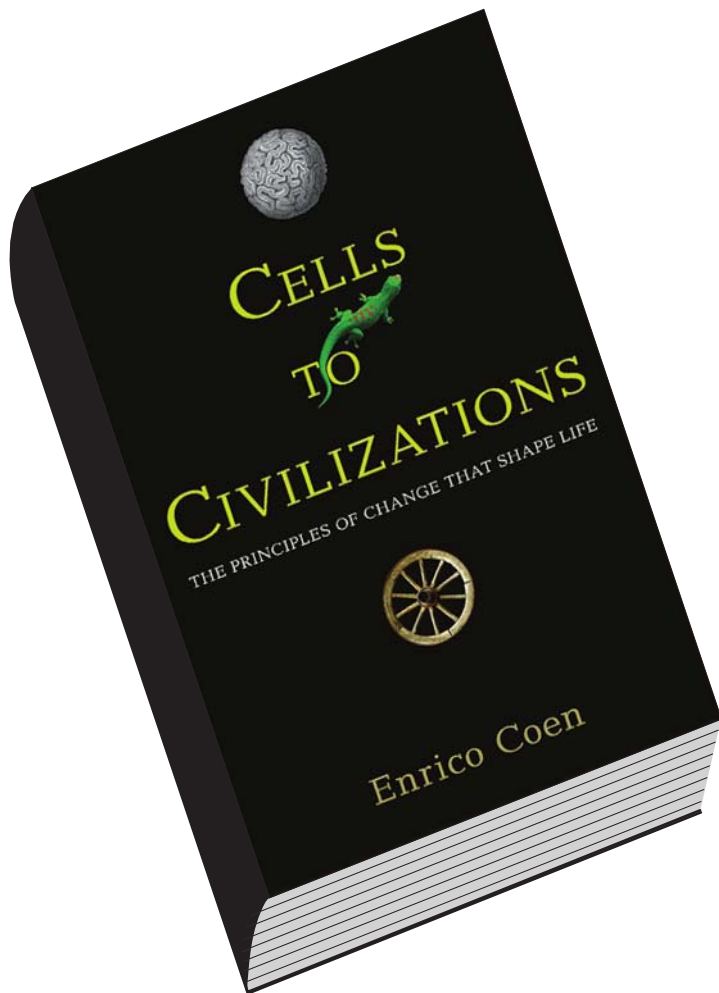


# Biology's lucky number seven

Charalambos Kyriacou commends a study into the fundamentals of biological organisation



**Cells to Civilizations: The Principles of Change that Shape Life**  
By Enrico Coen  
Princeton University Press  
360pp, £19.95  
ISBN 9780691149677 and  
9781400841653 (e-book)  
Published 20 June 2012

Last year when I was on holiday in Calabria, I read *The Girl with the Dragon Tattoo* by Stieg Larsson, and I was looking forward to reading the second and third books this summer. Instead, and in spite of my feigned reluctance, I was won over by *Times Higher Education's* flattery when I was asked to review *Cells to Civilizations*. So this summer found me back at the glorious beaches of Capo Vaticano in sight of the volcano at Stromboli

watching the kids frolic in the water while I worked. So what is this intriguingly titled book, which was responsible for taking up my quality family time, all about?

Enrico Coen, a plant biologist, suggests that seven organising principles are sufficient to explain much, if not all, of biology, whether we are dealing with genetics, populations, evolution, development, learning and brain function or culture. This is a lofty and ambitious project, so I admit to being somewhat sceptical at first. These principles are based on variation (mutation), persistence (DNA replication), reinforcement (more adaptive gene versions will tend to spread in a population), competition (that's obvious), cooperation (DNA bases

cooperate to generate a protein), combinatorial richness (the infinite DNA and protein space available based on four DNA bases and 20 amino acids), and recurrence (the never-ending process of natural selection for optimal adaptations). Further principles also emerge from combining these seven, the most important being the interaction between reinforcement and competition, which generates positive and negative feedback loops. For example, let's say a gene version is particularly good at getting an organism to reproduce – this is positive feedback, the gene increasing the number of copies of itself and its carriers. However, a consequence is that resources will eventually become a limiting factor, so that competition among individuals occurs, giving a negative feedback that restricts and limits numbers and drives further natural selection.

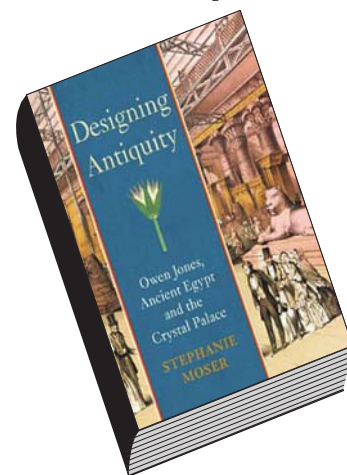
I have framed these seven-(plus) principles initially within a genetic and evolutionary context, as does Coen, but he then skilfully extends these to development and shows how cell patterns arise from what initially appears to be an amorphous blob of cytoplasm (something first modelled in simple mathematical terms by Alan Turing in 1952), and through these principles, especially the feedback combo, generates the multidimensional embryo. Coen then moves on to the nervous system and how it responds to stimuli, and how repeated exposures to stimuli can modulate the firing of nerve cells, leading to the process of learning. He shows how learning, evolution and development are all connected through these now-familiar principles. It is this middle section on neural patterns that is the most challenging part of the book, yet Coen's masterful use of analogies and metaphors eases the reader through this hurdle and on to the final section on culture. Using the context of Leonardo da Vinci's Florence, Coen describes the advances of art and technology using the same principles he has developed from his early pages, embedding cultural change as a consequence of our neuronal intelligence that is itself a product of our genetic, developmental and evolutionary history.

Coen thinks of our genetic, evolutionary, developmental and cultural potential as clouds

governed by these principles that move relentlessly on a never-ending path determined by the complexities of our environment. One could perhaps argue that these rules are so all-encompassing that almost any subject matter could be described by them – for example, can they be applied to economics? Probably. But there is much more than just semantics at play here, as Coen has got to grips with something that significantly enhances our understanding of our biological and cultural heritage. Furthermore, his prose is every bit as good as Richard Dawkins' or Steve Jones', and his rich illustrations, particularly the way he uses classical and modern art to make his points, refreshes the text and keeps one's focus on the arguments. His clever ideas and engaging and creative writing style suggest that he would make a fascinating dinner companion.

I loved this book and will put it on the general reading list for our biology undergraduates. I suspect it will also find resonance with the interested layman. Now, back to Larsson...

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**Designing Antiquity: Owen Jones, Ancient Egypt and the Crystal Palace**  
By Stephanie Moser  
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The 19th century saw widespread education of the public in all manner of fields, not least architecture, history and