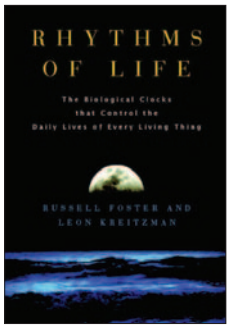
# The clock that tells the time




**Rhythms of Life: The Biological Clocks that Control the Daily Lives of Every Living Thing**

**by Russell Foster and Leon Kreitzman**

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**Reviewed by Vincent M Cassone**

Legions of clichés rise up in a mind confronted with reviewing a book about 'biological clocks', but *Rhythms of Life: The Biological Clocks that Control the Daily Lives of Every Living Thing* by Russell Foster and Leon Kreitzman is truly a timely issue. This book chronicles the recent rise of a scientific discipline from the footnotes of microbial genetics, plant biology, endocrinology and neuroscience. From these humble beginnings, the field has become generally recognized as the study of a fundamental biological property, the capacity of nearly all free-living organisms on earth to respond to and predict temporal changes in their environment and to coordinate rhythmic processes within them. The book describes the history of a relatively small group of dedicated scientists from diverse disciplines who have converged on a common question: how do the many types of organisms tell time? And it describes the growth of this small group to the point that almost every issue of *Nature, Science* or *Cell* contains a biological clocks paper.

Foster is a highly regarded scientist who has specialized in the study of the photoreceptive molecules responsible for entrainment of endogenous rhythms to environmental light cycles, and Kreitzman is a professional science writer. They have put together a credible and engaging account of the fundamental issues of the function of biological clocks and the molecular, cellular and systems level organization of the clocks of many different types of organisms. Then they discuss the impact of this remarkable clock (or clocks) on seasonal cycles of reproduction, migration, hibernation and other processes, on sleep and on medical conditions such as cardiovascular disease, cancer and jet lag.

The chapter explaining the interaction of mammalian circadian clocks with sleep/wake regulation is particularly useful, as the fields studying clocks and sleep have been by and large 'rival siblings'. (There is love there but there is also the inheritance to think about.) On one side, the biological clocks field has enjoyed tremendous success in discovering the systems, cellular and molecular bases for photic input, oscillator regulation and output pathways of clocks in a variety of species. However, the relationship between clocks *per se* and human health has been a more difficult case to make. It is there, to be sure, but it is not clear at this stage. On the other hand, the case for the importance of sleep to individual health and public health policy has been the headwaters for the font of public and institutional support for the field. The cellular and molecular basis for sleep is still a mystery. Without denigrating either field, Foster and Kreitzman integrate biological clock regulation of wakefulness with the homeostatic pressure for sleep and make a very strong case for the study of both as a single discipline.

As such, the volume is an excellent introduction to the field of chronobiology (the study of the effects of time on living things) for physicians interested in the field, scientists from other disciplines wishing to learn more about this new area, or beginning graduate students. However, it will not serve as a textbook, because it does not cover the field completely, or as a general interest text, as it contains many sophisticated molecular biological notions without complete explanation. Even so, if I were to suggest a text to a colleague wanting to get caught up on the field, this one would be very near the top of my list.

There are some curious stylistic and textual quirks in this book. For example, it is replete with prosaic quotes from scientific and popular texts that are neither erudite nor poetic. There is also an unusual fascination for Buddhist concepts and ancient Chinese observations without attribution. For example, on page 67, the authors suggest, in reference to the suprachiasmatic nucleus (SCN), the master pacemaker in mammals, that "Buddhists name this spot 'the third eye' as it is supposed to open in enlightenment." Although this is an interesting notion, there are no indications from my reading, at least, that Siddhartha Gautama had the SCN in mind in terms of 'enlightenment'.

Further, although the text extensively cites many popular science texts about the history of the field, significant oversights in citation are egregious. How can one discuss the significant contributions of James Watson, Francis Crick, Seymour Benzer, Max Delbruck, Hans Kalmus and others without citing their papers? Also, though the discussion of scientists and their home universities provides a personal side to this interesting story, very often the institution and the research are mismatched for the time when the research was done. For example, Robert Y. Moore was not at the University of Pittsburgh when he discovered the importance of the SCN to biological timing; he was at the University of Chicago then. Similarly, William Schwartz came to the University of Massachusetts after he had shown that the SCN rhythmically takes up glucose. The name of Friedrich Stephan, a co-discoverer of the SCN currently at Florida State University, is misspelled badly. There are also some scientific factual errors, albeit minor, in the book. For example, the house sparrow retina does not release the hormone melatonin as the book attests on page 125.

All in all, however, in spite of these idiosyncrasies, the book is entertaining and largely accurate. As stated above, the book is timely, but its subject is timeless in all aspects of its nature, whether it is the daily cycles of sleep and wakefulness, the seasonal cycles of reproduction or the tick-tick-ticking that counts the passage of our lives. ■

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