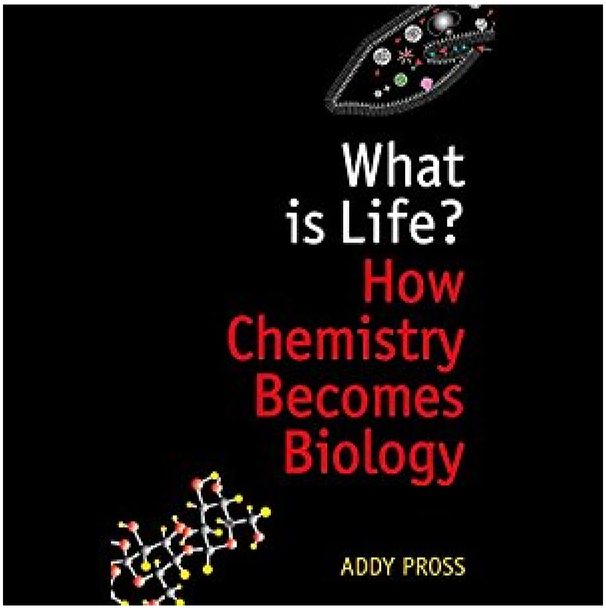
What Is Life?: How Chemistry Becomes Biology



Synopsis

Seventy years ago, Erwin Schrdinger posed a simple, yet profound, question: What is life?. How could the very existence of such extraordinary chemical systems be understood? This problem has puzzled biologists and physical scientists both before, and ever since. Living things are hugely complex and have unique properties, such as self-maintenance and apparently purposeful behaviour which we do not see in inert matter. So how does chemistry give rise to biology? Did life begin with replicating molecules, and, if so, what could have led the first replicating molecules up such a path? Now, developments in the emerging field of 'systems chemistry' are unlocking the problem. Addy Pross shows how the different kind of stability that operates among replicating entities results in a tendency for certain chemical systems to become more complex and acquire the properties of life. Strikingly, he demonstrates that Darwinian evolution is the biological expression of a deeper and more fundamental chemical principle: the whole story from replicating molecules to complex life is one continuous coherent chemical process governed by a simple definable principle.

Book Information

Audible Audio Edition

Listening Length: 6 hoursÂ andÂ 50 minutes

Program Type: Audiobook

Version: Unabridged

Publisher: Audible Studios

Audible.com Release Date: October 14, 2014

Whispersync for Voice: Ready

Language: English

ASIN: B00NJ2Z19G

Best Sellers Rank: #11 inÂ Books > Audible Audiobooks > Science > Chemistry #182 inÂ Books > Science & Math > Biological Sciences > Biology > Molecular Biology #275 inÂ Books > Engineering & Transportation > Engineering > Bioengineering > Biochemistry

Customer Reviews

In "Campbell's Biology" (Reece et al., 2014) this question appears on page one. "At the most fundamental level, we may ask: What is life? Even a child realizes that a dog or plant is alive, while a rock or a car is not [maybe not your car but mine on the other hand...]. Yet the phenomenon we call life defies a simple, one-sentence definition. We recognize life by what living things do." Campbell's lists the attributes of life as order, energy processing, evolutionary adaptation, response to the environment, regulation, and reproduction.At a significantly more advanced academic level in "Molecular Biology" (Clark et al., 2013), this same question is posed at the beginning of chapter one. On page three it is stated that the basic ingredients needed to sustain life include genetic information [this book is essentially about cells], a mechanism for energy generation, machinery for making more living matter, a characteristic outward physical form, an identity or self, the ability to reproduce, and adaptation. The header of the next paragraph states boldly that "Living Creatures Are Made of Cells".However well intended, they are both wrong, or better, myopic in their vision and scope. Life exists all around us. Literally everything is alive.Galaxies are ordered collections of stars, they process energy, they evolve, they certainly respond to the presence of other galaxies through gravitational force, they self-regulate their behavior by means of internal forces, and they reproduce other galactic forms in the process of colliding with other galaxies.What is life? is not the most insightful question to answer if our objective is a better understanding of the universe in which we live. Why is there life? is a much better origin from which to proceed. As described in the first couple of paragraphs above we tend to see life though an anthropomorphic lens, which has a much too narrow field of view. We tend to look at the end result of some 13 billion or more years of universal evolution and call that "life". So in order to make sense of that description of life we must somehow explain how life evolved from non-life. A valiant attempt has been made by Addy Pross in his book titled - you guessed it - "What is Life?: How Chemistry Becomes Biology".Pross to his credit eschews the two-stage process of getting from non-life to life. He maintains that it has always been a continuous process, and he is certainly on the right track: up until he waves his hands at a most crucial point in the argument."It now seems increasingly likely that several billion years ago some replicating system [of chemicals] of unknown identity, but of low complexity, set off along the long and winding road toward high complexity." After that injunction he is good to go, and makes some excellent arguments that deal mostly with how more complex chemical molecules formed - those that combined to produce what we now like to call living organisms. He also makes a strong case for life as an emergent property of a system - i.e. a population of individuals - rather than as a characteristic of any one individual in that population. He does this in spite of his disparaging the concept of "emergent properties" early on in the book.Addy comes so close, but fails to realize that if he stepped back a bit further it is clear - at least to me - that the propensity for life is built into atomic structure. Pross will respond by saying that is what he intended to portray - but he doesn’t say it explicitly. Shortly after the beginning of our universe we simply had hydrogen atoms. Why in heaven’s name [pun intended] did we get the rest of the periodic table? Because hydrogen atoms, due to their valence properties, are social creatures, and enjoy cohabitating with one another. Add gravity, the cupid of attraction, and hydrogen atoms find one another and immediately bond because they are by nature capable of bonding. Add enough hydrogen atoms packed together by gravity and the heat of fusion produces stars wherein other atoms of higher atomic number are created, all because of their bonding properties at both the atomic and subatomic level. Life began with the bonding of hydrogen atoms. Pross is correct in stating that life is a property of populations and not of individuals.All that has been required for the continual triumph of life over the suppressive Second Law is available energy, information about the nature of the surrounding environment supplied by a few fundamental forces, some very obliging universal constants, and billions of years of getting to know one another well enough to build complex family relationships.Coda: It is not given for us to know what can happen in thousands of millions of years when our lifetimes are measured in but a few. Suffice to say that we can see evolution with our own eyes as we watch in wonder at the endogenous molecular changes wrought by our attempts to extinguish the lives of unwanted cells, microbes and viruses.

