

Book review: Ecological Developmental Biology

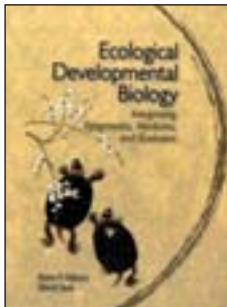
The Environment's Gentle Influence

It's nutrition that makes a bee larva become a huge, fertile queen or a tiny, sterile worker. And it's hot weather that makes unborn turtles become female. A didactic masterpiece about environmental effects on embryonic development.

Imagine you are given the entire information about a fertilized egg, its DNA sequence, its protein and RNA distribution. Can you predict how the animal will look? In their book *Ecological Developmental Biology: Integrating Epigenetics, Medicine and Evolution*, Scott Gilbert and David Epel give a clear answer to that question: No. You also need to consider the profound effects that the environment has on embryonic development and that may lead to remarkable changes in the animal's phenotype.

Environmental effects

With its first official symposium held in 2001, modern ecological developmental biology, or eco-devo, is a rather young scientific discipline. It studies how environmental factors such as pathogens, competitors, symbionts and nutritional differences, influence the development of an animal's phenotype. The authors, Gilbert and Epel, have both specialised in developmental bio-



logy. Gilbert teaches developmental biology and genetics at Swarthmore College, Pennsylvania, investigating turtle shell formation, while Epel is an emeritus development researcher from Hopkins Marine Station in Pacific Grove, California.

Their huge eco-devo *oeuvre* is far more than the field's first textbook. They not only give a comprehensive description of the current knowledge of eco-devo, corroborated by fascinating examples from the animal world, but they also go a step further and investigate eco-devo's close relationship with other scientific disciplines. By putting a main focus on the molecular mechanisms underlying eco-devo phenomena, Gilbert and Epel establish tight connections to the field of epigenetics. Their discussion of eco-devo in the context of human diseases emphasises the field's relevance for medicine.



It was their breakfast cereal that made these busy insects grow into female worker bees.

Most remarkable, however, are their ideas about eco-devo's implications for the theory of evolution.

It's all about nutrition, dude!

The book focuses on the embryonic and larval development of animals (plants and mammalian postnatal brain development, both also highly affected by the environment, are not considered). The first chapters introduce astonishing case studies of how the environment influences normal animal development. Take, for instance, ants and bees: Whether a larva becomes a huge, fertile queen or a tiny, sterile worker depends

almost exclusively on the nutrition it receives. It is also well established that sex determination in many reptiles is temperature-dependent. But did you know that chemicals secreted by predators cause the water flea to become defensive and grow a helmet?

The environment is also a source of signals that can disturb normal development. In this context we learn, among other things, how a mother's diet may influence her unborn child's susceptibility to certain diseases in later life.

Seeping in the genome

In the final chapters, Gilbert and Epel propose an intriguing connection between eco-devo and evolution. They demonstrate that phenotypic changes induced by the environment can, under persisting selective pressure, become integral to the genome (a process called 'genetic assimilation'). Does this eventually mean that the environment is able to influence the direction of evolution? A provocative and spectacular possibility indeed!

Gilbert and Epel's work contains a wealth of fascinating information about the biological world, described in a crystal-clear and engaging writing style and with informative, aesthetic figures. This, together with its clear and comprehensive structure, makes the book a didactic masterpiece. On top of that, your *Lab Times* reviewer could not find any formal or scientific mistakes. You can feel on every page that this work was written with care (and maybe even love). Its intended target audiences are biology students, teachers and scientists alike, and although they are all excellently served, the latter will benefit most. Indeed, it would be a pity to use *Ecological Developmental Biology* exclusively as a textbook. Read it and be inspired! Highly conceptual, thought-provoking and beautiful – this is biology at its best.

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Scott F. Gilbert & David Epel: *Ecological Developmental Biology: Integrating Epigenetics, Medicine, and Evolution*. Sinauer Associates, 2008. 459 pages, 182 illustrations, €43.