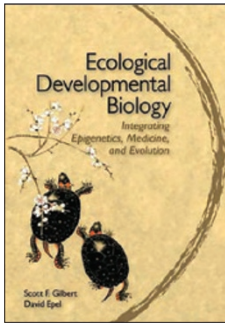


Endless forms most beautiful and wonderful



Ecological Developmental Biology: Integrating Epigenetics, Medicine, and Evolution

By **Scott F. Gilbert & David Epel**

Sinauer Associates, Inc., 2008
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Reviewed by **Stephen C Stearns**

The new textbook *Ecological Developmental Biology* describes how variation in the environment alters development and thereby affects both medical conditions and the evolutionary process. Some of the many effects are quite dramatic. They are all described in clear prose accessible to any biologist and of interest to many, as this ambitious transdisciplinary synthesis aims to tie ecology, epigenetics and development together to found a new field that can serve as a launching pad for many new ideas.

Rather than targeting a specific course, the goal of the authors was to present all the important ways in which environmental variation affects development, ecology and evolution—and in that they have succeeded very well. The framework of the textbook, however, is not one commonly adopted in existing developmental or evolutionary biology courses. Because of its large evolutionary and ecological component, this textbook will not be used in courses on developmental biology. Because of its neglect of evolutionary genetics and phylogenetics, it will not be used in courses on evolutionary biology. And because it touches on only a few issues in evolutionary medicine, although it does so excellently, it will not be used alone in courses on that subject. It is, however, well suited to a graduate seminar covering the intersection of ecology, development and evolution, and would also serve well in an evo-devo course as a supplementary textbook.

The authors frame their argument for integrating environmental influences on epigenetics into development, medicine and evolution by dividing their text into three parts: “Environmental signals and normal development,” “Ecological developmental biology and disease states” and “Toward a developmental evolutionary synthesis.”

They begin with dramatic examples of plasticity and polyphenism in which changes in the environment induce changes in the development of the phenotype (chapter 1). They then weave intellectual history into the latest experimental advances to present the mechanisms that underpin plasticity and epigenetics and why one should care about

them (chapter 2). Their description of the development of symbioses, several of which pertain to the ‘old friends’, or hygiene, hypothesis in evolutionary medicine, was enlightening. They emphasize bacteria in mammals and fungi in plants—no doubt that they are important—but neglect the worm infections whose disappearance seems to explain the increasing frequency of autoimmune diseases such as type 1 diabetes and multiple sclerosis (chapter 3). They conclude the first part of the book with a description of embryonic defenses that establishes the robustness of normal development. This reads more like a laundry list of fascinating mechanisms than a logical report carefully developed to advance a larger argument (chapter 4).

The central part of the book deals with issues of medical significance. Their discussion of teratogenesis makes a compelling case for the relevance of eco-evo-devo in evolutionary medicine (chapter 5), and their analysis of endocrine disrupters of development is relevant both to environmental studies and to environmental medicine (chapter 6). I would recommend both chapters to any woman contemplating or in the midst of pregnancy. Their review of the epigenetic origins of adult diseases is magisterial and packed with useful new ideas about a very hot area (chapter 7).

The last third of the book is conceptually the most ambitious. It seeks to establish a central role for ecological developmental biology in evolutionary theory. The authors take the now-tired position that development has been unfairly neglected and written out of the modern synthesis. However, this claim, although describing the state of the field 50 or 60 years ago, does not honestly reflect the current state of play (chapter 8)—development is well integrated into evolutionary biology courses as they are now taught at major universities. Developmental biologists should stop complaining about the neglect of development in evolutionary explanation and relax: they have won recognition.

From there follows a lovely, competent overview of evo-devo, not long enough to support an entire course in that subject but certainly a wonderful chapter to assign in an introductory course on evolutionary biology (chapter 9). West-Eberhardt’s very interesting ideas about the role of plasticity in evolution as a creative force in phenotypic innovation are used in the closing argument that thinking about development fundamentally changes our view of the causes of evolutionary change. It is not yet clear that they are correct, but this does richly deserve further investigation.

The second edition (there should be one) should contain much better signposting that explicitly develops the logic of the overall argument, at least in part through overviews of major aims and conclusions at the start of each of the three parts. Is it important to evolutionary thought that environmental impacts on development are pervasive? Does incorporating them solve an outstanding puzzle? They certainly do help us to understand how “from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved” (Darwin, 1859). The case for paying attention to environmental influences on development has been made, and they clearly extend the range of phenomena that can now be rigorously analyzed. However, much work remains to be done to understand what differences environmental influences make to well-established evolutionary and ecological theories of genetic change and population and community dynamics.

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