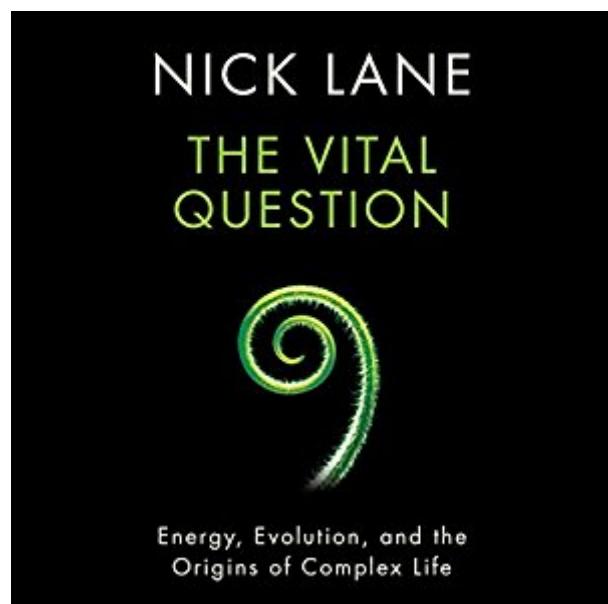


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# The Vital Question: Energy, Evolution, And The Origins Of Complex Life



## Synopsis

To explain the mystery of how life evolved on Earth, Nick Lane explores the deep link between energy and genes. The Earth teems with life: in its oceans, forests, skies, and cities. Yet there's a black hole at the heart of biology. We do not know why complex life is the way it is or, for that matter, how life first began. In *The Vital Question*, award-winning author and biochemist Nick Lane radically reframes evolutionary history, putting forward a solution to conundrums that have puzzled generations of scientists. For two and a half billion years, from the very origins of life, single-celled organisms such as bacteria evolved without changing their basic forms. Then, on just one occasion in four billion years, they made the jump to complexity. All complex life, from mushrooms to man, shares puzzling features, such as sex, which are unknown in bacteria. How and why did this radical transformation happen? The answer, Lane argues, lies in energy: All life on Earth lives off a voltage with the strength of a lightning bolt. Building on the pillars of evolutionary theory, Lane's hypothesis draws on cutting-edge research into the link between energy and cell biology in order to deliver a compelling account of evolution from the very origins of life to the emergence of multicellular organisms while offering deep insights into our own lives and deaths. Both rigorous and enchanting, *The Vital Question* provides a solution to life's vital question: Why are we as we are, and indeed, why are we here at all?

## Book Information

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## Customer Reviews

According to Nick Lane the science of biology has at least two holes in it: 1) How did life arise on Earth? and 2) How did complex life arise on Earth? To answer these questions Nick Lane reduced them further to one simple inquiry: what is living? To seasoned science readers Nick Lane will be a

very familiar name. That's because he wrote several biology books all of which were at least great reading including Power, Sex and Suicide, Oxygen, and Life Ascending. In Power, Sex and Suicide Nick Lane considered the humble mitochondria. In Oxygen Lane considered the various roles of oxygen in cell life and death. And finally in Life Ascending Nick Lane made a tour of evolution's ten greatest inventions in which he also detailed his thoughts on DNA. In this book Lane draws from his earlier works, pulling them together and building on them in considering his grand question: What is living? To answer this question Lane considers the three main domains of life now on Earth: bacteria, archaea and eukaryotes. Bacteria and archaea are simple single celled creatures that differ in how their DNA replicates and also how their cell membranes are constructed. Eukaryotes combine bacteria in the form of mitochondria inside archaea to create essentially super cells capable of producing 200,000 times the energy what either could produce alone. According to fossil records archaea and bacteria have inhabited Earth for the better part of four billion years. It took another two and a half billion for them to combine forces creating eukaryotes and of course much more time after that for eukaryotes to create the more visibly complex life we think of when we think of biology. So what is living?

The book covers three inter-related topics: the origin of life, the origin of complex organisms (eukaryotes), and the consequences of having a dual system of inheritance (nuclear and mitochondrial genes) in complex organisms. Lane proposes that the system by which most organisms convert energy to usable biochemicals (especially ATP) provides an important clue about how life originated. Organisms pump hydrogen ions outside of a membrane in a fashion analogous to a pump that pushes water into a water tower. Much as the flow of water out of a tower can be used to power an electric generator, organisms use this hydrogen ion gradient to produce ATP which serves as universal source of energy for cells. Lane argues that deep-sea alkaline hydrothermal vents provided all the conditions necessary for the origin of life. These vents continuously provide hydrogen and carbon dioxide which can be combined to yield energy and organic compounds. These vents also contain metallic compounds, especially iron and sulfur containing compounds, that could serve as catalysts for the chemical reactions needed by the precursors of living organisms. Furthermore, the structures created in these vents contain pores that could serve as nurseries for the precursors of living organisms. Most importantly, boundaries in these pores permit the creation of an electrochemical gradient similar to hydrogen ion gradient that exists in living things. Complex organisms, called eukaryotes, are much larger than bacteria and have multiple structures inside the cell, especially mitochondria and nucleus. This branch of the tree

of life includes all multi-cellular organisms such as fungi, plants, and animals.

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