This is a very good book. Life he defines as having purpose I agree. Evolution is a fact as much as a such things in the past can possibly be proven. Similarly, we evolved from the same primitive life forms that all life on this planet arose from. However, his proof that purpose is an emergent property falls very short. The origins of life are still a huge mystery. Like the origins of the universe which also seems to have a purpose, the origins of life may lie outside of sciences' capabilities. It is good, even imperative that we try to search and research for the answers to these questions regardless that we may not be able to find them. Addy Pross' book is another step in the right direction.

This is a book about abiogenesis; how chemical auto-catalytic replicating molecules developed metabolism (energy gathering abilities) and complexification in it's continuing "drive" toward Dynamic Kinetic Stability, and gradually became what we today call biology.There is a good deal of enlightenment here.As chemistry merges into biology.Enticing insights and illumination on the topic of the abiogenesis of Earth life.Very worthwhile.A very illuminating and fascinating and persuading way of describing what we know about life's processes and emergence from chemical reactions.Dynamic Kinetic Stability. Persistence.Replication. Metabolism (Energy gathering capabilities).Complexification. Reaction Networks Formation.Systems Chemistry."A working definition of life: a self-sustaining kinetically stable dynamic reaction network derived from the replication reaction.""The moment some non-metabolic (downhill) replicator acquired an energy-gathering capability, could be thought of as the moment that life began."

Review for Pross A, (2012) What is Life? How Chemistry becomes Biology. Oxford University Press.....................This book fills an important gap in the quest to explain how life could have emerged from precursor processes and it forms an important addition to the growing concept of "universal Darwinism". The author identifies systems chemistry as the field of study that leads to his approach. He looks for intermediate stages that are precursors of "life" and proceeds to spell out the likely role of autocatalytic chemistry occurring at a deep oceanic vent as the source of RNA from which life could have arisen. His description of this process leads on to identifying dynamic kinetic stability (DKS) as the particular variety of stability for these stages. DKS is not usually observed in regular chemistry but occurs in the persistence of entities capable of self-reproduction.He invokes the Second Law of Thermodynamics to explain why "chemical reactions proceed such that less stable materials are transformed into more stable materials". Preservation of stability is seen as essential to the survival of systems. Any cyclic system and its complex successors must be subject to the occurrence of variants (error) that may be self-corrected or may become incorporated in the system where they may have negative, neutral or positive effects. Negative effects prevent survival. Neutral effects can be incorporated harmlessly in the system. Positive effects may offer a benefit in adapting to the environment in which the system operates.Somewhere along the chain of events there should be a system which allowed the emergence of a facility to multiply from a precursor state that could only recycle itself without producing copies of itself.I await his next book that should look toward other precursor systems to connect the cyclic self-organising physical systems operating under Newton’s Laws of Motion with the self-replicating systems associated with DKS and thus further, towards life.

LIFE) What is Organic Chemistry? Chemistry Book 4th Grade | Children's Chemistry Books Surviving Chemistry Review Book: High School Chemistry: 2015 Revision - with NYS Chemistry Regents Exams: The Physical Setting Surviving Chemistry Workbook: High School Chemistry: 2015 Revision - with NYS Chemistry Reference Tables Modern Chemistry Florida: Holt Chemistry and Modern Chemistry FCAT Standardized Test Preparation Surviving Chemistry Guided Study Book: High School Chemistry: 2015 Revision - with NYS Chemistry Regents Exams: The Physical Setting What Becomes of the Brokenhearted: A Memoir Gordon Matta-Clark: Experience Becomes the Object When Breath Becomes Air Ecce Homo: How One Becomes What One Is; Revised Edition (Penguin Classics) The Next Africa: An Emerging Continent Becomes a Global Powerhouse Death Becomes Her: The Kurtherian Gambit, Book 1