $89.95. ISBN 0-19-924939-3.

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A revolution in understanding developmental biology has been fueled by molecular and genetic approaches to the discipline. Two recently published textbooks of Developmental Biology are worthy contenders in the fight to maintain perspective in the midst of this molecular detail. Essentials of Developmental Biology by Jonathan Slack and Principles of Development by Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, and Jim Smith are intended as introductions and overviews of the field suitable for undergraduate students.

While both texts present the major principles and supporting evidence to the student, their approach to the material is very different. Slack focuses on the understanding of development gained through molecular and genetic experiments. In his streamlined presentation each sentence counts; theories and supporting experimental evidence are presented but interpretation is left largely to the student and instructor. This minimalist approach emphasizes the modern view over the classical. In contrast, Wolpert et al. present a more detailed narrative. Here too, the emphasis is on current molecular and genetic evidence, but such details are incorporated in the context of classical experiments. Wolpert et al. use the experimental evidence to promote and support their conceptual framework as a unified theory of development.

The decision of which text to choose is based in part on teaching style. Instructors often use either a top-down or a bottom-up approach. In the top-down approach, the instructor uses a detailed text and winnows the essential material for the student. In a bottom-up approach, the instructor uses a sparse text as a foundation, then supplements with lectures, additional readings from the literature, popular press or other texts. Wolpert et al. approaches development from the top-down: they present concepts, theories and interpretations; experiments are used as support. Slack moves from the bottom-up: he presents the data that the teacher and student use to further their own synthesis.

Content

The overall content of the texts is similar. Chapters can be grouped together: First are the Basics, as each text presents an overview of the field, its basic principles and techniques. Second are the Common Events of early embryology. Third are Selected Topics, including organogenesis or other later events.

The Basics of Slack's text immediately establishes the importance of current molecular approaches, with an entire chapter that identifies key molecular components, another chapter that covers developmental genetics, and a third that describes experimental techniques. The molecular chapter includes a very useful Appendix that describes some developmentally important gene products and families. Chapters on Major Model Organisms cover Common Events. Here Slack addresses common features of development in one chapter, followed by details of the major model organisms used in many developmental biology laboratories. In each of these chapters, specific techniques and developmental processes that are particularly well suited to each system are amplified. Slack has an excellent section on mouse technology that includes basic information on embryonic stem cells, knockout and transgenic mice, selectable expression via the Cre-lox system and enhancer traps. Selected Topics include chapters on: the nervous system, mesodermal organs, imaginal discs, stem cells, and regeneration.

Wolpert et al.'s text, though not formally subdivided, can be split into three units as well. The Basics begins with a more historical perspective that incorporates the descriptive embryology of some of the major model organisms. Conceptual tools and theories, including organization of complex structures through pattern formation, cellular behavior and differential gene activity follow. Unlike Slack, key molecular components are presented in the specific context within which they are discussed. The Common Events, according to Wolpert et al., are involved in patterning of the body plan. This theme unifies chapters about vertebrates, Drosophila, invertebrates and plants. Each of these chapters addresses, in depth, the embryology, experimental approach and molecular components of developmental processes, such as axis formation or specification of germ layers. Only after setting up body plans do Wolpert et al. address processes of morphogenesis, cell differentiation and gene expression.

Selected Topics include organogenesis, nervous system, germ cells, regeneration, growth, and evolution to complete this text. Compared with the very concise treatment offered by

Slack, the content of Wolpert et al.'s book provides more information about the investigative approach to the experiments and discoveries. It also presents Wolpert et al.'s theories and models of development.

Two significant differences in the content of the two texts are the inclusion of chapters about plant development and evolution in the text by Wolpert et al. For the instructor who wants to provide evolutionary context for development this provides an opportunity to present evolutionary principles and the potential to broaden the course focus.

Organization and style

In the past, many Developmental Biology texts used the time line of development as their basis of organization. Each step, from fertilization to gastrulation and then organ formation was presented. The shift in current texts emphasizes the experimental approach and the integration and commonality of events among organisms.

In each of his three sections, Slack constructs very short chapters; each chapter holds to a basic theme. Thus it is easy for the reader to compare and to understand the significant similarities of processes among model organisms. Once he has explained the experimental basis for developmental biology, Slack reduces emphasis on the experimental approach. Data are emphasized instead. Theories and testable models are not prominent in this treatment, but could be supplemented from the current literature.

The organization and style of Wolpert et al.'s text is more conversational. The authors aim to guide the student through the topic. The chapters are longer and broader in scope, providing background and supporting experimental evidence. Theories and models abound, both amply supported with diagrams. In addition to the standard model organisms and canonical developmental processes, Wolpert et al. include some interesting variants. For instance, they contrast the development of the long germ band insect, *Drosophila*, with that of short germ band insects. Although interesting for the experienced reader, such variants may confuse the beginner. Occasionally the organizational choices are not readily apparent. For instance, chapters describing axis formation, germ layer specification and neural induction (ch 3,4) are separated from descriptions of gastrulation and neural tube formation (ch 8).

Supporting characters: illustrations, appendices and web pages

Essential Developmental Biology by Slack is illustrated entirely with line drawings. These evoke the feeling of blackboard diagrams. The line drawings are for the most part clear illustrations of the principles that the author intends to illustrate. One example, a "generic" segmented animal used to describe experimental embryology, requires extra concentration to decipher the principles.

The previously mentioned appendix, Gene Products Important during Development, is quite useful. Web page support for Slack's book is available at http://www.blackwell-science.com/slack. There one has access to the illustrations and to four sample chapters.

Principles of Development by Wolpert et al. employs many vivid, full-color diagrams and drawings, supplemented with photographs. For the student, the illustrations are helpful for demonstrating complex topics. Wolpert et al. includes a glossary. For the student unfamiliar with jargon and genes relevant to developmental biology, a glossary can be a very efficient study aid. The web page for Wolpert et al's book is available at http://www.oup.co.uk/best.textbooks/biology/wolpert. It has supporting materials for the lecturer and student. For the lecturer there are illustrations, lecture outlines and review questions. For the student, the web links will be a useful supplement.

Cost and size

Although factors of cost and weight should not be primary considerations for textbook choice, they certainly do concern our students. Essentials of Developmental Biology costs less than $50. It is a small, paperback, and would be easy to carry to class without risking serious injury. At just over 300 pages students might read every page. Principles of Development is a larger book, available as both paperback ($59) and hard cover ($89). With more than 500 pages there is room both for reading and for skimming.

In the final analysis, choice of a textbook depends on the nature of the course. Since both of these texts provide basic information, the difference between them is in how they may be used. Slack provides molecular data and an outline of development. The challenge for the instructor is to embellish this framework with supplemental material that would illustrate the investigative approach beneath the accumulated data, lead the students to analyze the experiments, and illustrate the beauty of the embryo. Wolpert et al. provide a much broader scope; they include the developmental context and interpretation of the molecular data. The challenge in this case is to disentangle the evidence from the interpretation and to provoke the students into thinking of alternative explanations. Both texts are useful additions to the teaching arsenal of the developmental biologist.

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